Published in final edited form as:

J Affect Disord. 2017 August 01; 217: 42–47. doi:10.1016/j.jad.2017.03.063.

Transcranial magnetic stimulation for treatment-resistant depression: Naturalistic treatment outcomes for younger versus older patients

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Abstract

Background—Repetitive transcranial magnetic stimulation (TMS) has been shown to be safe and effective for treatment-resistant depression (TRD) in the general adult population. Efficacy among older (≥ 60 years) patients, who have a greater burden of cognitive, physical, and functional impairment compared to their younger counterparts, remains unclear. The current study aimed to characterize antidepressant response to an acute course of TMS therapy among patients aged ≥ 60 years compared to those < 60 years in naturalistic clinical practice settings.

Methods—Data were retrospectively collected and pooled for adults with TRD (N = 231; n = 75 aged ≥ 60 years and n = 156 < 60 years) who underwent an acute course of outpatient TMS therapy at two outpatient clinics. Self-report depression scales were administered at baseline and end of acute treatment. Change on continuous measures and categorical outcomes were compared across older vs. younger patients.

Results—Both age groups showed significant improvements in depression symptoms. Response and remission rates did not differ between groups. Age group was not a significant predictor of change in depression severity, nor of clinical response or remission, in a model controlling for other predictors (all $p > .05$).

Limitations—Limitations include reliance on self-report clinical measures and variability in comorbidity and concurrent pharmacotherapy due to the naturalistic nature of the study.

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Author contributions: LC, CC, NP, and AG developed the study idea and methods. CC contributed to manuscript writing, wrote the data tables, and coordinated the co-authors' contributions. CC and AG conducted data analyses. NP and AG contributed to manuscript writing. JB, MN, BG, AT, and LC contributed to data collection, interpretation of results, and revising the paper. All authors approved the final version.

Institutional review board: Collection and analysis of data extracted from medical records for the current study was approved by the Institutional Review Boards (IRBs) at Butler Hospital and the Providence Veterans Administration Medical Center.

Conclusions—Results suggest that effectiveness of TMS for TRD is not differentially modified by age. Based on these naturalistic data, age alone should not be considered a contraindication or poor prognostic indicator of the antidepressant efficacy of TMS.

Keywords

Transcranial magnetic stimulation; TMS; Depression; Geriatric

1. Introduction

Repetitive transcranial magnetic stimulation (TMS) is a non-invasive brain stimulation treatment for people with major depressive disorder resistant to first-line pharmacotherapy and psychotherapy interventions (“treatment resistant depression,” TRD; American Psychiatric Association, 2010). TMS uses brief magnetic field pulses to induce electrical currents in the cerebral cortex, which impacts a number of processes involved in brain function (Chervyakov et al., 2015). TMS for TRD in the general adult population has demonstrated safety, tolerability, and efficacy in multiple randomized controlled trials (e.g., George et al., 2010; Levkovitz et al., 2015; O'Reardon et al., 2007); similar outcomes have been reported in naturalistic effectiveness research (Carpenter et al., 2012) and retrospective case reviews (Connolly et al., 2012). However, TMS outcomes among older adults (> 60 years) with TRD remain unclear.

Depression is the second most common psychiatric disorder in the elderly (Panza et al., 2010), and about one third of elderly depressed patients have TRD (Mulsant and Pollock, 1998). Compared to their younger counterparts, elderly depressed patients often suffer from a greater burden of cognitive, physical, and functional impairment (Knöchel et al., 2015; Mulsant and Pollock, 1998); poorer course of major depressive disorder (MDD; Licht-Strunk et al., 2007); inadequate antidepressant response or early symptom relapse (Knöchel et al., 2015; Whyte et al., 2004); and more medication side-effects (Lyness et al., 1996). Older patients may also experience more medical comorbidities and significant psychosocial stressors, such as social isolation and caregiver dependence (Knöchel et al., 2015). Given that depression in older age involves these unique clinical challenges, it is important to understand whether available treatments for TRD can be applied in this population.

