Role of Hopelessness in Suicidal Ideation Among Patients With Depressive Disorders

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ABSTRACT

Objective: The cognitive theory of suicide postulates that hopelessness is an essential precondition for suicidal ideation in patients with depressive disorder . However, the explanatory power and predictive value of hopelessness for suicidal ideation remain uncertain.

Methods: From 1997 to 2007, patients with depressive disorder who were cohorts from the Vantaa Depression Studies (n = 406) completed the Scale for Suicide Ideation (SSI), Beck Hopelessness Scale (BHS), Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), Perceived Social Support Scale–Revised (PSSS-R), and Eysenck Personality Inventory–Q (EPI-Q) at baseline, 6 and 18 months, and 5 years. We conducted a mixed-effects generalized linear regression and clustered receiver-operating characteristics analysis to test how well BDI and BHS predict severe suicidal ideation within and between patients.

Results: BHS predicted clinically significant suicidal ideation (odds ratio [OR] = 2.8), explaining 13.1% of between-patient and and 3.5% of within-patient variance of SSI. Adjusting for the fixed effect of BDI removed a substantial part of the effect of BHS on SSI (adjusted OR = 1.38, $P = .018$). BAI moderated the effect of BHS on SSI, whereas EPI-Q and PSSS-R did not. BDI detected suicidal ideation more accurately (area under the receiver-operating characteristics curve [AUC] = 0.846) than BHS (AUC = 0.754).

Conclusions: In patients with depressive disorder, hopelessness explains suicidal ideation, but largely because it covaries with depressive symptoms. The role of hopelessness as a central determinant of suicidal ideation in depression may have been overestimated. Symptoms of anxiety moderate the association between hopelessness and suicidal ideation. Severity of depressive symptoms may predict suicidal ideation more accurately than hopelessness.

J Clin Psychiatry 2020;81(2):19m12866

To cite: Baryshnikov I, Rosenström T, Jylhä P, et al. Role of hopelessness in suicidal ideation among patients with depressive disorders. *J Clin Psychiatry*. 2020;81(2):19m12866.

To share: https://doi.org/10.4088/JCP.19m12866

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Previous suicide attempt and diagnosis of major depressive disorder (MDD) are among key risk factors for completed suicide.[1,2] Therefore, recognizing risk factors for suicidal behavior in patients with depressive disorders is a cornerstone of suicide prevention.

Suicidal behavior represents a continuous process, starting with suicidal ideation and progressing to suicide attempts.[3,4] Among psychiatric patients with a current episode of MDD, about 60% experienced suicidal ideation, and among those who attempted suicide, almost all had suicidal ideation.[5] Severity of depression and hopelessness are central risk factors for suicidal ideation in patients with MDD.[6–12]

Hopelessness as a concept in suicide research was originally derived from Beck's cognitive theory of depression.[13,14] In this theory, hopelessness refers to a negative belief about the future according to which problems are perceived as insolvable. This belief, in turn, predisposes to suicidal ideation.[15] Also, other major psychological theories of suicide, such as the 3-step theory,[3,16] interpersonal theory of suicide,[17,18] and fluid vulnerability theory,[19] regard hopelessness as an important cause of suicidal ideation in depressed patients.

The existing evidence only in part supports the cognitive theory, which delineates hopelessness as a central determinant of suicidal ideation. While some authors[20–26] indicate that hopelessness is a strong predictor for suicidal ideation, other authors[27–29] have shown only weak predictive value of hopelessness for suicidal ideation.

When examining the predictive value of different risk factors for a specific outcome, 2 aspects should be considered: (1) state versus trait characteristics of risk factors and outcomes[30] and (2) possible interactions among risk factors.[31]

Most studies have investigated hopelessness as a trait, not as a within-individual state-dependent phenomenon.[32] However, among patients with MDD, hopelessness has both a trait- and a state-related characteristic.[33–35] Hopelessness rises during depression and is alleviated upon recovery, but not all depressed patients feel equally hopeless.[35] The same is true for suicidal ideation as an outcome.[5,36] Furthermore, both suicidal ideation and hopelessness dramatically vary within hours and days in psychiatric patients.[37] As not all depressed patients are equally hopeless[33,35] or suicidal,[1,38] it is essential to

Clinical Points

- Hopelessness predicts severe suicidal ideation, which is largely due to covariation with depressive symptoms. Hopelessness is not the only determinant of suicidal ideation in depression.
- Subjective severity of depression predicts emergence of suicidal ideation even more accurately than hopelessness and is therefore a central target of treatment.
- Subjective anxiety also predicts suicidal ideation. When depression and anxiety are both high, hopelessness does not contribute much further to emergence of suicidal ideation. Therefore, besides depression, anxiety is also an important treatment target.

elucidate the extent to which hopelessness explains within- and between-patient variance of suicidal ideation in patients with depressive disorders.

A related question is how different risk factors interact when predicting an outcome. Hopelessness often covaries with symptoms of depression.[39] Therefore, considering the predictive value of hopelessness for suicidal ideation, it is important to know whether hopelessness predicts suicidal ideation independently of co-occurring depression. However, the few studies[22,40,41] that have investigated the predictive value of hopelessness for suicidal ideation when controlling for depressive symptoms have yielded somewhat inconsistent results.

Finally, factors influencing temporal variation of a risk factor may affect its explanatory power and predictive value. Previously, we have shown that concurrent depressive and anxiety symptoms and low social support explain both state and trait variance, whereas personality traits explain trait variance of hopelessness.[35] The moderating effect of these factors on the association between hopelessness and suicidal ideation is unknown.

We examined the predictive value of hopelessness for suicidal ideation in a 5-year study of patients with depressive disorders. Specifically, we evaluated (*a*) the predictive power of hopelessness for within- and between-patient variance of suicidal ideation and (*b*) the extent to which hopelessness predicts suicidal ideation independently of co-occurring depression or anxiety. Furthermore, we explored (*c*) the moderating role of anxiety, social support, and such personality traits as neuroticism or, alternatively, harm avoidance and self-directedness on the association between hopelessness and suicidal ideation.

METHODS

Vantaa Depression Study and Vantaa Primary Care Depression Study

This study comprises two cohorts—the Vantaa Depression Study (VDS) and the Vantaa Primary Care Depression Study (PC-VDS)—collaborative research projects of the Mood Disorder Research Unit of the Department of Mental Health and Substance Use of the National Institutes of Health and Welfare, Helsinki, Finland. The ethics committee approved the research protocols. The study methodologies have been described in more detail elsewhere: VDS[42,43] and PC-VDS.[44] The VDS was conducted from 1997 to 2002 and the PC-VDS from 2002 to 2007.

Participants

Altogether, 1,917 primary care or psychiatric patients were screened for acute depressive states (PC-VDS) or MDD (VDS). *DSM-IV*[45] diagnoses were verified by clinical interviews (Structured Clinical Interview for DSM-IV Axis I Disorders in PC-VDS; Schedules for Clinical Assessment in Neuropsychiatry in VDS). In PC-VDS, two-thirds (66.4%) of the patients had MDD at baseline , 23.4% had lifetime MDD, and the rest had dysthymia or true minor depression.[44]

The final baseline dataset included 269 MDD patients (VDS) and 137 depressive disorder patients (PC-VDS) (total N = 406) examined on 4 occasions and comprising 1,624 observations in total. All of the participants provided their informed consent. Patient sociodemographic characteristics and the percentage of missing data are shown in Supplementary Table 1. The final dataset comprised 1,099 observations.

Baseline and Follow-Up Evaluation

After baseline assessments, patients were interviewed at 6 (VDS) and 18 months (VDS and PC-VDS) and at 5 years (VDS and PC-VDS).

Self-report scales. Hopelessness, symptoms of depression, anxiety, social support, and personality traits. In addition, patients filled in the self-reported scales at baseline and at all follow-up assessments: the Beck Hopelessness Scale (BHS),[46] the 21-item Beck Depression Inventory (BDI),[47] the Perceived Social Support Scale–Revised (PSSS-R),[48] and the 21-item Beck Anxiety Inventory (BAI).[49] Personality was assessed with Eysenck Personality Inventory–Q (EPI-Q).[50]

Cronbach α for BDI, BAI, and BHS were all ≈ 0.9, indicating excellent internal consistency. The BDI item inquiring about suicidal ideation was omitted in the analyses.

Suicidal ideation. We assessed suicidal ideation using the Scale of Suicide Ideation (SSI).[8] The sample distribution of the SSI is strongly nonnormal and challenging for statistical modeling (see Supplementary Figure 1; skewness = 2.2, kurtosis = 7.1). Because various cutoffs for clinically significant ideation have been used in the past (score range, 2– 6), we derived an empirically justified cutoff point (score 4) falling between the previous heuristic cutoffs using model-based clustering with mclust R package, version 5.2.[51] To avoid unfeasible solutions, we studied only baseline SSI values for those who had some suicidal ideation (SSI > 0, n = 203; see Supplementary Figure 2). The default (Bayesian Information Criterion–based) algorithm gave a two-cluster solution as the best description of the data density, with the values assigned to the high suicidal ideation cluster (SSI ≥ 4), representing suicidal ideation in our binary research variable (see Supplementary Figure 3). The Cronbach α for SSI was 0.9.

