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Anxiety and its disorders as risk factors for suicidal thoughts and behaviors: A meta-analytic review

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Abstract

Suicidal thoughts and behaviors are highly prevalent public health problems with devastating consequences. There is an urgent need to improve our understanding of risk factors for suicide to identify effective intervention targets. The aim of this meta-analysis was to examine the magnitude and clinical utility of anxiety and its disorders as risk factors for suicide ideation, attempts, and deaths. We conducted a literature search through December 2014; of the 65 articles meeting our inclusion criteria, we extracted 180 cases in which an anxiety-specific variable was used to longitudinally predict a suicide-related outcome. Results indicated that anxiety is a statistically significant, yet weak, predictor of suicide ideation (OR=1.49, 95% CI: 1.18, 1.88) and attempts (OR=1.64, 95% CI: 1.47, 1.83), but not deaths (OR=1.01, 95% CI: 0.87, 1.18). The strongest associations were observed for PTSD. Estimates were reduced after accounting for publication bias, and diagnostic accuracy analyses indicated acceptable specificity but poor sensitivity. Overall, the extant literature suggests that anxiety and its disorders, at least when these constructs are measured in isolation and as trait-like constructs, are relatively weak predictors of suicidal thoughts and behaviors over long follow-up periods. Implications for future research priorities are discussed.

Keywords

Suicide; Anxiety; Risk factor; Meta-analysis

1. Introduction

Suicidal behavior is a leading cause of injury and death across the globe (Centers for Disease Control and Prevention, 2011), with upwards of one million individuals who take their own lives annually (World Health Organization, 2012). In the United States alone, over 40,000 people die by suicide each year. In addition to completed suicides, approximately 3% of individuals make a suicide attempt during their lifetime (Borges et al., 2010; Nock et al.,

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2008). It is also estimated that approximately 9% of people report experiencing serious thoughts of suicide during their lives. Unfortunately, the U.S. suicide rate has risen steadily over the past decade (Centers for Disease Control and Prevention, 2011) and is projected to continue increasing over upcoming years (Mathers & Loncar, 2006).

One promising avenue toward reducing the global impact of suicide is to identify risk factors that predict suicidal thoughts and behaviors. Risk factors are not to be confused with correlates; whereas correlates represent concomitants or consequences of a phenomenon of interest and can be identified through cross-sectional methods, establishing risk factors necessitates longitudinal designs (Kraemer et al., 1997). For example, from a study showing that individuals who attempt suicide are more likely to be diagnosed with an anxiety disorder than those who do not attempt suicide, one may conclude that anxiety is a *correlate* of suicidal behavior. However, to determine that anxiety functions as a *risk factor* for suicidal behavior, it would need to be established that anxiety disorders precede and heighten future risk for suicide attempts. Establishing risk factors for suicidality is essential for a number of reasons, including improved understanding of underlying mechanisms, identification of at-risk individuals, and development of evidence-based prevention and treatment programs. Most previous studies have focused exclusively on correlates, which are unlikely to be as informative for prediction and intervention purposes. Accordingly, the primary goal of this study was to conduct a meta-analytic review of prospective studies that have evaluated *anxiety and its disorders* as risk factors for suicidal thoughts and behaviors. In a narrative review, it can be difficult to provide a comprehensive account of all relevant studies, reconcile contradictory findings, account for methodological variations across the literature, and ascertain overall magnitudes of risk factors under investigation. A meta-analysis can overcome these limitations, and thus would be very helpful in summarizing current knowledge about anxiety as a risk factor for suicidality.

There are several reasons why we chose to focus on anxiety in this meta-analysis. First, anxiety and its disorders are listed as important risk factors for suicide by a number of national organizations (e.g., American Association of Suicidology, 2015; American Foundation for Suicide Prevention, 2015; National Suicide Prevention Lifeline, 2015). Determining the strength of empirical evidence to support this information, which is widely disseminated to clinicians, researchers, and the public, is necessary.

Second, anxiety is implicated in many prominent theories of suicide. For example, according to Beck's cognitive model of suicide, once a suicide schema is activated, anxiety (and agitation) can serve as an expression of attentional fixation on suicide, which interacts with hopelessness to increase suicide risk (e.g., Wenzel & Beck, 2008; Wenzel, Brown, & Beck, in press). Although anxiety is not explicitly addressed in Joiner's interpersonal theory of suicide (Joiner, 2005; Van Orden et al., 2010), this model's emphasis on the fearsome nature of suicidal behavior is consistent with evidence showing that acute anxious states (e.g., heightened arousal/agitation, severe panic attacks) are often present immediately prior to lethal or near-lethal suicidal acts (e.g., Britton, Ilgen, Rudd, & Conner, 2012; Busch, Fawcett, & Jacobs, 2003; Conrad et al., 2009; Fawcett et al., 1990; Hall, Platt, & Hall, 1999; Ribeiro et al., 2015; Ribeiro, Silva, & Joiner, 2014). These findings align with Fawcett's influential conceptualizations of anxiety/agitation as a determinant for acute suicide risk

(e.g., Fawcett, 2001; Fawcett, Busch, Jacobs, Kravitz, & Fogg, 1997), and expert clinical consensus identifying agitation as a “warning sign” for suicide (e.g., Rudd et al., 2006). Furthermore, Baumeister (1990) conceptualizes suicide as the ultimate escape from aversive self-awareness and associated negative affect, which often includes anxiety. Along similar lines, Riskind and colleagues have theorized that a specific cognitive risk factor for anxiety (looming vulnerability), when coupled with hopelessness, enhances urges to escape psychological pain and elevates risk for suicide (e.g., Rector, Kamkar, & Riskind, 2008; Riskind, 1997; Riskind, Long, Williams, & White, 2000).