The effectiveness of TMS in older adults has been debated in the literature. Meta-analytical evidence based on six of the early TMS-TRD randomized control trials (RCTs) suggested that older age predicted poorer response (Fregni et al., 2006). However, a recent systematic review of both randomized and uncontrolled trials concluded that there was no reliable evidence negating the utility of TMS in elderly people with TRD, largely because most early trials excluded older adults (i.e., those > 60 years; Sabesan et al., 2015), and most studies reviewed by Fregni et al. (2006) used stimulation intensity at 90–110% percent of motor threshold (MT), which is less than what would be considered a standard “dose” in today's clinical practice (i.e., 120% MT). Sabesan et al. (2015) also indicated that TMS has a high degree of tolerability and safety among older elderly patients, leading them to conclude that elderly people with TRD should not be excluded in clinical trials or practice.

Four RCTs to date focused on older people (Jorge et al., 2008; Manes et al., 2001; Mosimann et al., 2004; note that Jorge et al. included two studies). Of note, the most recent of these studies used a stimulation intensity of 110% MT and demonstrated efficacy of TMS in geriatric patients with vascular depression (Jorge et al., 2008). Earlier trials using stimulation intensity equal to or lower than MT found no benefit compared to sham (Manes et al., 2001; Mosimann et al., 2004). However, no studies have yet examined whether elderly patients benefit from a 120% MT protocol, which is now the standard stimulation intensity used in clinical practice (George et al., 2010; O'Reardon et al., 2007).

A number of neurobiologically plausible mechanisms for an age-related TMS treatment effect have been posited, including atrophy of cortical gray matter (with associated greater coil-to-cortex distance), reduced synaptic connectivity, declining axon conduction velocities, and aging-related changes in lateralization, myelination, cerebrovascular function, and immune-inflammatory control (Bashir et al., 2014; Berlingeri et al., 2013; Knöchel et al., 2015; Kozel et al., 2000). Each of these factors could presumably alter the electromagnetic and anatomic properties of cortical tissue underneath the TMS coil, thereby altering the effect of TMS induced currents.

However, there have been remarkably few studies investigating this age-effect hypothesis directly (Riva-Posse et al., 2013), and it is difficult to draw any meaningful conclusions due to marked methodological variability in terms of coil placement, “dosing,” (e.g., stimulation frequency and intensity, number of pulses), and treatment duration. To our knowledge, no previous observational study or controlled trial has specifically examined the treatment outcome of TMS therapy in older individuals using more modern parameters (i.e., high frequency stimulation to the left dorsolateral prefrontal cortex (DLPFC), delivered at 120% MT). The current study aimed to characterize the therapeutic response to TMS among TRD patients aged ≥ 60 years compared to those < 60 years, through retrospective analysis of outcome data routinely collected on all patients who received an acute course of treatment at two collaborating outpatient TMS clinics in Providence, Rhode Island prior to April 30, 2016. The age of 60 was chosen as a cut-off based on research by Sabesan et al. (2015), who reported that few adults over age 60 have been included in efficacy studies (average age range 27–61). Based on prior literature suggesting benefit for elderly patients (Jorge et al., 2008; Sabesan et al., 2015), we hypothesized that older patients would show similar changes in depression symptoms compared to younger patients.

2. Methods

2.1. Sample

Collection and analysis of data extracted from medical records was approved by the Institutional Review Boards (IRBs) at Butler Hospital (BH) and the Providence Veterans Administration Medical Center (VA). The BH and VA outpatient TMS clinics use the same TMS devices, share psychiatrists and staff that train together, follow similar procedures, and routinely administer the same depression assessment scales at baseline and serially during an acute course of TMS therapy. The pooled data represent 231 adults from BH (n = 196) and the VA (n = 35) treated with TMS during the period of February 2009 to April 2016. Data were included for analysis in this naturalistic outcomes study if the patient met the following

inclusion criteria: 1) primary DSM-IV or V diagnosis of MDD (single or recurrent episode without psychotic features); 2) resistance to or intolerance of 1 trials of antidepressant medications; 3) no previous TMS therapy exposure; 4) a TMS-trained psychiatrist determined that TMS represented an appropriate treatment option; and 5) standard clinical assessments of depressive symptom severity were completed at pre-treatment baseline and at least once after the course of daily TMS treatments was initiated.