Table 1. Generalized Multilevel Regression Models Predicting Suicidal Ideation[a]

		Model I		Model II		Model III	
Effect Type	Variable	β	95% CI	β	95% CI	β	95% CI
Fixed	Intercept	−1.230	−1.608 to −0.895	−2.307	−2.877 to −1.835	−2.290	−2.857 to −1.819
	Sex (male)	0.162	−0.348 to 0.680	0.472	−0.062 to 1.033	0.457	−0.074 to 1.016
	Follow-up 1	−1.199	−1.925 to −0.535	−0.231	−0.996 to 0.486	−0.197	−0.963 to 0.522
	Follow-up 2	−1.551	−2.093 to −1.053	−0.538	−1.118 to 0.017	−0.491	−1.071 to 0.065
	Follow-up 3	−1.338	−1.889 to −0.825	−0.415	−1.014 to 0.164	−0.354	−0.955 to 0.228
	BHS	1.020	0.798 to 1.266	0.357	0.091 to 0.629	0.459	0.183 to 0.745
	BDI	...	...	1.488	1.124 to 1.904	1.545	1.206 to 1.939
	BAI	...	...	−0.028	−0.300 to 0.243	...	... ...
	BAI × BHS	...	...	...	...	−0.250	−0.458 to −0.050
Random	Between	1.471	0.819 to 1.657	1.485	0.766 to 1.741	1.433	0.741 to 1.720
	Within	3.290	...	3.290	...	3.290	...
R^2_{GLMM}	Marginal	0.280	...	0.420	...	0.450	...
	Conditional	0.503	...	0.601	...	0.617	...
$\Delta_{BHS}(R^2_{GLMM})$	Marginal	0.166	...	0.003	...	0.031	...
	Conditional	0.035	...	0.023	...	0.037	...

[a]Values in the table are regression coefficients (β) and variance-component estimates (σ), 95% confidence intervals, explained variance proportions (R^2), and changes in explained variance when entering the variable when entering BHS to the model [$\Delta_{BHS}(R^2_{GLMM})$]. In these models, conditional $1 - R^2_{GLMM}$ equals the proportion of within-patient (plus error) variance, and by implication, conditional $\Delta_{BHS}(R^2_{GLMM})$ also represents change in within-patient variance. Between-patient variance shares can be obtained by subtracting marginal R^2_{GLMM} from the conditional. (Similarly, for BHS-related change, see Supplementary note 1 in Supplementary Material for details.)

Abbreviations: BAI = Beck Anxiety Inventory, BDI = Beck Depression Inventory, BHS = Beck Hopelessness Scale, CI = confidence interval, GLMM = generalized linear multilevel models.

Symbol: ... = not applicable.

Statistical Methods

Mixed-effects generalized linear regression models were used to predict repeated observations of clinically significant levels of suicidal ideation (lme4 R package, version 1.1–12).[52] Temporally stable between-individual differences were captured by random intercept (individual-specific variations) that represents trait variance in suicidal ideation, as opposed to within-individual state variance (time-specific variations). Generalized coefficients of determination were used to assess marginal SSI variance explained by covariates only, as well as conditional variance explained by both covariates and the latent SSI trait (the random effect).[53] Mixed-effects models sometimes fail to converge due to insufficient information available in the data. In these cases, questions pertaining to fixed effects can still be posed using generalized estimating equations (GEEs), which adjust ordinary regression estimates for nonindependent observations due to repeated sampling (geepack R package, version 1.2–1).[54] Finally, we analyzed the Beck Hopelessness Scale's accuracy as a diagnostic instrument for detecting severe suicidal ideation using clustered receiver operating characteristicsanalysis.[55] This method is like ordinary receiver operating characteristics (ROC) analysis, but unbiased with nonindependent repeat observations. We also compared diagnostic accuracy of hopelessness to 2 depression scales, the BDI and the Hamilton Depression Rating Scale (HDRS),[56] and the anxiety scale BAI in detecting severe suicidal ideation.

RESULTS

Correlation Between the Total Scores

The correlations between the total scores on BDI, BAI, and BHS at 4 time points are reported in Supplementary Table 2.

Hopelessness as an Explanation for Suicidal Ideation

Hopelessness was a significant predictor of more severe suicidal ideation in a baseline model that included sex and follow-up as fixed effects plus a random intercept (β = 1.02, SE = 0.12, $P < .001$; effect size as odds ratio [OR] = 2.8 [95% CI, 2.22 to 3.55]) (see Table 1 and Figure 1). However, the patients did not differ from one another in how hopelessness was associated with suicidal ideation (no random slope: $\chi^2_2 = 0.643$, $P = .725$; without correlated random effects $\chi^2_1 = 0.223$, $P = .637$). As all generalized variance inflation factors were below 1.84, no multicollinearity emerged.

Predictive Value of Hopelessness When Symptoms of Depression and Anxiety Are Adjusted

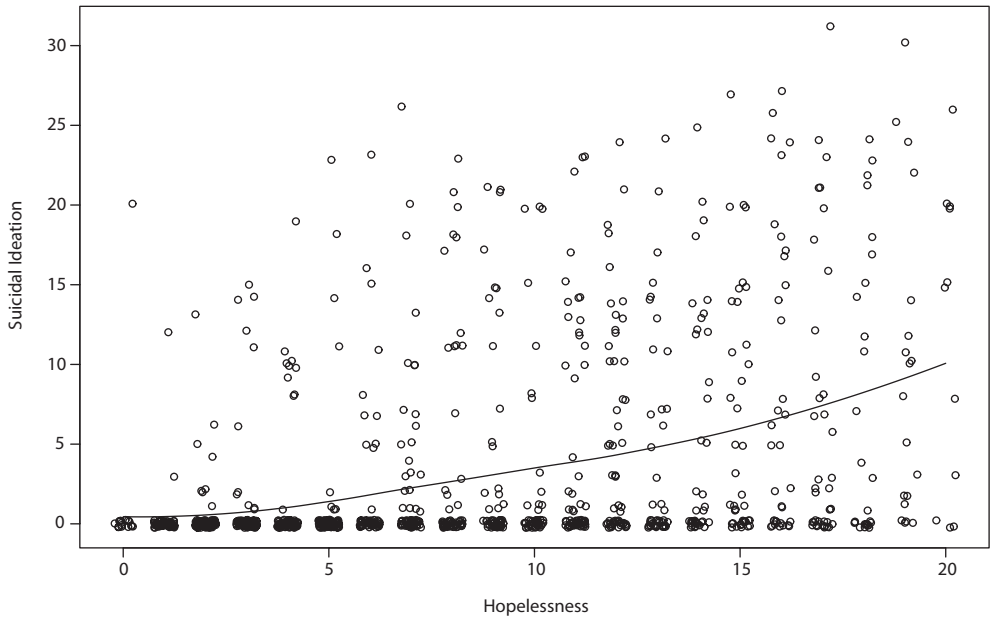
The association between suicidal ideation and depressive symptoms is shown in Figure 2 and between suicidal ideation and anxiety symptoms in Supplementary Figure 4. Adjusting for BAI had only a minor effect on the association between BHS and SSI (β = 0.80 instead of β = 1.01), but adjusting for the fixed effect of BDI explained much, although not all, of the effect (β = 0.32, SE = 0.13, $P = .018$; adjusted OR = 1.38) (see Figure 3).

ROC Analysis of Diagnostic Accuracy

As shown in Table 2, the full and the trimmed BDI were significantly more accurate indicators of severe suicidal ideation than BHS, and BHS was on par with the BAI. The full BDI strongly correlated with the trimmed version that excluded items on suicidal thoughts and hopelessness ($r = 0.997$), and predictions of suicidality based on these two versions did not noticeably differ.