Third, anxiety and related disorders (broadly defined here as anxiety, obsessive–compulsive, trauma and stressor-related, and somatic symptom disorders) have received theoretical and empirical attention as potential risk factors for suicide. First and foremost, these disorders are characterized by aversive, avoidant reactions to emotional experiences (Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014). Suicidal thoughts and behaviors have similarly been conceptualized as avoidant or escape-based responses to the experience of strong emotions (Baumeister, 1990; Boegers, Spirito, & Donaldson, 1998; Briere, Hodges, & Godbout, 2010; Bryan, Rudd, & Wertenberger, 2013; Shneidman, 1993), highlighting the potential functional similarities of these phenomena. Further, behavioral avoidance, a hallmark feature of anxiety disorders, often results in significant isolation, reduced quality of life, and impaired functioning (e.g., Massion, Warshaw, & Keller, 1993; Olatunji, Cisler, & Tolin, 2007), which confer additional risk to suicidality (Kanwar et al., 2013; Kaplan, McFarland, Huguet, & Newsom, 2007). Other avoidance strategies (e.g., suppression) often used by individuals with an anxiety disorder have also been shown to exacerbate vulnerability to suicidal thoughts and behaviors (Amir, Kaplan, Efroni, & Kotler, 1999).

In addition to promising theoretical relevance of anxiety disorders to suicidality, empirical investigations of this relationship generally show that anxiety disorders are independently associated with suicidal thoughts and behaviors. Although several earlier studies indicated that anxiety disorders are not related to suicidality (e.g., Hornig & McNally, 1995; Warshaw, Massion, Peterson, Pratt, & Keller, 1995), converging empirical evidence suggests that a broad range of anxiety and related disorders (including panic disorder, posttraumatic stress disorder [PTSD], social anxiety disorder, and generalized anxiety disorder [GAD]) function as statistically significant risk factors for suicidal thoughts and behaviors (Boden, Fergusson, & Horwood, 2007; Bolton et al., 2008; Borges, Angst, Nock, Ruscio, & Kessler, 2008; Gradus et al., 2010; Nepon, Belik, Bolton, & Sareen, 2010; Nock et al., in press, 2009, 2010a; Noyes, 1991; Sareen, 2011; Sareen et al., 2005; Thibodeau, Welch, Sareen, & Asmundson, 2013; Weissman, Klerman, Markowitz, & Ouellette, 1989; Wilcox, Storr, & Breslau, 2009).

For example, Nock and colleagues (2010a) observed that anxiety disorders significantly predicted future suicide attempts in a large, nationally representative sample ($N = 9282$), when controlling for psychiatric comorbidity. Indeed, anxiety disorders produced larger population attributable risk proportions (PARPs), which take into account the prevalence of predictors and distribution of comorbidity, for suicide ideation and attempts than impulse-control and substance use disorders. Among suicide ideators, anxiety disorders played a larger role than mood disorders, impulse-control disorders, and substance use disorders in

accounting for subsequent suicide attempts. Findings from a cross-national study by Nock and colleagues (2009) are similar, with anxiety serving as a more powerful predictor of suicide attempts among ideators than mood, impulse-control, and substance use disorders. A recent meta-analysis of 42 studies further supports the notion that anxiety disorders and suicidal behavior are related (Kanwar et al., 2013); however, by including a combination of cross-sectional and longitudinal studies, the conclusions that can be drawn from this previous meta-analysis regarding anxiety (and specific disorders) as risk factors are tempered.

In summary, researchers, theorists, and clinicians have evidenced a longstanding interest in the role of anxiety and its disorders in suicide. A meta-analysis of longitudinal studies is necessary to synthesize the available literature on anxiety as a risk factor for suicidal thoughts and behaviors. Specifically, we aimed to: (1) estimate the predictive power (i.e., risk factor magnitude and accuracy) of anxiety as a risk factor for suicide-related outcomes, (2) compare the strength of effect sizes across types of anxiety (e.g., disorders, symptoms), and (3) examine potential moderators of the association between anxiety and suicide-related outcomes, including sample type, sample age, and length of follow-up period. To our knowledge, this represents the first effort to provide a comprehensive, quantitative review of the predictive ability of anxiety and its disorders for suicidal thoughts and behaviors.

2. Method

This meta-analysis complies with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009).

2.1. Search strategy and selection

We conducted a comprehensive literature search of PsycINFO, PubMed, and Google Scholar from database inception through December 2014 to identify studies eligible for the current review. The prediction-related terms *longitudinal*, *longitudinally*, *predicts*, *prediction*, *prospective*, *prospectively*, *future*, *later*, and *follow-up* were entered simultaneously with the self-injury-related terms *self-injury*, *suicidality*, *self-harm*, *suicide*, *suicidal behavior*, *suicide attempt*, *suicide death*, *suicide plan*, *suicide thoughts*, *suicide ideation*, *suicide gesture*, *suicide threat*, *self-mutilation*, *self-cutting*, *cutting*, *self-burning*, *self-poisoning*, *deliberate self-harm*, *DSH*, *nonsuicidal self-injury*, and *NSSI*. Given the inconsistent and ambiguous terminology used to describe self-injury (with or without suicidal intent) in the literature (Nock, 2010), we employed a wide range of self-injury-related terms to reduce the likelihood of missing relevant studies. The reference sections of identified articles were also searched for other relevant publications.

Fig. 1 presents a PRISMA diagram of the study selection process. A total of 2385 unique publications were identified by initial literature searches; after reviewing each abstract, 642 studies were deemed eligible for further review. The authors then reviewed each full-text study and identified 65 publications that met criteria for inclusion in the meta-analysis (see Appendix A for references for articles included in meta-analyses).

2.2. Inclusion and exclusion criteria

To be included in this meta-analysis, studies had to first include a longitudinal analysis predicting one or more of the following suicide-related outcomes: suicide ideation, suicide plan, suicide gesture, suicide attempt, or suicide death. Correspondingly, we excluded studies with outcomes that included nonsuicidal self-injury (NSSI) only. We also excluded studies that lumped nonsuicidal and suicidal behavior together into a single outcome (e.g., “deliberate self-harm”) because including these combined variables would render it difficult to draw strong conclusions about the association between anxiety and *suicidal* outcomes specifically. Second, included studies had to use one or more of the following anxiety-specific predictors: any individual anxiety diagnosis (i.e., agoraphobia, anxiety disorder not otherwise specified, GAD, panic disorder, social anxiety disorder, specific phobia) or anxiety diagnosis grouping (e.g., “any anxiety disorder” as defined by study authors), any obsessive-compulsive or related disorder (e.g., OCD), any trauma or stressor-related disorder (e.g., adjustment disorder, PTSD), any somatic symptom disorder, symptoms of anxiety (diagnosis-specific and general; e.g., scores on self-report and clinician-rated measures such as the Beck Anxiety Inventory [BAI; Beck, Epstein, Brown, & Steer, 1988], Hamilton Anxiety Rating Scale [HARS; Hamilton, 1959], or Yale-Brown Obsessive Compulsive Scale [Y-BOCS; Goodman et al., 1989], panic attacks). Correspondingly, we excluded studies only examining constructs or symptoms broadly related but not specific to anxiety (e.g., neuroticism, negative affect, emotion dysregulation). We also excluded studies combining anxiety and mood disorders into a single variable (e.g., internalizing problems, “mood or anxiety diagnosis”) because including these overlapping predictors would undermine our conclusions regarding the specific effect of *anxiety* on suicidal thoughts and behaviors. Finally, studies had to provide sufficient statistical information to conduct the present analyses, appear in a publication, and present original data not already reported in another study.

