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Original Study

The Course of Depressive Symptoms Over 36 Months in 696 Newly Admitted Nursing Home Residents

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ABSTRACT

Objectives: To investigate the course of depressive symptoms in newly admitted nursing home (NH) residents and how resident characteristics were associated with the symptoms. To identify groups of residents following the same symptom trajectory.
Design: An observational, multicenter, longitudinal study over 36 months with 7 biannual assessments.
Setting and Participants: Representing 47 Norwegian NHs, 696 residents were included at admission to a NH.
Methods: Depressive symptoms were assessed with the Cornell Scale for Depression in Dementia (CSDD). We selected severity of dementia, functional impairment, physical health, pain, use of antidepressants, age, and sex as covariates. Time trend in CSDD score was assessed by a linear mixed model adjusting for covariates. Next, a growth mixture model was estimated to investigate whether there were groups of residents following distinct trajectories in CSDD scores. We estimated a nominal regression model to assess whether the covariates at admission were associated to group membership.
Results: There was a nonlinear trend in CSDD score. More severe dementia, a lower level of functioning, poorer physical health, more pain, use of antidepressants, and younger age at admission were associated with higher CSDD scores. Growth mixture model identified 4 groups: (1) persistent mild symptoms (32.6%), (2) persistent moderate symptoms (50.8%), (3) increasing symptoms (5.1%), and (4) severe but decreasing symptoms (11.6%). A lower level of functioning, poorer physical health, more pain, use of antidepressants, and younger age at admission were associated with higher odds for belonging to the severe but decreasing symptoms group compared with the persistent mild symptoms group.
Conclusions and Implications: Most NH residents were in trajectory groups with persistent mild or moderate depressive symptoms. Residents with more severe dementia, lower levels of functioning, poor physical health, severe pain, younger age at admittance, and who are using antidepressants should be monitored closely and systematically with respect to depression. Taking actions toward a more personalized treatment for depression in NHs is a priority and should be investigated in future studies.

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Depression and depressive symptoms are common among nursing home (NH) residents. According to a systemic review, the median prevalence of major depressive disorders and depressive symptoms were 10% and 29%, respectively[1]

Depressive symptoms have several potential etiologies in NH residents. The symptoms can, for example, be related to a mood disorder, may overlap with symptoms of dementia, may be linked to a medical disorder or medications taken for a disorder, or they may be related to leaving one's home and/or the loss of close relationships with family and friends and/or to loss of autonomy.[2,3] Thus, depression in NH residents is multifaceted and difficult to diagnose.[4,5]

Both depression and higher levels of depressive symptoms have negative consequences for NH residents. They are reportedly associated with more pain,[6,7] poorer quality of life,[8] progression of cognitive decline,[9,10] greater disability,[11,12] and increased mortality.[5,13,14] Furthermore, such symptoms have an impact on the use of healthcare services.[5,10,15,16]

As depression and depressive symptoms are highly prevalent in NHs and have far-reaching consequences for residents and society, how depressive symptoms unfold over time is particularly understudied.[5] Complex health conditions and high dropout rates, mainly because of death, complicate relevant studies.[17] A recent systematic review of risk factors for depression in long-term care pointed to the general lack of knowledge of the interplay over time between depression and its risk factors.[12] As depression can be remediable, identifying groups of patients at particular risk is essential to tailor treatment programs.[14,18,19] There are few studies that include residents at NH admittance and assess their depressive trajectories over time, and such studies are warranted.[5,20]

Thus, in this 36-month longitudinal study of newly admitted NH residents with or without dementia we investigated the course of depressive symptoms and how resident characteristics were associated with the symptoms. We further aimed to identify groups of residents following the same symptom trajectory and to assess whether their characteristics at admittance were associated with belonging to such groups.

Methods

Design

This article is based on data from the Resource Use and Disease course in dementia–Nursing Home (REDIC-NH) study. The REDIC-NH is a Norwegian, observational, multicenter, longitudinal study of newly admitted NH residents.[21] For this report, the residents were assessed biannually over the course of a study period of 36 months (ie, 7 assessments, T0–T6).

Participants

We included 696 newly admitted residents representing 47 NHs. All residents 65 years or older, or younger than 65 years with established dementia of any etiologic subtype, with an expected stay of 4 weeks or more were eligible to participate in this study. We excluded residents with life expectancy of less than 6 weeks.