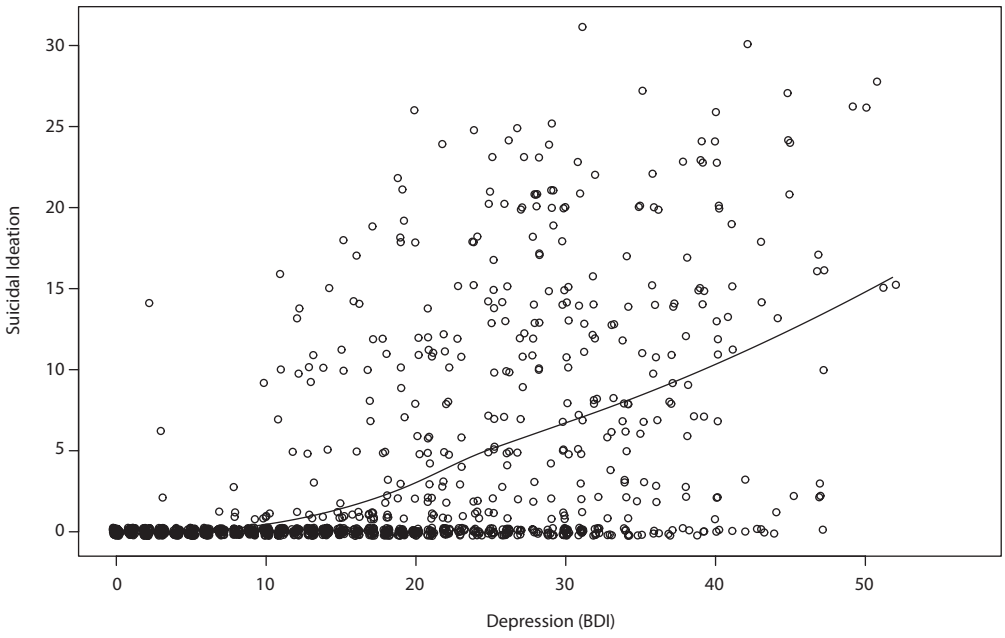
For all observations (persons and time points), 43.5% exceeded or were at a BHS total score of more than 9.

Figure 1. Scatter Plot of Suicidal Ideation and Hopelessness in Patients With Depressive Disorders[a]



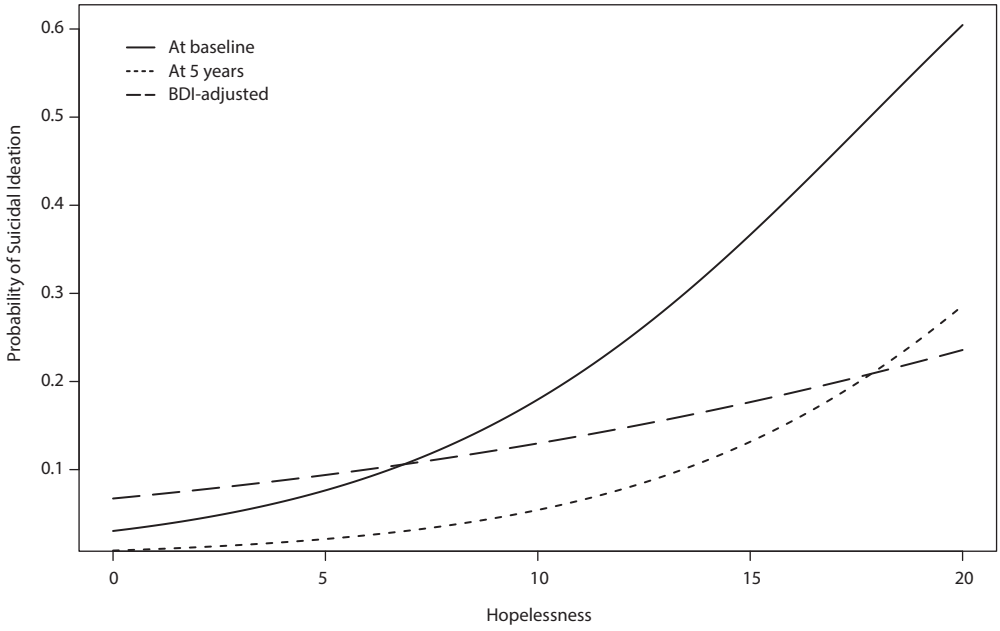
[a]The circles are raw data points and the solid line a local regression ("smoothed") estimate of the association. A small amount of "jitter" (small random displacements) has been added to the data point to enhance visibility of overlapping points.

Figure 2. Association Between Suicidal Ideation and Depressive Symptoms in Patients With Depressive Disorders[a]



[a]The circles are raw data points and the solid line a local regression ("smoothed") estimate of the association. A small amount of "jitter" (small random displacements) has been added to the data point to enhance visibility of overlapping points.

Figure 3. Probability of Severe Suicidal Ideation as a Function of Hopelessness at Baseline and at the 5-Year Follow-Up, and at Baseline When Adjusted for Symptoms of Depression for Those With a Beck Depression Inventory (BDI) Value of 24[a]



[a]The figure illustrates how recovery decreases overall risk of ideation, whereas controlling for depression severity instead reduces the responsiveness of the ideation risk to hopelessness.

Table 2. Classification Accuracy of Hopelessness, Depression, and Anxiety Scores for Severe Suicidal Ideation[a]

Sample	Hopelessness (ref)	BDI (Full)	BDI (Trim)	HDRS	BAI
Total					
AUC (SE)	0.754 (0.018)	0.846 (0.013)	0.835 (0.013)	0.832 (0.015)	0.742 (0.018)
ΔAUD (SE)	...	0.092 (0.0175)	0.080 (0.018)	0.078 (0.021)	0.012 (0.023)
$CI_{\Delta AUC}$	...	(0.058 to 0.126)	(0.044 to 0.115)	(0.038 to 0.119)	(−0.032 to 0.056)
P value	...	< .001	< .001	< .001	.600
Primary care					
AUC (SE)	0.814 (0.030)	0.861 (0.028)	0.848 (0.030)	0.828 (0.028)	0.760 (0.036)
ΔAUD (SE)	...	0.047 (0.033)	0.034 (0.035)	0.014 (0.033)	0.054 (0.043)
$CI_{\Delta AUC}$	...	(−0.018 to 0.111)	(−0.035 to 0.103)	(−0.052 to 0.079)	(−0.030 to 0.139)
P value	...	.158	.329	.681	.2106
Special care					
AUC (SE)	0.735 (0.022)	0.836 (0.015)	0.824 (0.015)	0.833 (0.017)	0.733 (0.022)
ΔAUD (SE)	...	0.101 (0.021)	0.089 (0.022)	0.098 (0.025)	0.002 (0.027)
$CI_{\Delta AUC}$	...	(0.060 to 0.142)	(0.047 to 0.131)	(0.049 to 0.147)	(−0.050 to 0.054)
P value	...	< .001	< .001	< .001	.943

[a]"Trim" refers to a trimmed analysis without suicidality and hopelessness items of BDI, and "AUC" to the area under the ROC curve, which is a measure of classification accuracy, varying between 0.5 (chance performance) and 1 (perfect accuracy).

Abbreviations: AUC = area under ROC curve, AUD = a difference between the AUC values, BAI = Beck Anxiety Inventory, BDI = Beck Depression Inventory, CI = confidence interval, HDRS = Hamilton Depression Rating Scale, ROC = receiver operating characteristic, SE = standard error, Trim = trimmed analysis.

Using this threshold would have resulted in sensitivity of 0.74 and specificity of 0.64 in detecting severe suicidal ideation, with positive predictive value (PPV) of 0.36 and negative predictive value (NPV) of 0.90, meaning that lack of moderate or severe hopelessness gives some certainty for lack of suicidal ideation, but presence of hopelessness is a relatively poor predictor of suicidal ideation. The respective numbers for severe hopelessness (score of 14 or more; 19.5% of observations) were 0.42 (sensitivity), 0.86 (specificity), 0.45 (PPV), and 0.85 (NPV).

Moderated Effects of Hopelessness on Severe Suicidal Ideation

We tested for interactions between hopelessness and social support, hopelessness and neuroticism, and hopelessness and depression. All of these variables had an independent

effect on severe suicidal ideation (all $P < .001$ both in GEE and in multilevel models). However, none of the multilevel models including interactions of these variables with BHS converged. Therefore, we used generalized estimating equations and found that the variables did not moderate the effects of hopelessness (all $P > .250$). In contrast, anxiety symptoms moderated the effect of hopelessness on suicidal ideation ($\beta = -0.275$, $P = .004$ in GEE).

Sensitivity Analysis

Omitting the BDI items about suicidal ideation and hopelessness did not significantly affect the results (see Supplementary Table 3 for details).

DISCUSSION

In our study, hopelessness explained 13.1% of between-patient and 3.5% of within-patient variance of severe suicidal ideation. The predictive value of hopelessness markedly diminished when adjusting for symptoms of depression. Symptoms of anxiety weakly moderated the association between hopelessness and suicidal ideation, with hopelessness being a more potent risk factor among those with low anxiety. By contrast, neither the personality traits of neuroticism and extraversion nor social support appeared to moderate this relationship.

Our study has several major strengths. First, to our knowledge, this is the first study quantifying the strength of the association between hopelessness and state and trait characteristics of severe suicidal ideation in patients with depressive disorders. Second, the two cohorts cover a relatively large and regionally representative sample of patients with depressive disorders, and both cohorts employed similar methodologies, allowing their valid comparisons and the pooling of data. Third, all the patients were carefully diagnosed using structured clinical interviews. Fourth, we supplemented previous clinical cutoff points for SSI that define severe suicidal ideation with a data-driven model-based clustering solution for determining the cutoff point of SSI to define severe suicidal ideation.