2.3. Data abstraction

Authors systematically extracted relevant information from each article included in the present meta-analysis using a predefined coding strategy. Recorded information included: (a) year of study publication, (b) sample age (i.e., adult, adolescent, mixed), (c) sample size, (d) sample type (i.e., general, clinical, or history of prior SITBs), (e) length of study follow-up (in months), (f) statistical information for each unique prediction case (i.e., any instance using an anxiety-specific variable to longitudinally predict a suicide-related outcome), and (g) whether the prediction case was hypothesized to be a risk or protective factor (e.g., no psychopathology, reduction in anxiety). Whenever possible, we used the most unadjusted estimate(s) or extracted raw diagnostic data for our meta-analytic calculations; of note, only 10% of cases included our analyses were coded as adjusted (e.g., controlling for related variables such as age, gender, etc.).

2.4. Data analysis

Our outcomes of interest were suicidal thoughts and behaviors (i.e., suicide ideation, suicide attempt, suicide death); due to the fact that only one study reported on suicide gestures and plans (Borges et al., 2008), we did not conduct any analyses specific to these outcomes. Our

predictors of interest were anxiety-specific constructs. From each study, we extracted relevant statistics (e.g., zero-order correlation, 2×2 contingency table, odds ratio, hazard ratio, independent group means) for each unique predictor case. Protective factor cases (i.e., when a variable could be reasonably assumed to correspond to a reduction in risk for future suicidal behavior, such as *absence* of PTSD) and redundant cases (e.g., a non-unique case reported in two studies using the same sample) were removed. In addition, when one publication reported cases using the same predictor and outcome at multiple time points, we selected only the longest time point to reduce data dependency. Accordingly, we removed 6 cases, which resulted in a total of 180 unique prediction cases used in this review.

Prior to conducting our meta-analytic analyses, all relevant study statistics were converted to ORs and their 95% confidence interval (CI) in the program Comprehensive Meta-Analysis (CMA, Version 2; Borenstein, Hedges, Higgins, & Rothstein, 2005). Cases that reported hazard ratio (HRs) and lacked the raw data necessary to be converted to ORs were analyzed separately. We used random-effects models (Field, 2001; Hedges & Olkin, 1985; Hedges & Vevea, 1998) for all calculations. These models assume that reported effect sizes across studies represent a random sampling of studies distributed around a true effect size for the population whereas the assumption of fixed effects models is that included studies reflect the true population effect size. Thus, we chose random-effects models to take into account both between- and within-study heterogeneity across the publications included in our meta-analysis.

First, we pooled all ORs from included studies to estimate overall effect sizes for *any anxiety construct* (i.e., any type of anxiety diagnosis and symptoms) predicting suicide ideation, attempt, and death. Then, we estimated effect sizes for *anxiety symptoms* (e.g., total scores on diagnosis-specific or general anxiety measures, panic attacks), excluding anxiety diagnoses, on the same suicide-related outcomes. Next, we estimated effect sizes for *any type of anxiety diagnosis* (i.e., adjustment disorder, agoraphobia, anxiety disorder not otherwise specified, GAD, OCD, panic disorder, PTSD, social anxiety disorder, somatic symptom disorder, specific phobia, “any anxiety diagnosis” as defined by the study authors) predicting suicide-related outcomes. Finally, we conducted diagnosis-specific analyses for the following individual diagnoses on suicide ideation, attempt, and death: adjustment disorder, agoraphobia, GAD, OCD, panic disorder, PTSD, social anxiety disorder, somatic symptom disorder, and specific phobia. Diagnosis-specific analyses were not conducted for anxiety disorder not otherwise specified because there was only one case using this particular diagnosis. A total of 20 cases used HRs only, which all predicted either attempt or death. We pooled these cases separately to estimate overall effect sizes for *any anxiety construct* predicting suicide attempt and then death.

Several tests were used to assess for potential publication bias in our meta-analysis. First, Orwin's fail-safe N was used to estimate the number of missing studies with ORs of 1.00 necessary to lower the magnitude of observed overall effect sizes to a negligible value; for these analyses, we set the alternative OR to 1.01. We also employed Egger's test of the intercept, which uses precision (i.e., inverse of the standard error) to predict the standardized effect (i.e., effect size divided by the standard error). In Egger's equation, the slope of the regression line indicates the size of the effect and the intercept indicates bias. Last, we used

a funnel plot, which depicts the standard error of each included study on the vertical axis relative to the effect size magnitude on the horizontal axis. When studies are symmetrically dispersed around the combined mean effect size, it is likely the meta-analysis captured all relevant studies, whereas an asymmetrical distribution of studies indicates publication bias. Duval and Tweedie's Trim and Fill test was used to quantify the nature of publication bias. Specifically, this analysis identifies the number of studies missing due to publication bias, estimates the effects of these missing studies, adds the unpublished studies to the analysis, and re-estimates the overall effect size estimate. Should the initial and re-estimated ORs significantly differ, one can conclude that the effect observed in the meta-analysis is biased.

The program MetaDiSc Version 1.4 (Zamora, Muriel, & Abaira, 2014) and random-effects models were used to conduct diagnostic accuracy analyses in order to provide detail in addition to overall ORs regarding patterns of included data. Our diagnostic accuracy statistics involved generating sensitivity (true positive rate; e.g., of all individuals who attempt suicide, the percentage that we would predict will make an attempt based on the presence of an anxiety disorder) and specificity (true negative rate; e.g., of all individuals who do not attempt suicide, the percentage that we would predict will not make an attempt based on the absence of an anxiety disorder) values. We also generated receiver operating characteristic (ROC) curves, which plots the sensitivity against the false positive rate (1 — specificity) for each prediction case; areas under the curve (AUCs) and corresponding standard errors were then calculated and used as our primary indicator of diagnostic accuracy. We adhered to the following guidelines in interpreting AUCs: $>.90$ suggesting excellent prediction, $.80-.89$ good prediction, $.70-.79$ fair prediction, $.61-.69$ poor prediction, and $.50-.59$ extremely poor prediction (Šimundi, 2008).