Data Collection

Data at baseline (T0) were collected within a month of admission to the NH, and follow-up data were collected biannually (Table 1 details the attrition throughout the study period). Data were collected between March 2012 and November 2017. Healthcare workers in NHs, mainly registered nurses (74%), collected the data under the supervision of 10 research nurses. Prior to the study, the research nurses attended a 5-day training program to learn the study procedures and measures, and the data collectors attended a 2-day training program. Data were collected from resident records and through structured interviews with the residents, their next of kin, and caregivers in the NHs.[21,22]

Measures

We used the Cornell Scale for Depression in Dementia (CSDD) to assess depressive symptoms.[23] The CSDD comprises 19 items that are

Table 1
Demographic and Clinical Characteristics of the Study Population and Attrition Throughout the Study Period of 36 months

	T0 (n = 696)	T1 (n = 508)	T2 (n = 427)	T3 (n = 349)	T4 (n = 294)	T5 (n = 235)	T6 (n = 194)
Age in y—mean (SD)	84.5 (7.5)	84.7 (7.5)	85.2 (7.7)	85.4 (7.9)	85.4 (7.9)	85.8 (8.1)	86.1 (8.0)
Female sex (%)	64.1	66.3	67.7	69.6	66.0	64.7	71.1
CSDD—mean (SD)	6.6 (5.3)	5.8 (4.9)	5.9 (4.8)	6.5 (4.8)	6.4 (4.8)	6.6 (5.4)	6.4 (5.0)
CSDD >8 (%)*	30.4	23.6	26.0	29.3	27.3	26.8	27.8
CDR, sum of boxes score—mean (SD)	10.3 (4.3)	11.0 (4.3)	11.7 (4.2)	12.4 (4.3)	12.9 (4.3)	13.6 (3.9)	13.6 (4.2)
PSMS sum—mean (SD)	15.3 (4.5)	16.0 (4,8)	16.7 (4.7)	17.5 (4.8)	18.4 (4.8)	19.4 (4.7)	19.8 (5.0)
GMHR (fair/poor, %), as opposed to (excellent/good, %)	52.7	53.9	60.4	64.9	68.3	72.2	73.1
MOBID-2, mean (SD)	2.1 (2.1)	2.1 (2.0)	2.2 (2.0)	2.2 (2.0)	2.3 (2.1)	2.3 (1.9)	2.4 (2.0)
Use of antidepressants (yes, %)	28.4	38.0	40.3	39.8	41.8	42.1	41.8
Attrition:							
Deaths (n, cumulative)	0	115	191	261	324	371	422
Resident moving home or to another institution (n, cumulative)	0	32	49	51	55	60	61
Resident or nursing home withdrawn from the study (n, cumulative)	0	6	10	12	12	16	18
Not analyzed at the specific follow-up due to protocol violation (n)	0	35	19	23	11	14	1

CDR, Clinical Dementia Rating (scoring range 0-18); CSD, The Cornell Scale for Depression in Dementia (scoring range 0-38); GMHR, The General Medical Health Rating Scale (excellent/good, fair/poor); MOBID-2, Mobilization-Observation–Behavior–Intensity–Dementia 2; PSMS, The Physical Self Maintenance Scale; SD, standard deviation; T0, Admittance to nursing home; T1, 6-month follow-up; T2, 12-month follow-up; T3, 18-month follow-up; T4, 24-month follow-up; T5, 30-month follow-up, T6, 36-month follow-up.

*Barca ML, Engedal K, Selbaek G. A reliability and validity study of the Cornell scale among elderly inpatients, using various clinical criteria. *Dement Geriatr Cogn Disord*. 2010;29:438–447.

scored as 0 (absent), 1 (mild or intermittent), 2 (severe); these can also be scored as "Item unable to evaluate." Before calculating a sum score ranging from 0 to 38, where a higher score denotes more severe symptoms, any item marked as unable to evaluate or any missing values were replaced by a score of 0. This method of imputing the CSDD is in line with previous recommendation.[24] However, a sum score was not calculated if 20% or more of the items were missing.[2,25]