Our study also has limitations. First, our design did not allow us to investigate the temporal course of hopelessness and suicidal ideation within the clinical time frame of days or weeks, de novo emergence of suicidal ideation in short time periods, or moment-to-moment covariations. Measurement of predictive values involved a diagnostic prediction of concurrent suicidal ideation within the same time point, not future suicidal ideation, so the potential causal nature of these constructs cannot be inferred. Second, imputation methods of missing data were not used, resulting in a decrease in the number of observations from 1,624 to 1,099. Third, individual-specific treatment effects were not controlled. Fourth, personality was assessed using the Eysenck Personality Inventory, as more modern scales were not available in Finnish at the time that the follow-up study commenced. Fifth, the findings could be partly explained by overlap in item content, but they remained similar in sensitivity analyses using the BDI without items about suicidal ideation and hopelessness. Finally, the study findings are limited to the prediction of suicidal ideation and do not apply to the prediction of suicidal behavior including death by suicide.

Hopelessness significantly predicted severe suicidal ideation in patients with depressive disorders (OR = 2.8). This finding is consistent with the meta-analysis of Ribeiro et al,[32] which showed that hopelessness is the strongest predictor of suicidal ideation (weighted OR = 2.19).

However, the predictive value of hopelessness markedly decreased, but did not fully vanish, when adjusting for symptoms of depression (OR = 1.38). Studies examining the predictive value of hopelessness for suicidal ideation separately from symptoms of depression are scarce and have yielded contradictory results. For example, in a cross-sectional study[41] of psychiatric outpatients, hopelessness adjusted for symptoms of depression was a stronger predictor of suicidal ideation than the BDI scale per se. However, in another cross-sectional study[40] of a community sample of adolescents, the predictive value of depression for suicidal ideation was considerably higher than the predictive value of hopelessness.[4] In a recent prospective study by Wolfe et al,[22] hopelessness was positively related to suicidal ideation over a 6-month treatment with fluoxetine independently of changes in depression severity only in female, but not male, adolescents. In our previous longitudinal study[57] of adult depressed patients assessed by SSI, BDI, and BHS weekly, the decline in suicidal ideation was independently predicted by preceding declines in the levels of both depressive symptoms and hopelessness. However, the hazard ratio for BHS was slightly lower than for BDI in terms of prediction of the decline in SSI. Thus, although hopelessness is a significant predictor for suicidal ideation in adult depressed patients, it is a poorer predictor when adjusted for symptoms of depression.

We showed that the presence of moderate (BHS total score from 9 to 13) or severe (BHS score over 14) hopelessness was a poor predictor of severe suicidal ideation, although the lack of moderate hopelessness strongly predicted lack of severe suicidal ideation. As the predictive value of hopelessness, when adjusting for symptoms of depression, is small, in clinical settings, assessment of the severity of hopelessness combined with the measurement of symptoms of depression does not yield additional clinically important predictive power of suicidal ideation.

The low predictive value of hopelessness, when adjusting for severity of depression, for suicidal ideation challenges the cognitive theory of suicidal ideation in depressed patients, assuming that hopelessness is a central cause for suicidal ideation. However, this finding seems to be in line with other theories of suicide, eg, the fluid vulnerability theory, suggesting that hopelessness is an important, but not sufficient, factor for development of suicidal ideation.[19]

In our study, hopelessness explains only 3.5% of within-patient variance of severe suicidal ideation. However, hopelessness explains almost 13.1% of between-patient

variance of suicidal ideation, indicating that hopelessness appears to be to a greater extent a trait-like risk factor for suicidal ideation. Thus, hopelessness may reflect more a stable predisposition for suicidal ideation than a temporally unstable within-individual tendency for severe suicidal ideation. Trait hopelessness in patients with depressive disorders is a poorly understood phenomenon, partly related to personality features such as high neuroticism and low extraversion.[35] Young et al[33] demonstrated that trait hopelessness predicts several negative outcomes, including more frequent occurrences of depression, more severe suicidal ideation, and more frequent suicide attempts, in depressed patients. Further research is required to answer these questions and elucidate the clinical utility of trait hopelessness.

As previously debated, a trait-like risk factor represents a temporally stable vulnerability to a disease, and it can be used to identify patients at risk regardless of the timing of the measurement, but not in monitoring temporal variation of an outcome. As suicidal ideation varies strongly within hours and days,[37] the timing of the measurement is crucial when estimating the predictive value of hopelessness for suicidal ideation. While many cross-sectional and prospective studies with several months or years between measurements yielded stronger estimates,[21,41,58] ecological momentary assessment studies with hours or days between measurements gave very low or even nonsignificant estimates for the predictive value of hopelessness for fluctuating suicidal ideation.[28,37]

We found that hopelessness more weakly predicts severe suicidal ideation when anxiety is higher. In line with our other findings, it seems that for a patient with a high degree of depression and anxiety, hopelessness does not contribute much further to emergence of suicidal ideation. Social isolation and poor social support are risk factors for suicide[59] and are important components of the interpersonal psychological model of suicidal behavior.[17] In our study, social support did not, however, moderate the effect of hopelessness on severe suicidal ideation. The same is true for personality traits. Therefore, poor social support as well as personality traits do not seem to act through the association between hopelessness and suicidal ideation.

Taken together, in patients with depressive disorders, the explanatory power and predictive value of hopelessness for significant suicidal ideation, when adjusting for the severity of depression, are low. In light of this finding, the cognitive theory of suicidal ideation may have overemphasized the role of hopelessness in the development of suicidal ideation. Hopelessness seems to be more a trait-like than a state-like risk factor for severe suicidal ideation, thus informing primarily about enduring predisposition. In clinical situations in which the focus is often on concurrent or short-term risk, current severity of depressive symptoms may predict suicidal ideation more accurately than hopelessness.

Submitted: April 9, 2019; accepted July 1, 2019.
Published online: February 11, 2020.
Potential conflicts of interest: None.
Funding/support: No funding, support, or sponsorship.
Previous presentation: Poster presented at the 21st Annual International Society for Bipolar Disorders Conference; March 22, 2019; Sydney, Australia.
Supplementary material: Available at PSYCHIATRIST.COM.

REFERENCES

1. Isometsä E. Suicidal behaviour in mood disorders—who, when, and why? *Can J Psychiatry*. 2014;59(3):120–130.
2. Hawton K, Casañas I Comabella C, Haw C, et al. Risk factors for suicide in individuals with depression: a systematic review. *J Affect Disord*. 2013;147(1–3):17–28.
3. Klonsky ED, Saffer BY, Bryan CJ. Ideation-to-action theories of suicide: a conceptual and empirical update. *Curr Opin Psychol*. 2018;22:38–43.
4. O'Connor RC, Kirtley OJ. The integrated motivational-volitional model of suicidal behaviour. *Philos Trans R Soc Lond B Biol Sci*. 2018;373(1754):20170268.
5. Sokero TP, Melartin TK, Rytsälä HJ, et al. Suicidal ideation and attempts among psychiatric patients with major depressive disorder. *J Clin Psychiatry*. 2003;64(9):1094–1100.
6. Pages KP, Russo JE, Roy-Byrne PP, et al. Determinants of suicidal ideation: the role of substance use disorders. *J Clin Psychiatry*. 1997;58(11):510–515.
7. Nock MK, Banaji MR. Prediction of suicide ideation and attempts among adolescents using a brief performance-based test. *J Consult Clin Psychol*. 2007;75(5):707–715.
8. Beck AT, Kovacs M, Weissman A. Assessment of suicidal intention: the Scale for Suicide Ideation. *J Consult Clin Psychol*. 1979;47(2):343–352.
9. Brown GK, Beck AT, Steer RA, et al. Risk factors for suicide in psychiatric outpatients: a 20-year prospective study. *J Consult Clin Psychol*. 2000;68(3):371–377.
10. Franklin JC, Ribeiro JD, Fox KR, et al. Risk factors for suicidal thoughts and behaviors: a meta-analysis of 50 years of research. *Psychol Bull*. 2017;143(2):187–232.
11. Vuorilehto MS, Melartin TK, Isometsä ET. Suicidal behaviour among primary-care patients with depressive disorders. *Psychol Med*. 2006;36(2):203–210.
12. Van Gastel A, Schotte C, Maes M. The prediction of suicidal intent in depressed patients. *Acta Psychiatr Scand*. 1997;96(4):254–259.
13. Beck AT. Thinking and depression, I: idiosyncratic content and cognitive distortions. *Arch Gen Psychiatry*. 1963;9(4):324–333.
14. Beck AT, Kovacs M, Weissman A. Hopelessness and suicidal behavior: an overview. *JAMA*. 1975;234(11):1146–1149.
15. Rush AJ, Beck AT. Cognitive therapy of depression and suicide. *Am J Psychother*. 1978;32(2):201–219.
16. Klonsky ED, May AM. The Three-Step Theory (3ST): a new theory of suicide rooted in the "ideation-to-action" framework. *Int J Cogn Ther*. 2015;8(2):114–129.
17. Van Orden KA, Witte TK, Cukrowicz KC, et al. The interpersonal theory of suicide. *Psychol Rev*. 2010;117(2):575–600.
18. Joiner T. *Why People Die by Suicide*. Cambridge, MA: Harvard University Press; 2005.
19. Rudd MD. *Fluid Vulnerability Theory: A Cognitive Approach to Understanding the Process of Acute and Chronic Suicide Risk*. Washington, DC: American Psychological Association; 2006:355–368.
20. Qiu T, Klonsky ED, Klein DN. Hopelessness predicts suicide ideation but not attempts: a 10-year longitudinal study. *Suicide Life Threat Behav*. 2017;47(6):718–722.
21. Cox BJ, Enns MW, Clara IP. Psychological dimensions associated with suicidal ideation and attempts in the National Comorbidity Survey. *Suicide Life Threat Behav*. 2004;34(3):209–219.
22. Wolfe KL, Nakonezny PA, Owen VJ, et al. Hopelessness as a predictor of suicide ideation in depressed male and female adolescent youth. *Suicide Life Threat Behav*. 2019;49(1):253–263.
23. Mazza JJ, Reynolds WM. A longitudinal investigation of depression, hopelessness, social support, and major and minor life events and their relation to suicidal ideation in adolescents. *Suicide Life Threat Behav*. 1998;28(4):358–374.
24. Kuo WH, Gallo JJ, Eaton WW. Hopelessness, depression, substance disorder, and suicidality—a 13-year community-based study. *Soc Psychiatry Psychiatr Epidemiol*. 2004;39(6):497–501.
25. Beck AT, Brown GK, Steer RA, et al. Suicide ideation at its worst point: a predictor of eventual suicide in psychiatric outpatients. *Suicide Life Threat Behav*. 1999;29(1):1–9.
26. Spokas M, Wenzel A, Stirman SW, et al. Suicide risk factors and mediators between childhood sexual abuse and suicide ideation among male and female suicide attempters. *J Trauma Stress*. 2009;22(5):467–470.
27. Ribeiro JD, Pease JL, Gutierrez PM, et al. Sleep problems outperform depression and hopelessness as cross-sectional and