To be included in diagnostic accuracy analyses, prediction cases had to provide raw data that could be converted into a 2×2 table with cells that indicate true positive, false positive, true negative, and false negative events. Whenever possible, raw data was obtained to maximize the number of prediction cases included in these analyses. Given the limited number of prediction cases for suicide ideation that provided sufficient information to run these analyses, diagnostic accuracy estimates were computed for outcomes of suicide attempt and death only. For suicide attempt, 39 prediction cases (spanning all anxiety constructs) were included, and for death, 26 cases (also spanning all anxiety constructs) were included in diagnostic accuracy analyses.

We used the I^2 statistic to examine heterogeneity within the meta-analysis, thereby justifying our use of random-effects models, which, as previously noted, account for important methodological variations across studies. An I^2 statistic >50 indicates high variance in observed effect sizes (Higgins, Thompson, Deeks, & Altman, 2003) and suggests that characteristics of individual studies should be examined as potential moderators of the observed effects of anxiety on suicide-related outcomes. The following variables were tested as potential moderators: sample type (i.e., general, clinical, history of self-injurious thoughts or behaviors [SITBs]), sample age (i.e., adult, adolescent, mixed), and length of follow-up period. For categorical variables (sample type and sample age), we examined the magnitude of effect size estimates for any anxiety construct predicting suicide ideation, attempt, and death at each level of the potential moderator. We treated length of

follow-up period as a continuous variable, and employed unrestricted maximum likelihood meta-regression using a random effects model to estimate the effect of length of follow-up period on the predictive ability of anxiety. For these analyses, we used R^2 as an indicator of moderator strength.

3. Results

3.1. Description of included studies

Characteristics of studies are presented in Table 1. Years of publication spanned 1982 to 2015. The 65 included articles yielded a total of 69 samples, as four publications reported data separately for males and females (i.e., Berglund & Nilsson, 1987; Lewinsohn et al., 2001; Reinherz et al., 1995; Tidemalm et al., 2014). Across all samples, there were a total of 852,159 participants. The median number of participants per study was 249 ($M = 12,350$, $SD = 44,712$, range = 26–309,861). Just over half of samples (52.2%) were classified as clinical (e.g., psychiatric patients), whereas 26.1% were drawn from the general community and 21.7% included only individuals with a history of prior SITBs. One study (Borges et al., 2008) used a combination of community-based participants and those with a SITB history. The majority of studies (71.0%) utilized adult samples; 21.7% of studies were conducted in adolescent-only samples and only 5 studies (7.2%) used mixed samples. Over half of included studies (55.1%) utilized samples from countries outside North America, most commonly in Europe.

Across all included studies, the median follow-up interval was 60 months ($M = 113.1$, $SD = 126.2$, range = 1–708 months). The most common follow-up period length was also 60 months (9 studies). Only 4 included studies had a follow-up interval shorter than 12 months, whereas just under one-third (30.4%) of studies had a follow-up period of 12 years or longer. With regard to predictors, the vast majority of studies (85.5%) reported at least one case in which an anxiety diagnosis (either a specific diagnosis [e.g., GAD, PTSD] or diagnosis grouping [e.g., any anxiety disorder]) was used to predict a suicide-related outcome. Of these, 11 studies also reported one or more additional case(s) using anxiety symptoms to predict a suicide-related outcome. Only 10 studies only included symptom-level anxiety predictors. For suicide-related outcomes, most studies (60.9%) reported at least one usable suicide attempt prediction case. Death was the second most common outcome examined, with 37.7% of studies presenting one or more cases in which an anxiety predictor was used to predict suicide death. Only 13.0% of studies included a prediction case for ideation. There was an average of 2.61 usable prediction cases per study.

3.2. Overall anxiety effect sizes and publication bias

3.2.1. Suicide ideation—Overall effect sizes for any anxiety construct predicting outcomes of suicide ideation, suicide attempt, and suicide death are presented in Table 2; these (and other overall OR) findings are also presented in Fig. 2. In total, 26 prediction cases included suicide ideation as an outcome. The overall OR for any anxiety construct predicting suicide ideation was statistically significant, but small. Heterogeneity among these cases was high, suggesting significant between-study variance. We employed multiple analyses to test for publication bias among suicide ideation prediction cases. Orwin's fail-

safe N value suggested that 884 cases with a mean OR of 1.00 would be necessary to lower the overall mean OR for any anxiety construct below our predefined threshold of 1.01. In addition, Egger's test demonstrated an intercept (B_0) of 0.91 (95% CI: $-2.02, 3.83$), $t(24) = 0.64$, $p = 0.27$, which provides no clear indication of publication bias. However, the funnel plot appeared asymmetrical, with a disproportionate number of studies falling on the right side of the mean effect (see Fig. 3). Duval and Tweedie's trim and fill analysis also detected 9 missing cases, and indicated that if these were included, the overall weighted OR would be slightly smaller (OR = 1.24, 95% CI: 1.01, 1.53).

As previously noted, there were no HR cases for suicide ideation. We also did not examine diagnostic accuracy for suicide ideation due to an insufficient number of cases with the information required for these analyses.

3.2.2. Suicide attempt—A total of 80 prediction cases that used (or could be converted into) an OR included suicide attempt as an outcome. The overall effect size estimate for any anxiety construct also reached the level of statistical significance, but was small (Table 2, Fig. 2). Similar to suicide ideation, heterogeneity among suicide attempt prediction cases was high. With regard to publication bias, Orwin's fail-safe N indicated that 838 cases with an OR of 1.00 would be needed to bring the combined weighted OR for suicide ideation below our threshold of 1.01. Egger's regression test produced an intercept (B_0) of 1.13 (95% CI: 0.66, 1.59), $t(78) = 4.83$, $p < .0001$, indicating that the less precise studies reported larger effect sizes, thereby suggesting significant publication bias. The funnel plot also appeared asymmetrical, with more studies falling to the right of the mean (see Fig. 3). Duval and Tweedie's trim and fill test indicated that 21 prediction cases were missing from our meta-analysis, and should these studies have been included, the combined mean OR for any anxiety construct predicting suicide attempt would be reduced to 1.20 (95% CI: 1.07, 1.34).