2.2. Treatment

The NeuroStar TMS Therapy system (Neuronetics, Inc., Malvern, PA) was used to deliver high-frequency (5 Hz or 10 Hz; Philip et al., 2015) stimulation over left DLPFC, typically with a schedule of 5 TMS sessions per week for 6 weeks, followed by 6 additional treatments in a taper schedule over three weeks. If remission was achieved prior to treatment number 30, the taper phase would begin earlier. In several cases at the BH site, the acute course was extended by additional treatments, for a maximum of 50 sessions. MT assessment occurred at the initial treatment session for determination of stimulation intensity, and was re-checked as clinically indicated through the acute course. External coordinates for coil placement over DLPFC were calculated by the device for a site 5.5 cm anterior from the MT location along a left superior oblique plane; adjustments were made for individual patients by the TMS physicians as needed to manage comfort and/or more accurately approximate the F3 location as defined by the international 10–20 system (Beam et al., 2009). Individual treatment sessions were delivered at 120% for a total of 3000 pulses. Consistent with common clinical practice, the total number of pulses per daily session could be increased to 4000 in cases where patients had not demonstrated substantial clinical improvement after the third week of treatment (George et al., 2010).

Consistent with the clinical practice in both settings, patients continued their ongoing (ineffective) psychiatric medications when they initiated the course of TMS. In the event of TMS-medication interactions, medication dose reductions and/or medication discontinuations were directed by TMS physicians so the course of TMS could be continued. Prescribing psychiatrists were discouraged from making other changes to a patient's medication regimen during the course of TMS therapy. For patients engaged in regular psychotherapy when they started TMS, there was no recommendation for change in schedule.

2.3. Measures

Demographic and clinical characteristics were extracted from medical records. Adverse events were retrospectively identified by examining clinically documented reasons for premature termination of the acute TMS course and categorized as serious and non-serious.

2.3.1. Outcome measures—Baseline and endpoint reports of depressive symptom severity were compared using the Inventory of Depressive Symptomatology–Self Report (IDS-SR; Rush et al., 2006) and the 9-item Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001). The PHQ-9 was not included in routine assessments for the earliest patients in the BH clinic, but it was consistently collected once implemented into standard procedures and is thus available for a subset $n = 221$ in this sample. The primary outcome for this study

was the change in baseline to endpoint score on the IDS-SR scale. Other outcomes included change on the PHQ-9, as well as response and remission rates. Clinical response was defined as 50% reduction of baseline scores on the IDS-SR or PHQ-9. Remission was defined by scores less than 14 on the IDS-SR and less than 5 on the PHQ-9.

2.4. Data analysis

Data from individual patients were grouped according to age at the point when TMS was initiated, such that the younger group included data from those younger than 60 years of age ($n=156$) and the older group included data from patients who were 60 years or older ($n=75$). Analyses were conducted using SPSS version 22 (IBM, Armonk, NY). Descriptive analyses were used to examine baseline sample characteristics. Independent samples t -tests were used to identify potential baseline differences between the older and younger age groups for clinically relevant continuous variables meeting the assumptions of parametric tests (baseline IDS-SR total score, baseline PHQ-9 total score, number of weeks of acute treatment). A nonparametric contrast (Mann-Whitney test) was used to compare the number of acute treatment sessions ($z_{\text{skewness}}=-5.16$, $z_{\text{kurtosis}}=8.44$) between groups. Categorical variables (sex, history of psychiatric hospitalization, prior ECT, adverse event occurrence) were examined using chi-square analysis. Treatment outcome for the entire sample was examined using paired sample t -tests for baseline-to-endpoint total scores on the IDS-SR and PHQ-9. Chi-square analysis was used to test whether response or remission rates differed by age group. Of note, we also completed post-hoc testing using age as a continuous variable to examine if age impacted outcomes in a way that was not detectable with our a priori grouping cut off.