The severity of dementia was assessed with the Clinical Dementia Rating (CDR) scale which covers 6 cognitive and functional domains.[26] The scoring ranges from 0 (no dementia) to 3 (severe dementia). In the analysis, we used the CDR sum of boxes score, where the maximum score is 18 and a higher score denotes more severe dementia.[27] In addition, an expert panel including 2 of the authors (GS and SB), used all collected information to systematically diagnose dementia according to the *International Classification of Diseases, Tenth Revision* research criteria[28] and mild cognitive impairment (MCI) according to the Winblad criteria.[21,29]

We used the Physical Self-Maintenance Scale (PSMS)[30] to assess each resident ability to perform personal activities of daily living. The PSMS covers 6 domains (scored 1–5), where a higher score denotes a lower level of functioning and the maximum score is 30. The PSMS and CDR sum of boxes were imputed and totaled in the same way as the CSDD.

Physical health was assessed with the General Medical Health Rating Scale (GMHR).[31] The GMHR rates the resident medical conditions and use of medication on a 4-point scale (excellent, good, fair, poor). In the analyses, the GMHR was dichotomized to "good" (excellent/good) and "poor" (fair/poor).

The Mobilization-Observation-Behavior-Intensity-Dementia-2 (MOBID-2) Pain Scale was used to assess pain.[32] In the analyses, we used the overall assessment of total pain on a 10-point visual analogue scale, where a higher score denotes more pain.

Use of medication was registered with the Anatomical Therapeutic Chemical classification system. We dichotomized the use of antidepressants (N06A) (yes/no) during the study period for the analyses.

The Supplementary Table 1 provides a more extensive description of the assessment scales.

Ethical and Legal Considerations

Nursing home personnel, including the physician, evaluated each resident's capacity to participate in the study. All residents with the capacity to participate gave written consent. For residents without the capacity to consent, their next of kin gave consent on their behalf. The Regional Ethics Committee for Medical Research in South-Eastern Norway approved the study (2011/1738a).

Statistics

We used the SPSS v 26 (IBM Corp), SAS v 9.4 (SAS Institute Inc), and STATA v 16 (StataCorp. LLC) to analyze data. Demographic and clinical characteristics were described as means and standard deviations (SDs) or frequencies and percentages.

The intraclass correlation coefficient was estimated to assess whether there was a hierarchical structure present in the dataset as the residents were included from different wards within different NHs. Cluster-effect was identified on both levels. Therefore, the overall trend in CSDD scores through the 7 assessment points was assessed by an unadjusted linear mixed model (LMM) with random effects for residents nested within ward which was again nested within NH. The model included a third-order polynomial for time as fixed effect because of a nonlinear trend in CSDD scores. The model was further adjusted for preselected covariates (severity of dementia, functional impairment, physical health, pain, use of antidepressants, age, and sex), based on a recent systematic review of the most important risk factors for depression in NHs.[12] Whenever possible, covariates assessed longitudinally and simultaneously with CSDD were included, and interactions between each covariate and time were added as fixed effects into the model. The adjusted model was then reduced for exhaustive interactions by Bayes Information Criterion (BIC), where a smaller value means a better model. Among information criteria, BIC is considered as most appropriate in selecting a correct model.[33] Post-hoc analyses were carried out to derive mean changes in CSDD scores between time points.

As a large share of residents died during the study period and mortality could have been informative with respect to CSDD scores, joint modeling assessing the longitudinal and survival processes simultaneously was performed. However, no evidence for informative mortality was identified; hence, only LMM results were reported.

LMM assesses trend among all residents. To explore the data further, a growth mixture model was estimated.[34,35] This approach attempts to identify unobserved groups of residents, each following a distinct trajectory in CSDD score, based on individual profiles and using a set of statistical criteria; BIC, nonoverlapping 95% confidence intervals of trajectories, reasonably large group size, and high average posterior probability of assignment. A nominal regression model was then estimated to assess whether the covariates at baseline were associated with group membership. Results with a P value of $<.05$ were considered statistically significant.

Results

Table 1 presents the demographic and clinical characteristics of the residents at different time points throughout the study period. Of the 696 residents included at T0, 446 (64.1%) were women and mean age was 84.5 (SD = 7.5) years, 583 (83.8%) had dementia, 96 had MCI (13.8%), 16 (2.3%) were cognitively healthy, and 1 (0.1%) could not be classified with respect to cognitive status.