There also were 10 HR cases included in the meta-analysis that used suicide attempt as an outcome. For any anxiety construct predicting suicide attempt, the overall weighted mean HR did not reach statistical significance; these cases also evidenced high heterogeneity (Table 2).

As previously noted, there were 39 suicide attempt prediction cases with sufficient information to conduct diagnostic accuracy analyses. Overall, the accuracy of anxiety in prediction suicide attempt was poor, indicating that although anxiety may confer risk for attempt, it is only slightly better than chance. Specifically, the AUC was .56 (SE = .02), indicating extremely poor prediction (see Fig. 4). Further, sensitivity (i.e., true positive rate) was very low at .12 (95% CI: .11, .13, $p < .001$). Although specificity (i.e., true negative rate) was acceptable at .88 (95% CI: .87, .88, $p < .001$), this is likely due to a rare outcome (suicide attempt) crossed with a relatively rare predictor (e.g., anxiety disorder).

3.2.3. Suicide death—There were 39 prediction cases with suicide death as an outcome included in OR analyses. The overall weighted mean OR for any anxiety construct did not reach statistical significance (Table 2, Fig. 2). Heterogeneity among these cases was lower than suicide ideation and attempt cases; indeed, the heterogeneity statistic suggests that less than half of variance was accounted for by between-study variance. Regarding tests for

publication bias, Orwin's fail-safe N suggested that 14 cases with mean ORs of 1.00 would be needed to bring the overall estimated OR for suicide death under our predefined value; of note, the overall effect size was already at our predefined value for a trivial magnitude. Egger's test resulted in an intercept (B0) of -0.21 (95% CI: $-0.67, 0.24$), $t(37) = 0.95$, $p = 0.18$, which is not indicative of substantial publication bias. The funnel plot for suicide death cases appeared asymmetrical (see Fig. 3), with more studies on the left side of the mean, but a Duval and Tweedie's trim and fill test indicated that no prediction cases were missing.

A total of 10 HR cases included suicide death as an outcome. The overall weighted mean HR for any anxiety construct predicting suicide death was statistically significant, yet small (Table 2). There was extremely high heterogeneity among these cases, suggesting substantial between-study variance.

Diagnostic accuracy analyses were conducted using the 26 suicide death cases that provided the necessary raw data. Similar to suicide attempt, specificity (.75; 95% CI: .75, .75, $p < .001$) was much higher than sensitivity, which was very poor (.05; 95% CI: .04, .05, $p < .001$). Again, this specificity value was likely an artifact of a rare outcome (suicide death) crossed with a relatively rare predictor (e.g., anxiety disorder). Further, the AUC did not reach statistical significance (.42, SE = .02; see Fig. 4), suggesting extremely poor overall prediction.

3.3. Anxiety symptoms effect sizes

3.3.1. Suicide ideation—Results from analyses corresponding to any anxiety symptoms (i.e., excluding anxiety and related diagnoses) predicting suicide ideation, attempt, and death are presented in Table 3 and Fig. 2. Analyses showed a small, but statistically significant overall OR. Heterogeneity among these cases was relatively low.

3.3.2. Suicide attempt—The overall OR for anxiety symptoms predicting suicide attempt was small, but reached statistical significance, with high between-cases variance (Table 3, Fig. 2).

3.3.3. Suicide death—The estimated overall OR for anxiety symptom cases predicting suicide death did not reach the level of statistical significance. There was low heterogeneity among these cases (Table 3, Fig. 2).

3.4. Anxiety diagnosis effect sizes

3.4.1. Suicide ideation—Findings from analyses of anxiety and related diagnoses predicting suicide ideation, suicide attempt, and suicide death are presented in Table 4 and Fig. 2. First, the combined effect of any type of anxiety diagnosis significantly predicted suicide ideation; there was also high heterogeneity among cases included in this analysis. Diagnosis-specific analyses indicated that the strongest predictor of suicide ideation was PTSD; however, one PTSD case with a notably large magnitude (OR = 4.21) may have been partially driving these findings, as no other suicide ideation prediction cases exceeded an OR of 2.33. Diagnoses of GAD, specific phobia, and social anxiety disorder were also significant predictors of suicide ideation. Corresponding I^2 statistics also suggest substantial

heterogeneity among PTSD and GAD cases, but not specific phobia or social anxiety disorder cases (Table 4). Of note, only 4 suicide ideation prediction cases were used to generate overall ORs for PTSD, specific phobia, and social anxiety disorder, and only 2 cases were used for GAD, thereby limiting the conclusions we can draw from this set of analyses. Overall effect size estimates were not computed for adjustment disorder, agoraphobia, OCD, panic disorder, or somatic symptom disorder because there was no more than one relevant case for each of these diagnoses.

3.4.2. Suicide attempt—The combined effect of any type of anxiety diagnosis on suicide attempt was also statistically significant, yet relatively small in magnitude (Table 4, Fig. 2). High heterogeneity among these cases was also observed. Diagnosis-specific analyses indicated that PTSD, panic disorder, and social anxiety disorder were significant predictors of subsequent suicide attempt; the strongest predictor of suicide attempt was PTSD followed by panic disorder. Of note, two prediction cases with ORs above 4.0 may have been driving the relatively high estimate for panic disorder, as no other cases included in any diagnosis-specific analysis for suicide attempt exceeded 3.3. Agoraphobia, GAD, OCD, somatic symptom disorder, and specific phobia did not reach the level of statistical significance. Adjustment disorder was a significant predictor of *fewer* suicide attempts. It is again important to consider the relatively small number of cases included in diagnosis-specific analyses for adjustment disorder, agoraphobia, OCD, somatic symptom disorder, and specific phobia (ranging from 2 to 5). Among the diagnosis-specific cases that produced statistically significant effect sizes, substantial heterogeneity was observed for PTSD, whereas relevant cases for panic disorder, social anxiety disorder, and adjustment disorder evidenced relatively low heterogeneity.