longitudinal predictors of suicidal ideation and behavior in young adults in the military. *J Affect Disord*. 2012;136(3):743–750.
28. Ben-Zeev D, Young MA, Depp CA. Real-time predictors of suicidal ideation: mobile assessment of hospitalized depressed patients. *Psychiatry Res*. 2012;197(1–2):55–59.
29. Kleiman EM, Turner BJ, Fedor S, et al. Examination of real-time fluctuations in suicidal ideation and its risk factors: results from two ecological momentary assessment studies. *J Abnorm Psychol*. 2017;126(6):726–738.
30. Kraemer HC, Gullion CM, Rush AJ, et al. Can state and trait variables be disentangled? a methodological framework for psychiatric disorders. *Psychiatry Res*. 1994;52(1):55–69.
31. Kraemer HC, Stice E, Kazdin A, et al. How do risk factors work together? mediators, moderators, and independent, overlapping, and proxy risk factors. *Am J Psychiatry*. 2001;158(6):848–856.
32. Ribeiro JD, Huang X, Fox KR, et al. Depression and hopelessness as risk factors for suicide ideation, attempts and death: meta-analysis of longitudinal studies. *Br J Psychiatry*. 2018;212(5):279–286.
33. Young MA, Fogg LF, Scheftner W, et al. Stable trait components of hopelessness: baseline and sensitivity to depression. *J Abnorm Psychol*. 1996;105(2):155–165.
34. Burr EM, Rahm-Knigge RL, Conner BT. The differentiating role of state and trait hopelessness in suicidal ideation and suicide attempt. *Arch Suicide Res*. 2018;22(3):510–517.
35. Baryshnikov I, Rosenström T, Jylhä P, et al. State and trait hopelessness in a prospective five-year study of patients with depressive disorders. *J Affect Disord*. 2018;239:107–114.
36. Mann JJ, Waternaux C, Haas GL, et al. Toward a clinical model of suicidal behavior in psychiatric patients. *Am J Psychiatry*. 1999;156(2):181–189.
37. Kleiman EM, Nock MK. Real-time assessment of suicidal thoughts and behaviors. *Curr Opin Psychol*. 2018;22:33–37.
38. van Heeringen K, Mann JJ. The neurobiology of suicide. *Lancet Psychiatry*. 2014;1(1):63–72.
39. Kendler KS. The phenomenology of major depression and the representativeness and nature of *DSM* criteria. *Am J Psychiatry*. 2016;173(8):771–780.
40. Labelle R, Breton JJ, Pouliot L, et al. Cognitive correlates of serious suicidal ideation in a community sample of adolescents. *J Affect Disord*. 2013;145(3):370–377.
41. Beck AT, Steer RA, Beck JS, et al. Hopelessness, depression, suicidal ideation, and clinical diagnosis of depression. *Suicide Life Threat Behav*. 1993;23(2):139–145.
42. Holma KM, Holma IA, Melartin TK, et al. Long-term outcome of major depressive disorder in psychiatric patients is variable. *J Clin Psychiatry*. 2008;69(2):196–205.
43. Melartin TK, Rytsälä HJ, Leskelä US, et al. Current comorbidity of psychiatric disorders among *DSM-IV* major depressive disorder patients in psychiatric care in the Vantaa Depression Study. *J Clin Psychiatry*. 2002;63(2):126–134.
44. Riihimäki KA, Vuorilehto MS, Melartin TK, et al. Five-year outcome of major depressive disorder in primary health care. *Psychol Med*. 2014;44(7):1369–1379.
45. American Psychiatric Association. *Diagnostic and Statistical Manual for Mental Disorders*. Fourth Edition. Washington, DC: American Psychiatric Association; 1994.
46. Beck AT, Weissman A, Lester D, et al. The measurement of pessimism: the Hopelessness Scale. *J Consult Clin Psychol*. 1974;42(6):861–865.
47. Beck AT, Ward CH, Mendelson M, et al. An inventory for measuring depression. *Arch Gen Psychiatry*. 1961;4(6):561–571.
48. Blumenthal JA, Burg MM, Barefoot J, et al. Social support, type A behavior, and coronary artery disease. *Psychosom Med*. 1987;49(4):331–340.
49. Beck AT, Epstein N, Brown G, et al. An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol*. 1988;56(6):893–897.
50. Eysenck SB, Eysenck HJ. An improved short questionnaire for the measurement of extraversion and neuroticism. *Life Sci (1962)*. 1964;3:1103–1109.
51. Fraley C, Raftery AE. Model-based clustering, discriminant analysis, and density estimation. *J Am Stat Assoc*. 2002;97(458):611–631.
52. Bates D, Mächler M, Bolker B, et al. Fitting linear mixed-effects models using lme4. *J Stat Softw*. 2015;67(1):1–48.
53. Nakagawa S, Schielzeth H. A general and simple method for obtaining R2 from generalized linear mixed-effects models. *Method Ecol Soc*. 2013;4(2):133–142.
54. Højsgaard S, Halekoh U, Yan J. The R package geepack for generalized estimating equations. *J Stat Softw*. 2005;15(2):1–11.
55. Obuchowski NA. Nonparametric analysis of clustered ROC curve data. *Biometrics*. 1997;53(2):567–578.
56. Hamilton M. A rating scale for depression. *J Neurol Neurosurg Psychiatry*. 1960;23(1):56–62.
57. Sokero P, Eerola M, Rytsälä H, et al. Decline in suicidal ideation among patients with MDD is preceded by decline in depression and hopelessness. *J Affect Disord*. 2006;95(1–3):95–102.
58. Beck AT, Steer RA, Kovacs M, et al. Hopelessness and eventual suicide: a 10-year prospective study of patients hospitalized with suicidal ideation. *Am J Psychiatry*. 1985;142(5):559–563.
59. O'Connor RC. Suicidal behavior as a cry of pain: test of a psychological model. *Arch Suicide Res*. 2003;7(4):297–308.

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THE JOURNAL OF
CLINICAL PSYCHIATRY
THE OFFICIAL JOURNAL OF THE AMERICAN SOCIETY OF CLINICAL PSYCHOPHARMACOLOGY

Supplementary Material

Article Title: Role of Hopelessness in Suicidal Ideation Among Patients With Depressive Disorders

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DOI Number: https://doi.org/10.4088/JCP.19m12866

List of Supplementary Material for the article

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Supplementary Table 1. Sociodemographic characteristics, and mean scores and standard deviations (SD) of Scale for Suicidal Ideation (SSI), Beck Depression Inventory (BDI), Beck Anxiety Disorder (BAI), Hamilton Rating Scale for Depression (HAM-D), Beck Hopelessness Scale (BHS) and Perceived Social Support Scale –Revised (PSSS-R) in Vantaa Depression Study (VDS, n=269) and Vantaa Primary Care Depression Study (PC-VDS, n=137).