Hierarchical linear regression was used to determine whether age group membership (younger versus older) was significantly associated with post-treatment severity scores on the IDS-SR and PHQ-9 in two separate, three-step models. Analyses were conducted using the last observation carried forward (LOCF) method. Baseline total severity scores were entered in Step 1. Step 2 included clinic site and history of past psychiatric hospitalizations (the only clinically relevant baseline variable found to differ significantly between groups, see results below). Step 3 added age group. Parallel three-step hierarchical logistic regression models were used to determine whether age group predicted response and remission status on the IDS-SR or PHQ-9.

2.5. Results

Demographics and clinical characteristics are presented in Table 1. The distribution of sex, history of prior ECT, number of treatments and duration of treatment course (weeks) did not differ between age groups. Employment status differed in an expected pattern, such that the younger group was more likely to be employed ($\chi^2(1)=15.7$, $p<.001$) and unemployed ($\chi^2(1)=5.2$, $p=.02$) and less likely to be retired ($\chi^2(1)=63.6$, $p<.001$). The younger group was significantly more likely to have a history of prior psychiatric hospitalization and had significantly higher baseline depression severity scores on the IDS-SR ($t=2.2$, $p=.03$) and PHQ-9 ($t=2.4$, $p=.01$).

2.5.1. Site differences—Patients were not found to differ by site in terms of baseline IDS-SR total score ($t=.5$, $p=.61$), baseline PHQ-9 total score ($t=.9$, $p=.34$), number of acute treatment sessions ($U=2811.0$, $p=.08$), or prior psychiatric hospitalization ($\chi^2(1)=.4$, $p=.51$). Patients at the BH site had significantly more weeks of treatment (BH: $M=9.4$, $SD=3.0$; VA: $M=7.8$, $SD=2.6$; $t=6.5$, $p=.002$) and were more likely to have had prior ECT, $\chi^2(1)=5.2$, $p=.02$ compared to those treated at the VA. The proportion of younger and older patients at each site did not significantly differ, $\chi^2(1)=3.3$, $p=.07$. More males than females were treated at the VA site than at BH, $\chi^2(1)=41.2$, $p<.001$.

2.5.2. Safety—There were no deaths, seizures or syncope in the entire patient sample. Significant adverse events did not differ by age groups. Rates of hospitalization for any reason did not differ by age group, $\chi^2(1)=.08$, $p=.77$. The total number of non-serious adverse events also did not differ by group, $\chi^2(1)=1.95$, $p=.16$ (see Table 1 for rates of specific observed events).

2.5.3. Treatment outcomes—There was a significant baseline-to-endpoint improvement for the patient group as a whole on the IDS-SR total scores (baseline $M=47.1$, $SD=10.7$; post-treatment $M=27.8$, $SD=15.5$; $t=20.1$, $p<.001$) and PHQ-9 total scores (baseline $M=18.7$, $SD=5.8$; post-treatment $M=9.5$, $SD=7.0$; $t=19.1$, $p<.001$). Both age groups had significant reductions in total IDS-SR score (Older: baseline $M=45.0$, $SD=10.8$; post-treatment $M=26.7$, $SD=14.7$; $t=11.5$, $p<.001$; Younger: baseline $M=48.1$, $SD=10.5$; post-treatment $M=28.3$, $SD=15.9$; $t=16.4$, $p<.001$) and total PHQ-9 score (Older: baseline $M=17.4$, $SD=5.1$; post-treatment $M=8.7$, $SD=6.7$; $t=11.5$, $p<.001$; Younger: baseline $M=19.3$, $SD=6.0$; post-treatment $M=9.9$, $SD=7.1$; $t=15.3$, $p<.001$).

Older patients were not significantly more or less likely to meet criteria for response (IDS-SR: 45.3% vs. 44.9%, $\chi^2(1)=.004$, $p=.94$; PHQ-9: 58.7% vs. 55.4%, $\chi^2(1)=.47$, $p=.49$) or remission (IDS-SR: 26.7% vs. 25.0%, $\chi^2(1)=.07$, $p=.78$; PHQ-9: 33.3% vs. 25.6%, $\chi^2(1)=1.2$, $p=.25$) than younger patients.