3.4.3. Suicide death—For any type of anxiety diagnosis predicting suicide death, the overall OR did not reach the level of statistical significance, and heterogeneity among these cases was present (Table 4, Fig. 2). Diagnosis-specific overall ORs for panic disorder and OCD were weak and nonsignificant, whereas adjustment disorder was shown to be a statistically significant predictor of fewer suicide deaths. I^2 statistics also suggested substantial heterogeneity was present among cases included in the overall “any anxiety diagnosis” analysis, but relatively low heterogeneity across cases included in diagnosis-specific analyses. We did not generate weighted suicide death ORs for agoraphobia, GAD, PTSD, social anxiety disorder, somatic symptom disorder, or specific phobia due to the fact that there was no more than one relevant case for each diagnosis.

3.5. Moderation analyses

We examined three potential moderators of the relationship between anxiety and suicide ideation, attempt, and death: sample type (i.e., general, clinical, history of prior SITBs), sample age (i.e., adult, adolescent, mixed), and length of follow-up period.

3.5.1. Sample type—Sample type did not moderate the relationship between any anxiety construct and suicide ideation or suicide death. However, suicide attempt prediction cases drawn from studies using general samples generated a significantly stronger overall effect size (OR = 2.98, 95% CI: 2.37, 3.75, $z = 9.35$, $p < .001$) than clinical populations (OR =

1.55, 95% CI: 1.38, 1.75, $z = 7.37$, $p < .001$) and individuals with a history of SITBs (OR = 1.16, 95% CI: 0.85, 1.59, $z = 0.94$, $p = .35$).

3.5.2. Sample age—The age of the study sample also did not affect the predictive ability of anxiety for suicide ideation or death. Similar to sample type, however, there was a moderation effect of sample age on the relationship between any anxiety construct and suicide attempt. Specifically, weighted mean effect sizes from studies using samples comprised of all adults (OR = 1.79, 95% CI: 1.56, 2.06, $z = 8.24$, $p < .001$) were significantly stronger than those using mixed samples (OR = 0.83, 95% CI: 0.62, 1.11, $z = -1.23$, $p = .22$). Of note, there were no significant differences between adult-only or mixed samples in comparison to adolescent-only samples (OR = .59, 95% CI: 0.99, 2.56, $z = 1.92$, $p = .06$).

3.5.3. Length of follow-up period—Results from maximum likelihood meta-regression analyses indicated that length of follow-up period significantly moderated the relationship between anxiety and both suicide ideation and attempt (see Fig. 5), but not suicide death. For suicide ideation, there was a small (but steady) decline in magnitude of combined ORs steadily as the length of follow-up period increased ($b = -0.005$, SE = 0.00, 95% CI: -0.01 , -0.00 , $z = -2.91$, $p < .01$), with follow-up length explaining 32% of the between-study variance. The same trend was observed for suicide attempt ($b = -0.004$, SE = 0.00, 95% CI: -0.01 , -0.00 , $z = -2.81$, $p < .01$), with follow-up length explaining 5% of between-study variance. Together, these findings indicate that with longer follow-up periods, the predictive ability of anxiety disorders and symptoms for suicide ideation and attempt weakens slightly.

4. Discussion

Suicidal thoughts and behaviors are public health problems that affect millions across the globe. Despite receiving increased empirical attention over the past 50 years, the rates of suicidal thoughts and behaviors have not abated. Identifying powerful and accurate risk factors is one promising means toward effective prevention and treatment, and thus eventual reduction, of these phenomena. Anxiety is one potential risk factor for suicidality that has been of particular interest to date. For one, anxiety is listed as a top risk factor for suicide by leading national organizations (e.g., AAS, AFSP, National Suicide Prevention Lifeline). Prominent theories of suicide (e.g., Baumeister, 1990; Joiner, 2005; Wenzel & Beck, 2008) also either directly address anxiety and/or are consistent with findings implicating the role of acute anxiety/agitation in suicidal behavior. In addition, converging evidence from large-scale longitudinal studies suggests that anxiety disorders significantly predict suicidal ideation and behaviors, even when controlling for comorbidity (e.g., Boden et al., 2007; Nock et al., 2009, 2010; Sareen et al., 2005). As such, the aim of this meta-analysis was to synthesize the existing knowledge of anxiety as a risk factor for suicidal thoughts and behaviors. Analyses indicated that anxiety and its disorders are statistically significant predictors of suicide ideation and attempts, but not deaths.¹ The strength of observed relationships was weak across all categories examined.

¹This refers to findings from weighted mean OR analyses, which were based on 80 and 39 cases (respectively), given that HR analyses for attempt and death were based on only 10 prediction cases each, and thus less reliable.

Although overall, anxiety and its disorders showed statistically significant prospective associations with suicide ideation and attempts, these findings do not translate into high clinical utility. Across all anxiety-related predictors and suicide-related outcomes, combined effect sizes were small, and no one predictor stood out as being significantly stronger than the rest. Specifically, the largest combined OR just exceeded 2.0, and most effect sizes that reached statistical significance clustered around 1.5. Given that the absolute risk of experiencing suicidal thoughts and behaviors (and especially attempts and deaths) is low, these estimates do not translate into clinically practical information. Consider an example using PTSD, the diagnosis that produced the largest overall effect on suicide attempts in our meta-analysis. Recent data suggest that in the United States, 0.4% of adults make a suicide attempt in a given year (Borges et al., 2006). Even when these odds are multiplied by 2.25 for individuals with PTSD, as our meta-analysis would suggest, the resultant odds are still close to zero. Determining that an individual has a 0.9% probability of attempting suicide in the next year based on a PTSD diagnosis (as opposed to a 0.4% probability for individuals without PTSD) does not provide meaningful information for clinicians facing critical decisions about suicide risk. This pattern of low clinical significance also holds for adjustment disorder, the only diagnosis evidencing a statistically significant *protective* effect against suicidal behavior (0.1% versus 0.4% probability of attempting suicide for individuals with and without this diagnosis, respectively). The limited clinical utility of our findings is even more striking when one considers the fact that clinicians are usually tasked with determining who is at risk for suicidal behavior over the next few hours or days, rather than months or years. In short, anxiety and its disorders, *at least as these constructs have been studied to date*, are unlikely to serve as powerful “real-world” indicators of risk for suicidal thoughts and behaviors.