In the LMM, none of the interactions between covariates and time were kept in the model, implying that change in CSDD score was not associated with the covariates. There was a nonlinear trend in CSDD score during the study period in both unadjusted and adjusted models (Figure 1, Table 2, and Supplementary Table 2 details the post hoc analyses). More severe dementia, lower level of functioning, poorer physical health, more pain, use of antidepressants, and younger age at admission were associated with higher CSDD scores in both unadjusted and adjusted LMMs (Table 2).

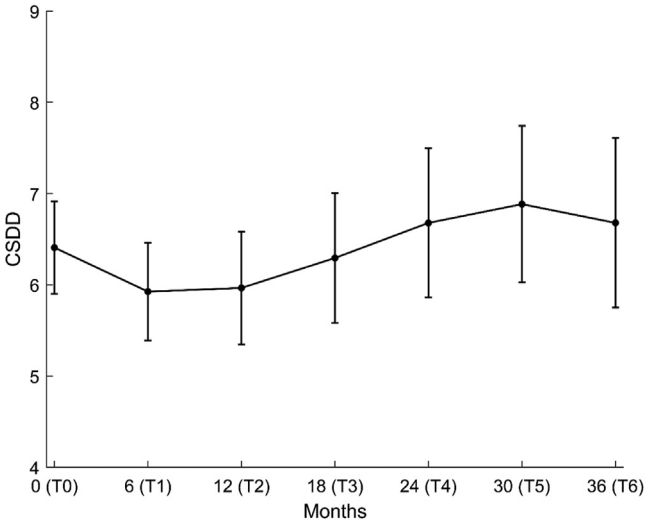

Fig. 1. Time trend of CSDD score (scoring range 0–38) over 36 months according to linear mixed model.

Table 2
Results of Linear Mixed Model for CSDD Score Adjusted for Cluster Effect Within Ward Nested Within NH

	Unadjusted Models RC (95% SE)	*P* Value	Adjusted Model RC (95% SE)	*P* Value
Intercept	6.41 (0.26)	<**.001**	6.23 (1.64)	<**.001**
Time*	−0.14 (0.05)	**.004**	−0.22 (0.05)	<**.001**
Time × time*	0.01 (0.004)	**.004**	0.01 (0.003)	**.001**
Time × time × time*	−0.0002 (0.00007)	**.012**	−0.0002 (0.00007)	**.011**
Covariate				
CDR-sum of boxes	0.32 (0.03)	<**.001**	0.22 (0.03)	<**.001**
PSMS	0.27 (0.02)	<**.001**	0.10 (0.03)	<**.001**
GMHR (good as ref.)	1.71 (0.20)	<**.001**	1.04 (0.20)	<**.001**
MOBID-2	0.51 (0.05)	<**.001**	0.40 (0.05)	<**.001**
Use of antidepressants ("no" as ref.)	1.25 (0.24)	<**.001**	1.11 (0.23)	<**.001**
Age	−0.08 (0.02)	<**.001**	−0.06 (0.02)	**.001**
Sex (female as ref.)	0.03 (0.31)	.930	−0.07 (0.28)	.799

CDR, Clinical Dementia Rating; CSD, The Cornell Scale for Depression in Dementia; GMHR, The General Medical Health Rating Scale; MOBID-2, The Mobilization-Observation–Behavior–Intensity–Dementia 2 Pain Scale; PSMS, The Physical Self Maintenance Scale; RC, Regression coefficient; ref., reference; SE, standard error.
Bold indicates the *P* values which are significant.
*Third order polynomial.

The growth mixture model for CSDD scores identified 4 different groups of residents each following distinct trajectories. Based on the severity and course of depressive symptoms over time, we labeled the groups as follows: persistent mild symptoms group (n = 225, 32.6%), persistent moderate symptoms group (n = 351, 50.8%), increasing symptoms group (n = 35, 5.1%), and severe but decreasing symptoms group (n = 80, 11.6%) (Figure 2 and Table 3). A low intercept (2.2) and persistent low CSDD scores throughout the study period characterized the group with persistent mild symptoms. The persistent moderate symptoms group had an intercept of 6.8 and the following CSDD scores were approximately 6–7. The increasing symptoms group had an intercept of 5.8, then the CSDD scores increased successively before they flattened/decreased towards the end. The severe but decreasing group had a high intercept at 15.2, and the CSDD scores decreased successively throughout the study period but stayed above 10. The average within-group probability for all groups was 0.78 or higher.