Hierarchical regression models examining age group as a predictor of IDS-SR and PHQ-9 post-treatment total scores, responder status, and remitter status are presented in Tables 2, 3. Age group was not found to be a significant predictor in any of the regression models.

2.5.4. Post-hoc hierarchical regression models—To explore whether age may have impacted outcomes in a way that was not detectable with our grouping cut off of 60 years, post-hoc analyses using the same hierarchical regression models were run with age as a continuous variable in Step 3. The pattern of results was the same as the original models. Age was not a significant predictor of IDS-SR post-treatment total scores ($\beta=-.02$, $p=.73$), responder status ($e^B=.99$, $p=.84$), or remitter status ($e^B=1.00$, $p=.65$). Age also was not a significant predictor of PHQ-9 post-treatment total scores ($\beta=-.05$, $p=.35$), responder status ($e^B=1.06$, $p=.58$), or remitter status ($e^B=1.00$, $p=.53$).

3. Discussion

This study examined the acute outcomes of older (aged ≥ 60 years) versus younger (<60 years) patients with TRD receiving TMS therapy in a clinical practice setting using modern parameters. We found very similar clinical characteristics between older and younger patients, and found no meaningful differences in treatment outcomes based on age. Age was not found to be a significant predictor of change in depression severity or reaching clinical response or remission with TMS. While a previously published large (n =307) naturalistic study (Carpenter et al., 2012) from 42 US practice sites found the cohort of individuals with age ≥ 55 fared better than the older ones in the sample, the present pooled 2-clinic sample contained a greater number of patients in the 60+ age range. Another notable difference between the two naturalistic samples is the relatively greater average number of treatment sessions (33.0 ± 8.4) in our 2-clinic sample compared to the prior study (28.3 ± 10.1). Insurance or comparable coverage for TMS was consistently available for patients represented in this data set, but it was not in place when the earlier observational study was conducted, so perhaps the equivalent outcomes for older and younger patients we report here reflects the fact that these patients were able to receive a full course of up to 36 treatments, if needed, while noting there was no difference in the number of treatments received by older and younger patients. The 45% IDS-SR response rate we report for this 2-clinic sample is similar to the 42% IDS-SR response rate described for the 42-site naturalistic treatment study and also aligns closely with the 41% IDS-SR response rate described in a recent chart review study (Bakker et al., 2015).

It is possible that findings regarding negative effect of advancing age on TMS outcomes described in earlier studies are related to interactions between age and other risk factors for non-response. For example, older age may be a proxy or overlapping risk factor for another variable that affects responder status in some studies. Other variables that have been implicated in age-related effects but were not systematically measured or analyzed in the current study include cortical atrophy, cognitive impairment, and psychiatric or medical comorbidities.

The present finding of equivalent antidepressant outcomes for older TMS patients adds to the growing body of literature suggesting that age does not negate the use of TMS in older adults with depression, including reports from randomized controlled TMS studies that specifically enrolled individuals > 60 years (Jorge et al., 2008; Manes et al., 2001; Mosimann et al., 2004) and demonstrated efficacy of TMS for older depressed patients. Additionally, when Lisanby and colleagues (Lisanby et al., 2009) analyzed predictors of response to TMS participants in the O'Reardon et al. (2007) study, they did not find age to be a statistical predictor of treatment nonresponse, with the caveat that while they did include participants ranging in age from 18 to 70 years, the majority were younger than 60 in the parent study. Due to its low side effect profile, potential for enhancement of working memory (Bagherzadeh et al., 2016) and lack of systemic side effects, TMS appears to be ideally suited as a treatment for older individuals with TRD who are stable as outpatients and able to travel to the clinic for daily treatment sessions.

