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Highlights

- Memory, attention, and total cognition are associated with suicidal ideation severity
- They remain significantly associated when depression symptoms are controlled for

Cognitive Impairment and Depression Symptoms are Independently Associated with Suicidal Ideation in US Veterans.

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Abstract

Depression is associated with cognitive impairment and suicidality. The independent association between cognitive impairment and suicidality is less clear. We examined the relationship between suicidal ideation and cognitive impairment in a sample of 50 veterans with depressive disorder diagnoses. Using zero-inflated Poisson regression, the severity of suicidal ideation was negatively associated with attention (incidence rate ratio [IRR] = 0.78, $p < .001$), memory (IRR = 0.87, $p > .001$), and total cognition (IRR = 0.90, $p = .007$) index scores as measured by the Dementia Rating Scale 2 (DRS-2). These three indices continued to significantly predict suicidal ideation severity once depression symptoms were controlled for.

Keywords: Depression; Cognition; Suicidal Ideation

1. Introduction

A large body of research has demonstrated an association between major depressive disorder (MDD) and cognitive impairment (CI; Rock et al., 2014). However, the literature examining the association between suicidal ideation (SI) and CI is significantly smaller and less developed. With the exception of a study by Pu and colleagues (2017), neurocognitive studies of SI have generally examined inpatient samples and operationalized SI as a binary variable (e.g., MDD with vs. without SI; Marzuk et al., 2005; Westheide et al., 2008). In the current study, we attempted to contribute to the existing literature by examining an outpatient sample, using continuous SI and depression measures, and determining whether CI is associated with SI severity when depression symptoms are controlled for.

2. Method

2.1 Sample and Procedures

The sample included 50 male United States (U.S.) veterans aged 31 to 65 who had a medical chart diagnosis of an affective disorder involving depression symptoms who had received mental health care from a Veterans Affairs (VA) outpatient provider at least once in the year prior to their participation. Veterans were recruited by screening outpatient clinic, direct referral from providers, and by recruitment advertisements posted in VA medical facilities. All recruitment and study procedures were approved by the local IRB. Fifty participants completed the battery.

2.2 Measure of Cognitive Functioning, Depression, and SI

The Dementia Rating Scale-2 (DRS-2) is a widely used brief neurocognitive measure that includes a variety of tests in order to assess impairment in five domains (attention, initiation/perseveration, visuospatial construction, conceptualization, and memory), as well as global CI (Jurica et al., 2001). We intended to exclude participants whose scores suggested that they suffered from a dementing disorder (i.e., total cognition raw score < 124 ; Montgomery and

Costa, 1983). No participants were found to have total cognition raw scores < 124 and thus all participants went on to complete the remainder of the study.

Employing the normative data in the DRS-2's manual, participants' raw scores on the DRS-2 were converted to age-corrected standard scores. The DRS-2 manual gives norms for individuals aged 56 and above. In our sample, 27 participants were younger than 56-years-old; for these participants, we used the 56-year-old norms to convert their raw scores into standard scores. A few previous studies have successfully employed the DRS-2 with individuals younger than the published norms, suggesting the viability of this approach (Mausbach et al., 2007; Randolph et al., 1998). As a reliability check, we reran all of the analyses using raw DRS-2 index scores and again while controlling for age and found the results substantively unchanged.

The Center for Epidemiologic Studies Depression Scale (CESD) is a 20-item self-report measure with a total score range of 0 – 60 that measures depression symptoms (Radloff, 1977). The Beck Scale for Suicide Ideation (BSS; Beck et al., 1997) is a 19-question self-report measure of SI severity with a total score range of 0 - 38.

2.5 Analyses

First, we visually examined the distributions of clinical and neurocognitive scores to identify any irregularities. We then examined the Pearson correlation coefficients or ANOVA results examining the relationship between potential covariates (i.e., age, years of education and marital status) and each of the cognitive indices. If a covariate was significantly associated with a cognitive index, it was included as a covariate in subsequent analyses involving that index. Given the over-representation of zero scores and Poisson-like distribution of BSS scores, we employed zero-inflated Poisson (ZIP) regression to predict SI scores with each of the cognitive indices individually. We then conducted a second set of ZIP regressions while controlling for depression symptoms using the subset of cognitive indices that significantly predicted SI scores in the first set of ZIP regressions.