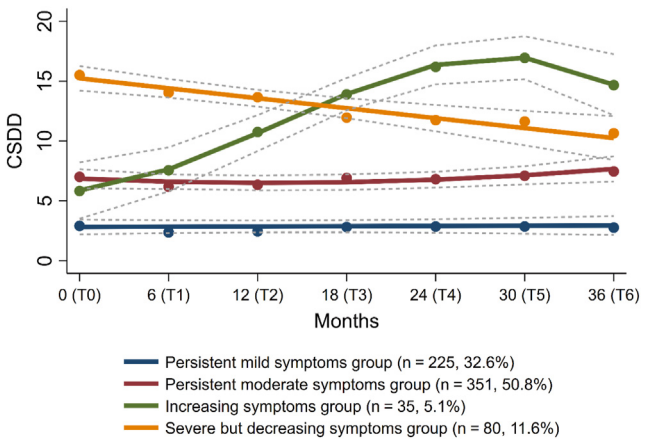

Fig. 2. Growth mixture model of CSDD scores (scoring range 0–38) showing trajectory groups (n = 691; ie, patients with nonmissing values of CSDD at inclusion). CSDD, Cornell Scale for Depression in Dementia.

According to adjusted nominal regression, lower level of functioning, poorer physical health, more pain, use of antidepressants, and younger age at admission were associated with higher odds for belonging to the group with severe but decreasing symptoms as compared with the group with persistent mild symptoms. In addition, more pain and younger age at admission were associated with higher odds for belonging to the group with persistent moderate symptoms compared with the group with persistent mild symptoms. Comparing the group with increasing symptoms with the group with persistent mild symptoms, there were no differences with respect to covariates (Table 3).

Discussion

This study showed a nonlinear trend in CSDD score over the study period of 36 months. There was a decrease in CSDD score the first 6 months, and from 12-month follow-up onward, the score increased successively but flattened and decreased somewhat toward the end of the study period. More severe dementia, lower level of functioning, poorer physical health, more pain, use of antidepressants, and younger age at admission were associated with more depressive symptoms. Furthermore, we were able to identify 4 groups following distinct trajectories in CSDD scores over 36 months: (1) persistent mild symptoms, (2) persistent moderate symptoms, (3) increasing symptoms, and (4) severe but decreasing symptoms.

According to the LMM, the residents had more depressive symptoms upon entering the NH than they did 6 months later. Previous studies have described the first period in a NH as challenging for vulnerable older persons and have noted that NH residents can display more depressive symptoms during their first months in a NH.[3,15,20] In a 20-year study, Villenueve et al discussed the phenomenon of "relocation stress syndrome" in persons who entered NHs.[36] In addition, depression can be a reason for NH placement.[37,38] Resident adaptions to the NH setting could be a factor to the decrease in depressive symptoms we observed 6 months after inclusion in our study, as also seen in other studies.[15,36] In the present study, we observed an increase in depressive symptoms after 12-month follow-up. There are few longitudinal studies for comparison. However, in a previous longitudinal study, we included residents with a mean stay of 941 days in a NH and had different assessment intervals, but we also saw increasing CSDD symptoms after 12-month follow-up.[25] This was related to an increase in nonmood symptoms of the CSDD (lack of joy, irritability, agitation, retardation, loss of interest, appetite loss, weight loss, lack of energy, diurnal variation, difficulty falling asleep, multiple awakening, and early morning awakening).[25,39] Consequently, in the present study, the increase in depressive symptoms after 12 months may be related to increasing nonmood CSDD symptoms. Moreover, Kurlowicz et al demonstrated how CSDD could label symptoms as depressive that were not necessarily due to a depressive disorder among frail NH residents with multimorbidity and functional impairment.[40] Indeed, our study population became more cognitively and functionally impaired and more residents experienced poorer physical health during the study period. Greater awareness of depressive symptoms over time in NH studies may also be a factor related to the increase in observer-rated depressive symptoms.[41] The flattening and decrease of CSDD score toward the end of the study period may, at least partly, be related to a survivor effect. Authors have previously described that survivors in NHs may display fewer depressive symptoms.[25,42] Although we have identified significant differences in CSDD scores during the study period, the clinical impact of these differences lying in the range of 1–2 points is debatable. The minimum clinically important difference (MCID) for CSDD has not been established.[43]