Limitations of the current study include those inherent to any retrospective, naturalistic study of TMS. Treatment was provided as an adjunct to ongoing pharmacotherapy, and in some cases, psychotherapy. We did not systemically measure time spent in patient-clinician interactions. Furthermore, we relied upon self-reports of clinical symptoms and did not conduct standardized clinical interviews to evaluate severity of depressive symptoms. Adverse events were retrospectively identified and were not systematically captured with the detail typically employed in a prospective clinical trial. It is also possible that outcomes were influenced by other unmeasured factors, such as medical and psychiatric comorbidity. Although all patients underwent medical clearance prior to starting TMS therapy, such clearance was limited primarily to confirmation of low seizure risk and absence of implanted intracranial metal; new illnesses and injuries occasionally occurred during the several months when TMS is being delivered. Despite these limitations, our relatively large sample size and use of naturalistic treatment data provides important information regarding the use of TMS in older individuals that is highly generalizable to clinical practice.

In conclusion, the results of this large retrospective study of TMS therapy outcomes from two outpatient clinics suggest that older patients with TRD have comparable outcomes to younger patients, with response rates in our sample generally consistent with others across the literature. These results replicate prior work indicating efficacy of TMS for older individuals, and demonstrate that age alone should not be considered a contraindication or poor prognostic indicator to TMS therapy.

Acknowledgments

Funding: Dr. Conelea's effort on the current study was supported by K23MH013617 from the National Institute of Mental Health. Dr. Philip's effort on the current study was supported by a Career Development Award (IK2 CX000724) from the U.S. Department of Veterans Affairs (Clinical Sciences Research and Development). The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the National Institutes of Mental Health or the Department of Veterans Affairs.

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Abbreviations

MDD	major depressive disorder
MT	motor threshold
TMS	transcranial magnetic stimulation
TRD	treatment-resistant depression

Table 1

Demographics, clinical characteristics, and baseline and post-treatment depression severity scores.

Demographic Variables	< 60 years (n =156)	60 years (n =75)	p-value
Treatment site			.07
Butler Hospital (n)	137	59	
Providence VAMC (n)	19	16	
Age, mean (SD, range)	45.5 (10.3, 19–59)	66.0 (5.5, 0–84)	< .001 *
Age by decade [n (%)]			
18–20 s	17 (7.4)	–	
30 s	24 (10.4)	–	
40 s	44 (19.0)	–	
50 s	71 (30.7)	–	
60 s	–	58 (25.1)	
70 s	–	15 (6.5)	
80 s	–	2 (.9)	
Female [n (%)]	101 (64.7%)	43 (57.3%)	.25
Employment status [n (%)]			
Employed	61 (39.1%)	10 (13.3%)	< .001 *
Disabled	48 (30.8%)	20 (26.7%)	.52
Leave of absence	7 (4.5%)	1 (1.3%)	.22
Student	4 (2.6%)	3 (4.0%)	.55
Retired	6 (3.8%)	35 (46.7%)	< .001 *
Unemployed	28 (17.9%)	5 (6.7%)	.02 *
Unknown	2 (1.3%)	1 (1.3%)	.97
Psychiatric History			
History of psychiatric hospitalization [n (%)]	111 (71.2%)	43 (42.7%)	.03 *
History of prior ECT [n (%)]	40 (25.6%)	23 (30.7%)	.42
TMS Course			
Number of treatments mean SD, range)	32.4 (9.0, 2–50)	34.2 (6.7, 6–50)	.41
Number of weeks in treatment mean (SD, range)	9.2 (3.2, 0–21)	9.1 (2.4, 1–16)	.78
Serious Adverse Events Related to Early Termination of TMS (total observed)			
Psychiatric hospitalization	7	3	.86
Medical hospitalization unrelated to TMS	0	1	.14
Adverse Events Related to Early Termination of TMS (total observed)	6	1	
Activation (insomnia, lability, irritability, agitation, anxiety)	3	0	.22
Substance use relapse	1	0	.48
Baseline symptom scores			
IDS-SR total score, mean (SD)	48.4 (10.5)	45.1 (10.7)	.03 *
PHQ-9 total score, mean (SD)	19.5 (6.0)	17.5 (5.1)	.01 *
Treatment outcomes			