3. Results

3.1 Preliminary Analyses

Consistent with previous studies of psychiatric outpatient populations (Beck et al., 1997), we found that SI scores were right-skewed, with 23 participants having a score of zero, 20 participants having scores between one and seven, and 7 participants having scores between ten and nineteen. Given that the 7 participants with elevated SI scores (i.e., ≥ 10) would be particularly important in our analysis, we carefully re-reviewed the medical records of these individuals to determine whether any extraneous factors might create a spurious or otherwise misleading relationship between SI scores and CI (e.g., if all 7 participants were taking the same sedating medication). In reviewing these records, we discovered that two participants had extensive histories of unreliable performance on neuropsychological and clinical testing. We excluded these participants from subsequent analyses, leaving a final sample of 48 participants. As a reliability check, we re-ran all of our analyses while including these two participants and found the results substantively unchanged.

Upon visual examination, the distribution of DRS-2 visuospatial construction index scores was clearly bimodal, with 44 participants having a standard score of ten and 4 participants having a standard score of seven. Given the lack of variability on this index, we refrained from conducting further analyses with it. None of the covariates were significantly related to the cognitive indices and thus were not included in subsequent analyses.

3.2 Regression Results

Results of the regression analyses are shown in Table 1. In the first set of ZIP regression analyses predicting SI scores using each of the cognitive indices, impairment on the attention, memory, and total cognition indices all significantly predicted the severity of SI among individuals who reported at least some SI (i.e., the count model). However, none of the cognitive indices were significant in the zero-inflation model, meaning that they did not significantly predict whether an individual would report the absence of SI. In the second set of ZIP regressions that predicted SI while controlling for depression scores using the three cognitive indices that were significant in the first set of analyses, all three cognitive indices (i.e., attention, memory, and total) continued to significantly predict the severity of SI symptoms but not their absence (i.e., were significant in the count but not the zero models). Depression symptoms, by contrast, significantly predicted both the severity of SI symptoms and their absence (i.e., were significant in both the count and zero-inflation models).

4. Discussion

4.1 General Discussion

Using zero-inflated Poisson regression (ZIP), we found that impairments in attention, memory, and global cognition were associated with increased SI severity but did not predict which individuals would report the absence of SI. All three indices continued to significantly predict SI severity when concurrent depression symptom severity was controlled for. Depression scores were found to significantly predict both the severity of SI and its absence.

Consistent with earlier studies, our findings support the possibility of an independent relationship between CI and SI beyond what can be explained by comorbid depression symptoms alone (Hemachandra et al., 2014; Pu et al., 2017). Our and others' findings suggest that the cognitive and neural underpinnings of SI may be at least partially dissociable from those underpinning depression symptoms. We also found that CI itself did not predict the presence or absence of SI, but was associated with increased severity of SI when SI was present. This pattern of findings is consistent with several existing models of SI, which propose that SI is caused by factors other than CI, e.g., perceived burdensomeness and thwarted belongingness or hopelessness (O'Connor and Nock, 2014). The fact that CI can nevertheless exacerbate SI when it is present is also consistent with existing models of SI, which propose several mechanisms by which CI might exacerbate SI, e.g., failed thought suppression, failure to shift attention away from rumination, and reduced problem solving ability, (O'Connor and Nock, 2014).