Table 3
Results of Growth Mixture Model (n = 691, ie, Patients With Nonmissing Values of CSDD at Inclusion) and Nominal Regression Model for Associations Between Clinical Characteristics and Group Belonging (n = 656, Group 1, Persistent Mild Symptoms Group as Reference)

Growth Mixture Model								
	Group 1 (n = 225, 32.6%)		Group 2 (n = 351, 50.8%)		Group 3 (n = 35, 5.1%)		Group 4 (n = 80, 11.6%)	
	RC (SE)	*P* Value	RC (SE)	*P* Value	RC (SE)	*P* Value	RC (SE)	*P* Value
Intercept	2.15 (0.28)	<**.001**	6.80 (0.33)	<**.001**	5.76 (0.91)	<**.001**	15.24 (0.50)	<**.001**
Linear	0.005 (0.01)	.711	−0.06 (0.04)	.116	0.15 (0.20)	.457	−0.14 (0.03)	<**.001**
Quadratic			0.002 (0.001)	**.030**	0.03 (0.01)	**.030**		
Cubic					−0.001 (0.0003)	**.004**		
Average within-group probability	0.81		0.78		0.85		0.86	

Nominal Regression Model				
	Unadjusted Models		Adjusted Model	
Covariate	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
CDR-sum of boxes				
Group 2	1.00 (1.00; 1.01)	.382	1.00 (0.99; 1.01)	.829
Group 3	0.98 (0.96; 1.01)	.172	0.98 (0.96; 1.01)	.204
Group 4	1.00 (0.99; 1.01)	.755	1.00 (0.99; 1.01)	.640
PSMS				
Group 2	1.06 (1.02; 1.10)	**.007**	1.04 (0.99; 1.08)	.114
Group 3	0.95 (0.87; 1.04)	.299	0.97 (0.88; 1.07)	.567
Group 4	1.13 (1.07; 1.20)	<**.001**	1.09 (1.02; 1.16)	**.009**
GMHR				
Group 2	1.44 (1.02; 2,03)	**.037**	1.20 (0.03; 1.75)	.320
Group 3	0.63 (0.29; 1.37)	.246	0.70 (0.31; 1.60)	.409
Group 4	2.51 (1.44; 4.38)	**.001**	1.84 (1.02; 3.35)	**.045**
MOBID-2				
Group 2	1.21 (1.10; 1.32)	<**.001**	1.19 (1.08; 1.31)	<**.001**
Group 3	0.94 (0.76; 1.17)	.605	0.99 (0.79; 1.24)	.941
Group 4	1.31 (1.16; 1.48)	<**.001**	1.25 (1.10; 1.43)	**.001**
Use of antidepressants (“yes”)				
Group 2	1.54 (1.03; 2.30)	**.037**	1.36 (0.90; 2.07)	.150
Group 3	1.68 (0.74; 3.80)	.213	1.56 (0.68; 3.58)	.290
Group 4	2.52 (1.43; 4.45)	**.002**	2.18 (1.20; 3.98)	**.011**
Age				
Group 2	0.95 (0.93; 0.98)	<**.001**	0.95 (0.92; 0.97)	<**.001**
Group 3	0.97 (0.92; 1.02)	.183	0.97 (0.92; 1.02)	.247
Group 4	0.94 (0.91; 0.97)	<**.001**	0.94 (0.91; 0.97)	**.001**
Sex (male)				
Group 2	1.10 (0.77; 1.58)	.588	1.02 (0.70; 1.50)	.907
Group 3	0.87 (0.39; 1.94)	.737	0.95 (0.42; 2.16)	.905
Group 4	1.31 (0.76; 2.25)	.332	1.20 (0.67; 2.14)	.547

CDR, Clinical Dementia Rating; CI, confidence interval; Group 1, Persistent mild symptoms; Group 2, persistent moderate symptoms; Group 3, increasing symptoms; Group 4, severe but decreasing symptoms; CSD, The Cornell Scale for Depression in Dementia; GMHR, The General Medical Health Rating Scale; MOBID-2, Mobilization-Observation–Behavior–Intensity–Dementia 2 Pain Scale; OR, odds ratio; PSMS, The Physical Self Maintenance; RC, regression coefficient; SE, standard error.
Bold indicates the *P* values which are significant.