	VDS (n=269)		PC-VDS (n=137)			
	n	%	n	%	χ^2	p
Gender						ns
Female	197	73.2	104	75.9		
Male	72	26.8	33	24.1		
Education[a]						ns
University or polytechnic	92	34.3	44	34.4		
Vocational	69	25.6	35	27.4		
None	108	40.1	49	38.2		
Marital status[b]						ns
Married or cohabiting	135	50.2	72	55		
Single	134	49.8	59	45		
Work status[c]					39.903	<0.001
Employed	194	73.5	83	61.0		
Unemployed	57	21.5	27	20.0		
Disability pension or retired	13	5.0	27	19.0		
Comorbid disorders Evaluated at baseline						
Any anxiety disorder	152	56.5	59	43.1	6.569	0.012
Alcohol dependence, current	38	14.1	6	4.4	8.924	0.002
Any personality disorder, current	118	43.9	71	51.8		ns
	Mean	SD	Mean	SD	t	p
Age, bl	39.7	11.1	45.3	13.7	-4.435	<0.001
BDI, bl	27.6	8.6	19.3	10.0	8.799	<0.001
BDI, 6 months[i]	12.7	10.0	15.0	11.4	-1.984	0.048
BDI, 18 months[l]	11.4	10.4	12.9	11.0		ns
BDI, 5 years[m]	10.7	10.5	14.4	11.2	-2.856	0.005
BAI, bl[d]	22.4	10.6	17.0	12.6	4.485	<0.001
BAI, 6 months[i]	13.7	10.6				
BAI, 18 months[j]	11.6	10.5	14.7	12.0	-2.464	0.014
BAI, 5 years[k]	13.1	10.8	13.6	12.5		ns
BHS, bl[e]	10.3	4.8	8.8	5.3	2.859	0.004
BHS, 6 months[f]	7.9	5.2				
BHS, 18 months[g]	7.4	5.2	7.6	5.8		ns
BHS, 5 years[h]	6.3	4.7	7.4	5.3		ns
HAM-D, bl	19.3	6.2	16.1	5.3	8.399	<0.001
HAM-D, 6 months[i]	9.2	7.7				
HAM-D, 18 months[j]	8.3	7.4	9.8	6.9		ns
HAM-D, 5 years[n]	10.0	8.5	11.3	7.9		ns
PSSS-R, bl[o]	39.1	12.8	43.0	12.6	-2.876	0.004
PSSS-R, 6 months[i]	42.6	12.6				
PSSS-R, 18 months[p]	42.5	13.6	45.7	12.4	-1.986	0.048
PSSS-R, 5 years[r]	42.3	12.9	47.0	12.5	-2.995	0.003

[a]missing data 9/137, [b]missing data 6/137, [c]missing data 5/269, [d]missing data 1/269, 4/137, [e]missing data 1/269, 5/137, [f]missing data 94/269, [g]missing data 42/269, 35/137, [h]missing data 112/269, 29/137, [i]missing data 40/269, [j]missing data 62/269,11/137, [k]missing data 86/269, 27/137, [l]missing data 63/269, [m]missing data 80/269, 27/137, [n]missing data 81/269, 26/137, [o]missing data 1/269, 7/137, [p]missing data 62/269, 35/137, [r]missing data 84/269, 33/137, [s]missing 1/269, [t]missing data 118/269, [u]missing data 69/269

Supplementary note 1

Several relationships between variance components and explained variance in mixed effect models are pertinent to our paper. We discuss these, starting from the definitions of Nakagawa and Schielzeth (2013)[1]. In a non-overdispersed (or "theoretical" in R package "MuMIn") binomial Generalized Linear Mixed Model (GLMM)[2], marginal variance explained is defined as

$$R^2_{GLMM(m)} = \frac{\sigma_f^2}{\sigma_f^2 + \sigma_a^2 + \sigma_e^2},$$

where σ_f^2 is variance attributable to fixed effects, σ_a^2 variance attributable to the random effect (patient-specific intercept in our case), and σ_e^2 is distribution-specific residual variance related to the link function; in the case of the binomial model and Logistic link, $\sigma_e^2 = \pi^2/3$. The residual variance includes both true within-patient change and measurement error. Thus, the marginal variance explained, or $R^2_{GLMM(m)}$, is what the fixed covariates of the model explain in the outcome variance. Conditional variance explained is instead defined as

$$R^2_{GLMM(c)} = \frac{\sigma_f^2 + \sigma_a^2}{\sigma_f^2 + \sigma_a^2 + \sigma_e^2}.$$

Thus, the conditional variance explained, or $R^2_{GLMM(c)}$, yields what the entire model explains of the outcome variation, including the random effect for between-patient differences. The variance not explained by the model is then

$$V = 1 - R^2_{GLMM(c)} = \frac{\sigma_e^2}{\sigma_f^2 + \sigma_a^2 + \sigma_e^2}.$$

That is the share of variance attributable to measurement error and within-patient differences over time. Now, we can ask how much the unexplained variance decreases when adding hopelessness variable (BHS) into the model by computing the difference $V_{noBHS} - V_{BHS} =: -\Delta_{BHS}(V)$, where V_{noBHS} is from a "baseline" model without BHS and V_{BHS} from an otherwise identical model that includes BHS. But, this quantity is also the change in relative importance of "within-patient" factors in the model. We can further deduce from the above definition of V that

$$-\Delta_{BHS}(V) = R^2_{GLMM(c):BHS} - R^2_{GLMM(c):noBHS} = \Delta_{BHS}(R^2_{GLMM(c)}).$$

In other words, unexplained variance and within-patient changes are interchangeable in the model, and by implication, directly related to explained variance. The between-patient variance does not hold a similar relationship with $R^2_{GLMM(m)}$, however, but can be obtained from it by

$$R^2_{GLMM(c)} - R^2_{GLMM(m)} = \frac{\sigma_a^2}{\sigma_f^2 + \sigma_a^2 + \sigma_e^2}.$$

Similarly, change in between-patient variance due to adding BHS to the model can be found as

$$\Delta_{BHS}(R^2_{GLMM(c)} - R^2_{GLMM(m)}) = \Delta_{BHS}(R^2_{GLMM(c)}) - \Delta_{BHS}(R^2_{GLMM(m)}).$$

Thus, the marginal and conditional R^2 values in our Table 1 also yield the relative variance components of interest in our paper either directly or through simple algebraic subtraction.

References:

1. Nakagawa S, Schielzeth H. A general and simple method for obtaining R2 from generalized linear mixed-effects models. Method Ecol Soc. 2013;4(2):133–142
2. Barton K. R package version 1.43.15, date: 2019-12-19. https://cran.r-project.org/web/packages/MuMIn/index.html

Supplementary table 2. Pearson's correlation analysis between the total scores of BHS, BAI and BDI in patients with depressive disorders at for time points during five-year follow up.

	BAI baseline	BAI six months	BAI eighteen months	BAI five years	BDI baseline	BDI six months	BDI eighteen months	BDI five year
BHS baseline	0.4*	-	-	-	0.5*	-	-	-
BHS six months	-	0.5*	-	-	-	0.5*	-	-
BHS eighteen months	-	-	0.5*	-	-	-	0.5*	-
BHS five years	-	-	-	0.6*	-	-	-	0.5*
BAI baseline	-	-	-	-	0.7*	-	-	-
BAI six months	-	-	-	-	-	0.7*	-	-
BAI eighteen months	-	-	-	-	-	-	0.7*	-
BAI five years	-	-	-	-	-	-	-	0.8*

*p≤0.0001; BDI – Beck Depression Inventory; BHS – Bech Hopelessness Scale and BAI – Beck Anxiety Inventory.

The sensitivity analysis for the generalized multilevel regression, when the BDI items about hopelessness and suicidal ideation are omitted

The predictive value of hopelessness for suicidal ideation when symptoms of depression and anxiety are adjusted

The association between SSI and the trimmed BDI is shown in the supplementary figure 5. Adjusting for BAI had only a minor effect on the association between BHS and SSI ($\beta = 0.81$ instead of $\beta = 1.02$) but adjusting for the fixed effect of the trimmed BDI explained much, though not all, of the effect ($\beta = 0.45$, s.e. = 0.13, $p < 0.001$; adjusted OR = 1.57).