Demographic Variables	< 60 years (n =156)	60 years (n =75)	p-value
IDS-SR total score, mean (SD)	28.3 (15.9)	26.7 (14.7)	.46
IDS-SR response rate [n (%)]	70 (44.9)	34 (45.3)	.94
IDS-SR remission rate, [n (%)]	39 (25.0)	20 (26.7)	.78
PHQ-9 total score, mean (SD)	9.9 (7.1)	8.7 (6.7)	.24
PHQ-9 response rate [n (%)]	82 (55.4)	44 (60.3)	.49
PHQ-9 remission rate [n (%)]	40 (26.5)	25 (33.8)	.25

Note: IDS-SR = Inventory of Depressive Symptomatology – Self Report; PHQ-9=9-item Patient Health Questionnaire; VAMC = Veterans Administration Medical Center. PHQ-9 subset comprises 148 and 73 individuals aged < 60 years and 60 years, respectively.

*
 $p < .05$.

Age group as a predictor of depression improvement on the Inventory of Depressive Symptomatology – Self Report.

Table 2

	Post-Treatment Total Score (n=227)					Response (n =231)					Remission (n =231)				
	B	SE B	β	R ²	R ²	B	SE B	e ^B	R ²	R ²	B	SE B	e ^B	R ²	R ²
Step 1															
Baseline IDS-SR total score	.64	.09	.43**	.19**		-.01	.01	.98	.004		-.07**	.01	.93	.09	
Step 2															
Baseline IDS-SR total score	.56	.09	.38**	.22	.03*	.001	.01	1.0			-.06**	.01	.94		.14
Clinic site	1.31	2.53	.03			-.04	.38	.95			.55	.44	1.74		
Past psychiatric hospitalization	5.86	2.03	.17**			-1.06**	.30	.34			-1.18**	.33	.30		
Step 3															
Baseline IDS-SR total score	.56	.09	.39**	.22	.001	.000	.01	1.0	.06	.01	-.06**	.01	.94	.14	.00
Clinic site	1.16	2.56	.02			-.03	.38	.97			.61	.44	1.84		
Past psychiatric hospitalization	5.98	2.05	.18**			-1.08**	.30	.33			-1.22**	.33	.29		
Age group	.93	2.0	.02			-.13	.30	.87			-.33	.35	.71		

Key: IDS-SR = Inventory of Depressive Symptomatology – Self Report; SE = standard error; R² = Cox & Snell's pseudo R-squared (in logistic regression models); e^B = exponentiated B.*
p < .05.**
p < .01.

Age group as a predictor of depression improvement on the 9-item Patient Health Questionnaire.

Table 3

	Post-Treatment Total Score (n =227)						Response (n =221)						Remission (n =221)					
	B	SE B	β	R ²	R ²	B	SE B	e^B	R ²	R ² a	B	SE B	e^B	R ²	R ² a	B	SE B	e^B
Step 1																		
Baseline PHQ-9 total score	.48	.08	.40**	.16**		-.02	.02	.97	.01		-.16**	.03	.84					
Step 2				.19	.03*				.04	.03				.13	.01			
Baseline PHQ-9 total score	.44	.07	.36**			-.01	.02	.99			-.15**	.03	.85					
Clinic site	-.01	1.17	.00			.19	.38	1.21			.24	.42	1.2					
Past psychiatric hospitalization	2.4	.94	.16**			-.86**	.31	.42			-.49	.33	2.2					
Step 3				.19	.00				.04	.00				.13	.00			
Baseline PHQ-9 total score	.43	.07	.36**			-.01	.02	.99			-.15**	.03	.85					
Clinic site	-.01	1.18	.00			.18	.38	1.20			.23	.42	1.2					
Past psychiatric hospitalization	2.4	.95	.16**			-.85**	.31	.42			-.49	.33	.61					
Age group	-.01	.94	-.001			.06	.30	1.06			.04	.34	1.04					

Key: PHQ-9=9-Item Patient Health Questionnaire; IDS-SR = Inventory of Depressive Symptoms – Self Report; SE = standard error; R^2 = Cox & Snell's pseudo R-squared (in logistic regression models); e^B = exponentiated B.

* $p < .05$.

** $p < .01$