There are several potential explanations for our findings that anxiety (diagnoses or symptoms) does not significantly predict suicide deaths. The interpersonal theory of suicide (Joiner, 2005; Van Orden et al., 2010) posits that for lethal suicidal behavior to occur, individuals must develop high levels of *acquired capability* through repeated experiences with painful and provocative events (e.g., Ribeiro et al., 2014). Indeed, some anxiety disorders examined here (e.g., agoraphobia, GAD) may be associated with significant *fear and avoidance* of the experiences required to develop this suicidal capability and more frightening, lethal suicidal behavior (e.g., Silva, Ribeiro, & Joiner, 2015). Thus, consistent with Joiner's model, hallmark features of anxiety *disorders* may protect against the transition from ideation (and even non-lethal suicide attempts) to death by suicide. Another related explanation is that the constructs of anxiety captured in this review are not as relevant to suicide deaths as specific, more acute anxiety-related symptoms. Given findings indicating that severe, heightened arousal is often present immediately prior to suicide (e.g., Busch et al., 2003; Robins, 1981; Way, Miraglia, Sawyer, Beer, & Eddy, 2005), and facilitates lethal suicidal behavior among at-risk individuals (e.g., Ribeiro et al., 2015), there is likely an important distinction between the role of anxiety disorders and general affective states of anxiety (e.g., trait-like anxiety, future-oriented worry) versus acute symptoms of anxiety and agitation (e.g., excessive motor and mental arousal) in predicting suicide deaths specifically.

We also observed several significant moderation effects in this meta-analysis. First, general samples generated larger effect sizes for prediction of suicide attempts than those drawn from clinical settings or with a history of SITBs. This is likely due to the fact that in samples of psychiatric patients and/or with a SITB history, confounding factors (e.g., psychopathology severity, prior suicidal behavior) were more likely to be controlled for (as a function of the sample selection) in comparisons between individuals with and without anxiety. In contrast, studies of community samples did not account for these related variables, and thus were likely to produce stronger effects. We also found that adult samples produced larger effects than samples combining adolescents and adults; however, the conclusions that can be drawn here are limited given the very small number of cases included in the mixed and adolescent-only analyses, and overlapping CIs for effect sizes produced in adolescent- and adult-only samples. Finally, studies with shorter follow-up periods demonstrated larger effects than longer follow-up intervals. This suggests that anxiety and its disorders may be stronger predictors of suicidal thoughts and behaviors over shorter amounts of time.

4.1. Limitations and future directions

Overall, the current evidence suggests that anxiety and its disorders do not substantially increase risk for future suicidal thoughts and behaviors; however, this conclusion only applies to the relationship between anxiety and suicide *as it has traditionally been examined*. The present meta-analysis identified several methodological limitations of existing research on anxiety as a risk factor for suicidality. First, the vast majority of studies have measured anxiety in terms of specific diagnoses or broad, trait-like symptoms, rather than dynamic, acute constructs. Second, the existing literature has generally analyzed anxiety in isolation, rather than in conjunction with other known risk factors. Finally, studies have tended to employ long follow-up periods, rather than the short follow-up periods more relevant to “real-world” assessment of suicide risk. Despite the fact that almost all previous studies have used these methods, few would expect *any* variable (anxiety-related or otherwise), when measured as a trait-like, static construct and studied in isolation, to accurately predict suicidal thoughts and behaviors over many years.

Thus, the possibility remains that anxiety is a very important risk factor for suicide, but it has not yet been studied under the conditions necessary to detect this relationship. Future studies must focus on *directly testing* prominent theories and models of suicide that conceptualize suicidal thoughts and behaviors as resulting from complex combinations of risk factors (distal and proximal, trait-like and unstable) interacting to heighten risk over short periods of time. For instance, rapid elevations in specific, acute anxiety-related constructs (e.g., heightened arousal/agitation, sudden onset of severe panic-like symptoms) may substantially increase risk for suicidal behavior *when such variables are combined with other potentially important factors* (e.g., acquired capability, lack of social support, prior engagement in SITBs, triggering events, psychiatric comorbidities). Even in these specific contexts, these constructs may only substantially enhance risk *for short periods of time*.

In order to better approximate these hypotheses, a number of methodological changes are needed in future research. For one, studies must employ more dynamic (including

physiological, implicit, and/or behavioral) measures of specific anxiety-related constructs hypothesized to be most pertinent to prediction of suicidal behavior as well as examine potential interactive effects with other known and more novel risk factors (e.g., implicit associations with suicide; Nock et al., 2010). It is also recommended that in future studies aiming to isolate the *unique* effects of a single risk factor (or specific combination of risk factors), researchers consistently adjust for factors that may influence the magnitude of their findings (e.g., gender, depression severity). Future investigations must also assess both putative risk factors and suicide-related outcomes much more frequently (rather than letting many months or years elapse between time points), and over much shorter periods of time (e.g., minutes, hours, days). It is also encouraged that researchers examine more fine-grained features of suicidal behavior (e.g., attempt frequency, lethality, intent) in order to refine our understanding of the longitudinal relationships between hypothesized risk factors and specific outcomes, including characteristics of those outcomes. Finally, very large numbers of participants must be included in these studies in order to detect a sufficient number of suicidal acts over follow-up intervals.

Previously, this type of research has not been feasible for the majority of researchers. Recent advancements in technology, however, have rendered it possible for many to conduct these studies much more easily and for relatively low cost. For example, ecological momentary assessment and other mobile technologies delivered through smart-phone or web-based methods serve as easily accessible, economically viable tools for researchers and participants alike. Future investigations that capitalize on current technological innovations have great potential for improving our understanding of effective prediction, prevention, and treatment of suicidal thoughts and behaviors, and thus reduce the impact of suicide worldwide.

5. Conclusions

This meta-analysis indicates that anxiety disorders and symptoms are statistically significant yet weak risk factors for future suicide ideation and attempts but not deaths. Given the methodological limitations of existing research in this area, however, results do not necessarily imply that anxiety plays a trivial or nonexistent role in suicide prediction. Rather, anxiety does not appear to confer meaningful risk for suicidal thoughts and behaviors under the specific conditions of how it has been examined to date. Future research must take advantage of recent technological advancements to generate potentially informative and practical knowledge about the role of anxiety-related constructs in conferring risk for suicidal thoughts and behaviors.