Moderated effects of hopelessness on severe suicidal ideation

We tested for interactions between hopelessness and social support, hopelessness and neuroticism, and hopelessness and depression. All these variables had an independent effect on severe suicidal ideation (all $p < 0.001$ both in GEE and in multilevel models). For better model convergence, we used generalized estimating equations (GEE) in testing of interactions and found that the variables did not moderate the effects of hopelessness (all $p > 0.059$). In contrast, anxiety symptoms moderated the effect of hopelessness on suicidal ideation ($\beta = -0.309$, $p < 0.001$ in GEE). Model III in the supplementary table 3 shows the corresponding multilevel model.

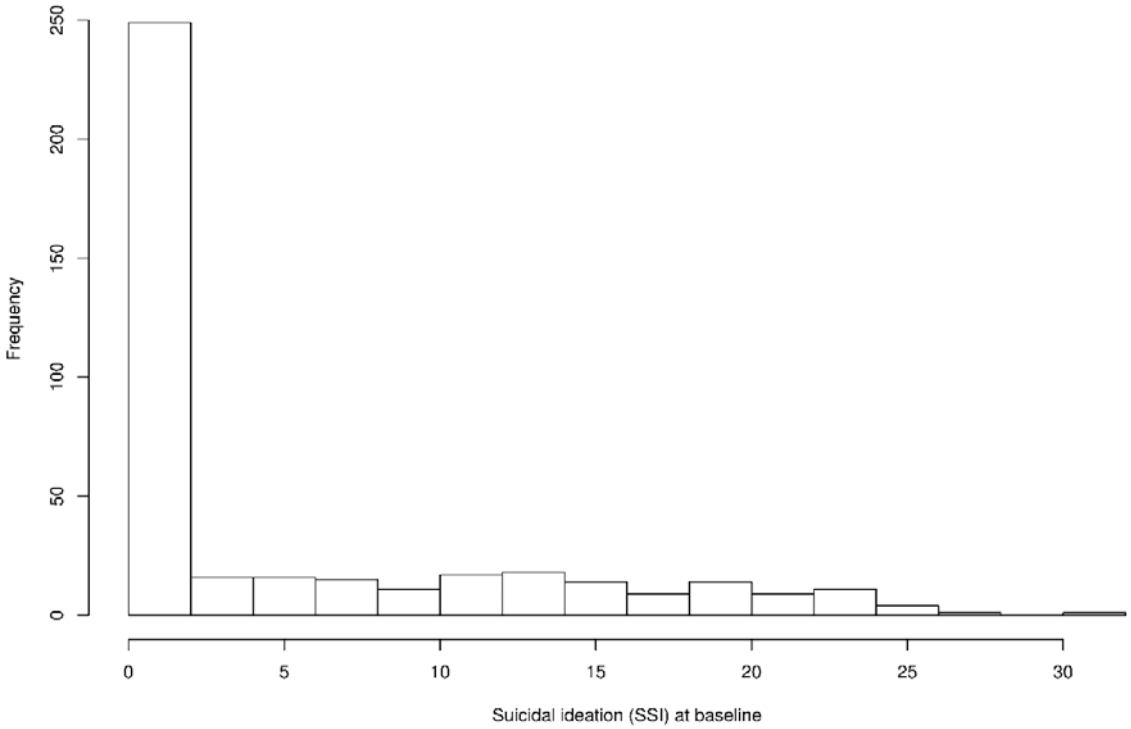
(Scroll for Supplementary Table 3.)

Supplementary table 3. Generalized multilevel regression models predicting suicidal ideation with the trimmed BDI (without items about hopelessness and suicidal ideation).

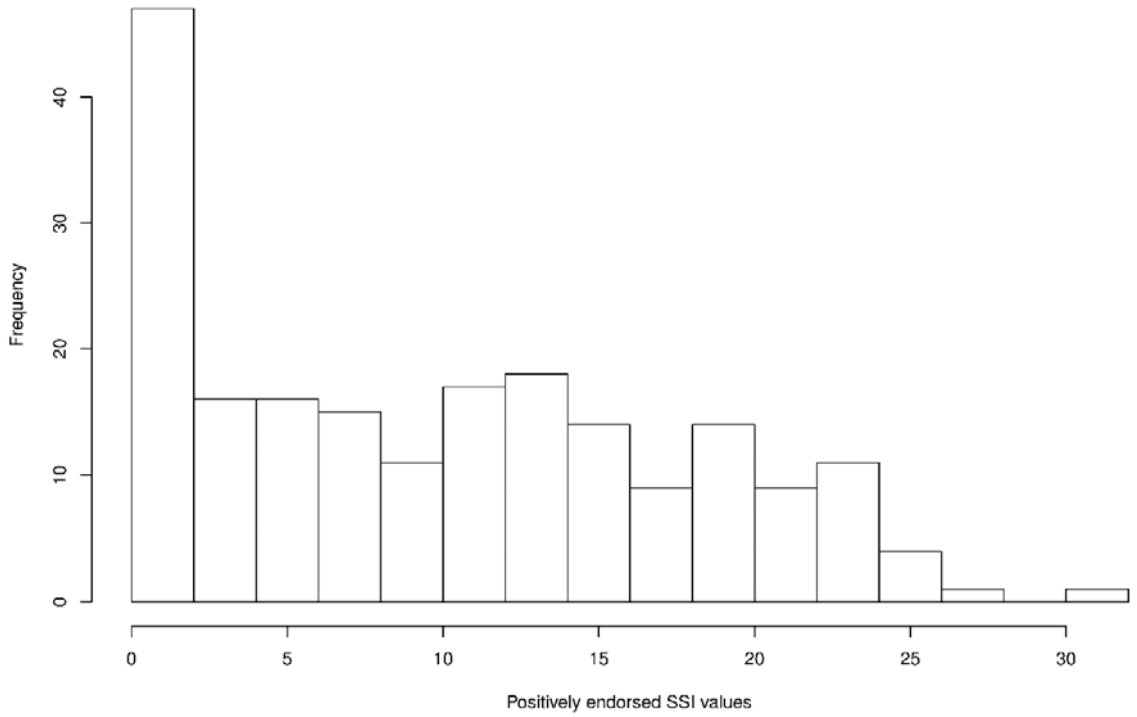
		Model I			Model II			Model III		
Effect type	**Variable**	**β**	**CI low**	**CI upp**	**β**	**CI low**	**CI upp**	**β**	**CI low**	**CI upp**
Fixed	Intercept	-1.230	-1.608	-0.895	-2.208	-2.765	-1.743	-2.185	-2.740	-1.722
	Sex (male)	0.162	-0.348	0.680	0.484	-0.050	1.047	0.464	-0.065	1.023
	Follow up 1	-1.199	-1.925	-0.535	-0.334	-1.095	0.378	-0.298	-1.059	0.415
	Follow up 2	-1.551	-2.093	-1.053	-0.645	-1.220	-0.097	-0.585	-1.159	-0.038
	Follow up 3	-1.338	-1.889	-0.825	-0.524	-1.119	0.049	-0.442	-1.038	0.134
	BHS	1.020	0.798	1.266	0.444	0.182	0.714	0.560	0.287	0.845
	BDI	-	-	-	1.315	0.963	1.714	1.285	0.936	1.682
	BAI	-	-	-	-0.033	-0.238	0.305	0.261	-0.050	0.578
	BAI*BHS	-	-	-	-	-	-	-0.334	-0.578	-0.101
Random	Between	1.471	0.819	1.657	1.536	0.795	1.756	1.440	0.747	1.716
	Within	3.290	-	-	3.264	-	-	3.870	-	-
R^2_{GLMM}	Marginal	0.280	-	-	0.403	-	-	0.450	-	-
	Conditional	0.503	-	-	0.593	-	-	0.617	-	-
$\Delta_{BHS}(R^2_{GLMM})$	Marginal	0.166	-	-	0.012	-	-	0.059	-	-
	Conditional	0.035	-	-	0.023	-	-	0.047	-	-

Values in the table are regression coefficients (β) and their lower (low) and higher (upp) 95% confidence intervals (CI, "low" for lower, "upp" for upper), and explained variance proportions (R2) and changes in explained variance when entering the variable BHS to the model ($\Delta_{BHS}(R^2_{GLMM})$).

Supplementary Figure 1. Histogram of the main outcome, a score for suicidal ideation (SSI), in the baseline follow up.