In our analyses, we included covariates mostly assessed longitudinally, and the findings were strikingly clear and robust. Our findings support conclusions from a systematic review of risk factors for depression in NH residents that cognitive and functional impairments are the most consistently documented risk factors. However, there are fewer studies and previous findings are more mixed with respect to physical health, pain, use of antidepressants, and age at admission as risk factors.[7,12] Further, studies have pointed to bidirectional relationships between depression and covariates in our study that can complicate the picture.[6,12,44,45]

The CSDD mean scores in our study were around 6 or 7 at all assessments but with relatively large SDs, indicating high between-patient variation. The growth mixture model identified 4 groups with distinct CSDD trajectories, with intercepts varying from 2.2 to 15.2. The overall increase in CSDD score from 12- to 30-month follow-up in the linear mixed model likely relates to the group with increasing symptoms and a small increase in CSDD score among the largest group with persistent moderate symptoms. Likewise, the decrease in CSDD score the first 6 months likely relates to the group severe but decreasing symptoms with highest intercept. There could be that a regression to the mean effect to some extent influenced the results. Another study of depressive symptom trajectories in NHs applied a method different from ours (hierarchical clustering) that complicates comparison. The study used the Geriatric Depression Scale to monitor depressive symptoms over 6 months, excluded residents with moderate to severe cognitive impairment, and found 3 homogeneous groups with distinct trajectories separated according to symptom severity.[46] In our study, approximately 5% followed the trajectory with increasing symptoms that crossed other trajectories. It would be of interest to characterize this group further to better identify residents at increasing risk for depression, but the nominal regression model was not able to demonstrate any differences compared with the group with persistent mild symptoms. Lack of statistical power could be a reason as only 35 (5.1%) residents were in the group with increasing symptoms. About 12% were in the group with severe symptoms that decreased during the study period. Residents with lower levels of functioning, poorer physical health, more pain, who used antidepressants, and at younger age at admittance to a NH had higher odds for belonging to this group compared with the group with persistent mild symptoms. This supports the notion that the presence of these factors at admittance is associated with more depressive symptoms over time. The fact that use of antidepressants was associated with more severe symptoms in several analyses in our study points to an opportunity for more-personalized antidepressant

treatment and other possible treatments for depression in NH residents.[14,45,47–49]

This study has limitations. Depressive symptom, particularly in patients with dementia can fluctuate in severity and duration,[23,45] and the study might have benefitted from more frequent assessments. Many different assessors might yield variations in the collected data that could influence the results. However, the assessors and the study nurses participated in standardized training to reduce variability, and the statistical models adjusted for potential cluster effect. Our study included well-documented risk factors as covariates, but did not deal with distinct psychological factors, such as perceived support, or NH-specific characteristics.[50] It is a weakness of the study that only 38 of the 47 NHs were able to report data on eligible residents and in these 38 NH less than 50% of eligible residents were included.[21] Furthermore, previous studies reporting results from the REDIC-NH study discussed the representativeness of the study because of the exclusion of respite residents with shorter expected stays and more women opposed to men, and a somewhat younger mean age among residents who declined to participate compared with those who participated.[17,21,22]

The strengths of this study are the longitudinal design involving residents at admittance to a NH, a reasonably large sample size, and a long follow-up period. The residents were assessed at regular intervals with well-established scales. Participants who drop out and missing data are inherent challenges to studies of this type. We used advanced statistical models including all available data in the analyses, also data from dropouts. Moreover, the joint modeling did not find evidence for informative mortality with respect to CSDD scores. The associations between CSDD scores and the selected covariates align with previous knowledge, which we see as a strength for our study. We included residents with all degrees of cognitive impairment, and only residents with life expectancy of less than 6 weeks were excluded. Thus, the study is of high clinical relevance for NHs.

Conclusions and Implications

Findings from our study contribute to more knowledge about depressive symptoms in NHs that may help to prevent depression and individualize treatment. Most (83%) NH residents were in trajectory groups with persistent mild or moderate depressive symptoms. Residents with more severe dementia, lower levels of functioning, poor physical health, severe pain, younger age at admittance, and who use antidepressants should be monitored closely and systematically with respect to depression. Our finding that the use of antidepressants was noticeably associated with more severe depressive symptoms calls for closely monitoring effects and for taking action toward more-personalized antidepressant treatment and other treatments for depression in the NH setting. Further research should aim to investigate the importance of personalized treatment programs for depression in NH residents.