4.2 Limitations

Our study was limited by the small number of veterans in our sample who had higher levels of SI. Our results should be confirmed in larger sample with better representation across the range of SI severity. A second limitation is that the DRS-2 is a short neurocognitive measure with a low testing ceiling. The use of a longer neurocognitive testing instrument with a higher ceiling would allow for more better identification of the cognitive abilities related to SI, as well as determining whether particularly good cognitive performance has a protective effect against SI. A third limitation is that several of the individuals in our sample were younger than the population that the DRS-2 was normed upon. Future studies should either restrict their sample to individuals within the DRS-2's age norms or else employ other cognitive measures that have been normed on a wider age range. A fourth limitation is that we did not control for multiple hypothesis testing in our analyses in order to maximize power (given our small sample size) and to provide initial findings in this little studied area; also, with a small sample size, multiple comparison correction can lead to systemic overestimation of true effect sizes, which we wished to avoid (Gelman et al., 2012). Given the increased risk of type I error, our findings should be replicated in future studies with larger sample sizes.

4.3 Conclusion

In a sample of veterans treated for depression symptoms in VA outpatient clinics, we found that attention, memory, and total cognition were associated with increased SI severity, including when depression severity was statistically controlled for.

Contributors

ATR conceived of the current study, conducted the statistical analysis, and wrote the initial draft of the manuscript. PP contributed to the design of the analysis, its interpretation, and to manuscript preparation. DRJ designed and executed the initial data collection protocol that created the dataset and contributed to the preparation and revision of the manuscript. HW contributed significantly to data preparation, analysis, and interpretation. BS, MG, and MB contributed substantially to the preparation and revision of the manuscript. CHB contributed to the statistical analysis, preparation, and revision of the manuscript. All authors contributed to and approved the final version of this manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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Conflict of Interest

The authors declare no conflict of interest.

Author Statement

ATR conceived of the current study, conducted the statistical analysis, and wrote the initial draft of the manuscript. PP contributed to the design of the analysis, its interpretation, and to manuscript preparation. DRJ designed and executed the initial data collection protocol that created the dataset and contributed to the preparation and revision of the manuscript. HW contributed significantly to data preparation, analysis, and interpretation. BS, MG, and MB contributed substantially to the preparation and revision of the manuscript. All authors contributed to and approved the final version of this manuscript.

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Table 1- Results of Zero-Inflated Poisson Regression Predicting Beck Suicide Ideation Scale (BSS) Scores Using Dementia Rating Scale-2 (DRS-2) Cognitive Indices Both With and Without Controlling for Center for Epidemiological Studies Depression Scale (CESD) Total Scores

Models w/o depression	Count Coefficients				Zero-Inflation Coefficients			
	B	SE B	Exp(B)	P	B	SE B	Exp(B)	P
Attention	-0.25	0.04	0.78	>.001	0.02	0.17	1.02	.920
Initiation/Perseveration	0.04	0.04	1.04	.302	0.13	0.14	1.14	.365
Conceptualization	-0.05	0.05	0.95	.262	0.02	0.16	1.02	.923
Memory	-0.13	0.03	0.87	>.001	0.15	0.11	1.16	.190
Total Cognitive Score	-0.11	0.04	0.90	.007	0.23	0.15	1.26	.129
Models w/ depression	Count Coefficients				Zero-Inflation Coefficients			
	B	SE B	Exp(B)	P	B	SE B	Exp(B)	P
Attention	-0.21	0.04	0.81	>.001	-0.16	0.20	0.85	.418
Depression	0.03	0.01	1.03	.008	-0.12	0.05	0.88	.009
Memory	-0.13	0.03	0.88	>.001	0.12	0.12	1.13	.339
Depression	0.05	0.01	1.05	>.001	-0.11	0.05	0.90	.016
Total	-0.09	0.04	0.91	.021	0.18	0.16	1.19	.276
Depression	0.04	0.01	1.05	>.001	-0.11	0.05	0.90	.017

Exp (B) count coefficients (i.e., incidence rate ratio/relative risk) can be interpreted as predicted ratio of change in BSS value for each single unit increase in predictor. E.g., for each 1 point increase in attention index standard score, BSS scores are predicted to decrease by a ratio of 0.78.

Exp (B) zero inflation coefficients can be interpreted as predicted ratio of likelihood of belonging to the 0 BSS value group for each single unit increase in predictor. E.g., for each 1 point increase in depression index score in the attention model, the likelihood of belonging to the 0 BSS score group decreases by a ratio .88.