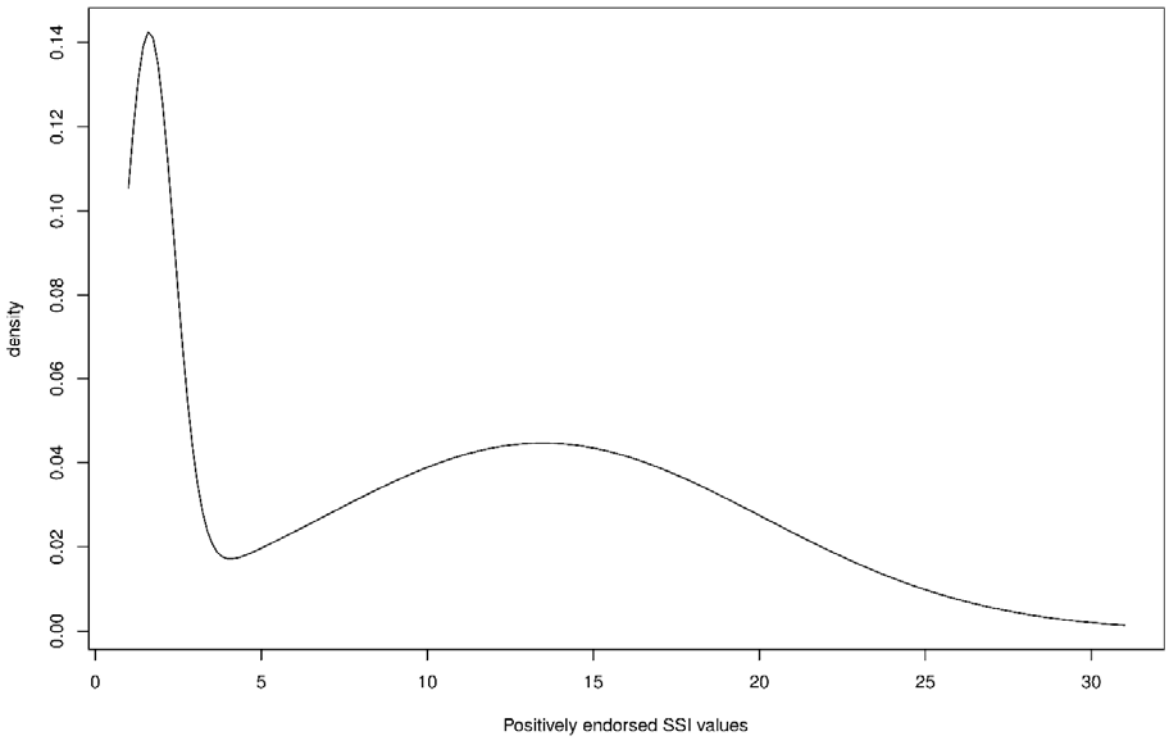


Supplementary Figure 2. Histogram of the score for suicidal ideation (SSI) for individuals with SSI > 0.



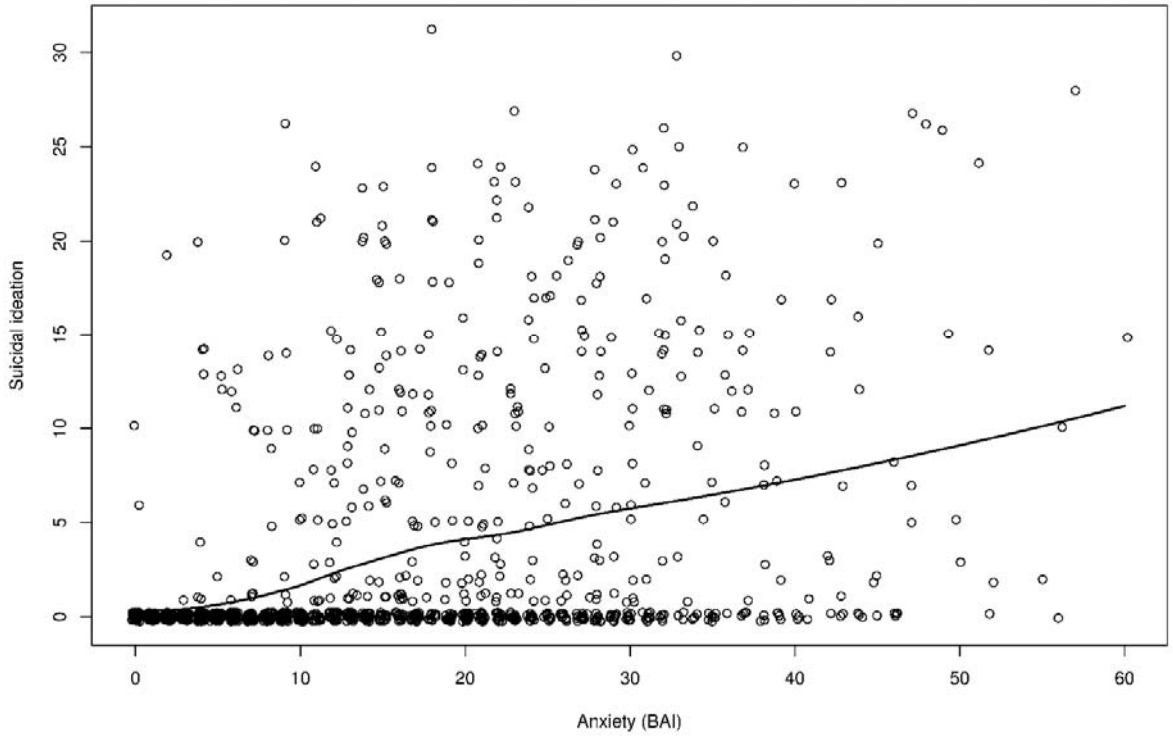
Abbreviations. SSI – Scale for Suicidal Ideation.

Supplementary Figure 3. The best-fitting model-based clustering density for the positive score for suicidal ideation (SSI) values [a].



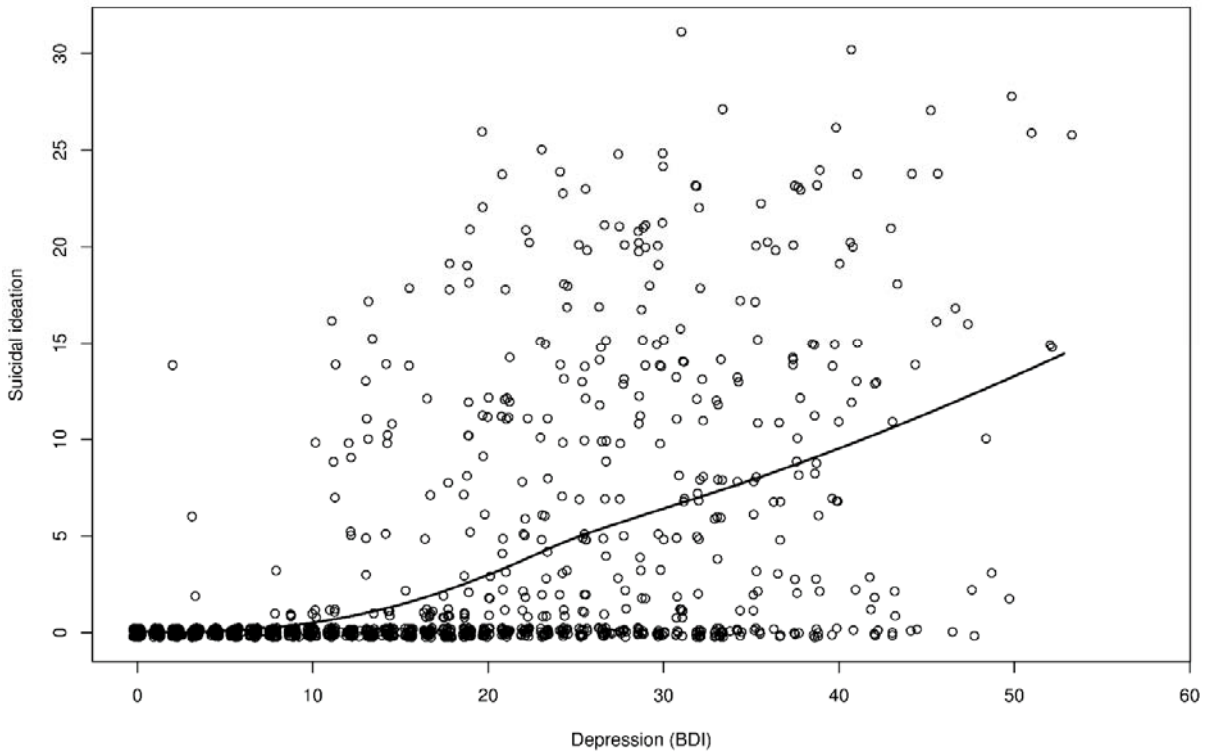
[a] The model had two normally distributed clusters, SSI value of 4 or higher being classified to the second, high-ideation cluster.

Supplementary Figure 4. The association between anxiety symptoms and suicidal ideation in patients with depressive disorders.



Abbreviations: BAI – Beck Anxiety Inventory.

Supplementary figure 5. The association between suicidal ideation and depressive symptom in patients with depressive disorders. The circles are raw data points and the solid line a local regression ('smoothed') estimate of the association[a]



[a]A small amount of 'jitter' (small random displacements) have been added to the data point to enhance visibility of overlapping points. The BDI score is an average of items, excluding suicidal thinking and hopelessness items, multiplied by 21 (#items in full inventory; 1 unspecified missing item was allowed too). Abbreviations: BDI – Beck Depression Inventory.