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Supplementary Table 1
Description of Assessment Scales Used to Collect Information for the Measures in the Study

Clinical Features	Assessment Scale/Methods	Description
Depressive symptoms	Cornell Scale for Depression in Dementia (CSDD)	The CSDD evaluates the following 19 items: anxiety, sadness, lack of joy*, irritability*, agitation*, retardation*, multiple physical complaints, loss of interest*, appetite loss*, weight loss*, lack of energy*, diurnal variation*, difficulty falling asleep*, multiple awakening*, early morning awakening*, suicidal ideation, poor self-esteem, pessimism, and delusion.† The 19 items are scored 0 (absent), 1 (mild or intermittent), 2 (severe), yielding a maximum score of 38, and higher score denotes more severe symptoms. A cut-off point of 8/9 can be indicative for depression.‡
Cognition	Clinical Dementia Rating (CDR)	The CDR evaluates the following 6 cognitive and functional domains: memory, orientation, judgement and problem solving, community affairs, home and hobbies, and personal care. The 6 items are rated from 0 (no dementia) to 3 (severe dementia). The CDR sum of boxes score ranges from 0–18, and a higher score denotes more severe cognitive impairment.
Personal activities of daily living	Physical Self-Maintenance Scale (PSMS)	The PSMS evaluates toileting, feeding, dressing, grooming, physical ambulation, and bathing. The six items are rated from 1 to 5 (total scoring range 6–30), and a higher score denotes lower level of functioning.
Physical health	General Medical Health Rating Scale (GMHR)	The GMHR takes into account the number of general medical conditions, the severity of the conditions, and the use of medications. The GMHR allows ratings of excellent/good/fair/poor.
Pain	Mobilization-Observation-Behavior-Intensity-Dementia Pain Scale (MOBID-2)	The MOBID-2 is proxy rated and evaluates pain intensity based on 5 guided movements and observations of five body organs the previous days. The 10 items are rated on a 10-point visual analogue scale and the scales yields a final overall assessment of pain, range 0–10 where a higher score denotes more pain.

*Nonmood factors of the CSDD.†

†Barca, ML, Selbaek, G, Laks, J, et al. The pattern of depressive symptoms and factor analysis of the Cornell Scale among patients in Norwegian nursing homes. *Int J Geriatr Psychiatry*. 2008;23:1058–1065.

‡Barca, ML, Engedal, K, Selbaek, G. A reliability and validity study of the Cornell Scale among elderly inpatients, using various clinical criteria. *Dement Geriatr Cogn Disord*. 2010;29:438–447.

Supplementary Table 2
Results of Post-Hoc Analyses Assessing Change in CSDD Score After LMM

Time Points	T1	T2	T3	T4	T5	T6
T0	−0.5 (−0.9; −0.1), **0.018**	−0.4 (−1.0; 0.1), 0.125	−0.1 (−0.8; 0.6), 0.745	0.3 (−0.5; 1.1), 0.505	0.5 (−0.4; 1.3), 0.264	0.3 (−0.7; 1.2), 0.561
T1		0.04 (−0.2; 0.3), 0.743	0.4 (−0.1; 0.9), 0.131	0.8 (0.1; 1.4), **0.029**	1.0 (0.2; 1.7), **0.010**	0.8 (0.01; 1.5), **0.046**
T2			0.3 (0.1; 0.6), **0.017**	0.7 (0.2; 1.2), **0.004**	0.9 (0.4; 1.5), **0.002**	0.7 (0.05; 1.4), **0.035**
T3				0.4 (0.2; 0.6), **0.001**	0.6 (0.2; 1.0), **0.001**	0.4 (−0.3; 1.0), 0.241
T4					0.2 (0.01; 0.40), **0.040**	0.0 (−0.7; 0.7), 0.997
T5						−0.2 (−0.7; 0.3), 0.426

T0, admittance to nursing home; T1, 6-month follow-up; T2, 12-month follow-up; T3, 18-month follow-up; T4, 24-month follow-up; T5, 30-month follow-up; T6, 36-month follow-up.
Numbers are mean changes, 95% confidence intervals, and *P* values.
Bold indicates the *P* values which are significant.