Appendix A. References for articles included in meta-analyses

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Highlights

- We conducted a meta-analysis of anxiety predicting suicidal thoughts and behaviors.
- Anxiety was a significant risk factor for suicide ideation and attempts.
- As it has traditional been studied, anxiety is a weak predictor of suicidality.
- Future research must approximate current theories about risk factors for suicide.

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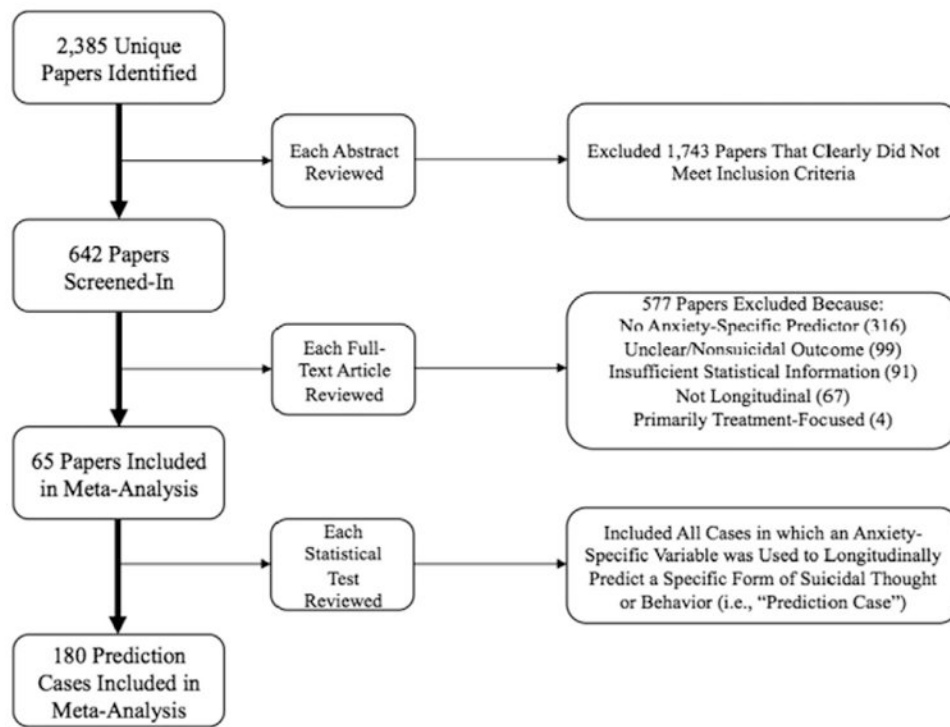


Fig. 1.
PRISMA diagram.

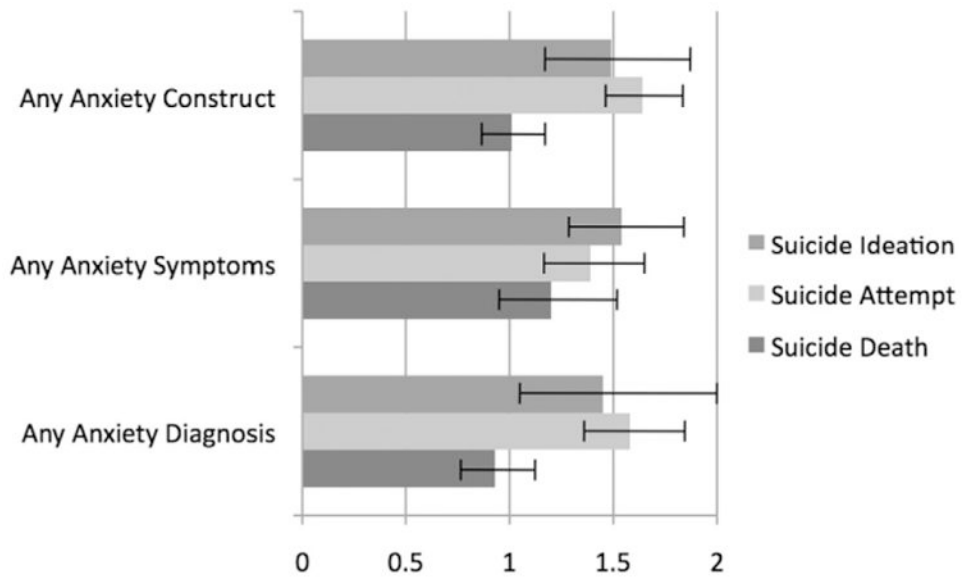


Fig. 2. Overall odds ratios (ORs) and corresponding 95% confidence intervals for any anxiety construct, any anxiety symptoms, and any anxiety diagnosis predicting suicide ideation, suicide attempt, and suicide death. An OR must exceed 1.0 to be statistically significant.

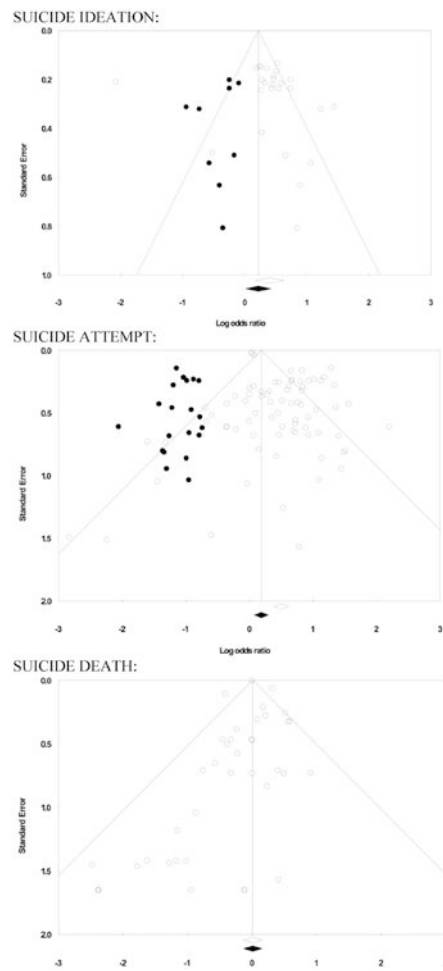


Fig. 3. Funnel plots for anxiety constructs predicting suicide-related outcomes (ORs). Open circles indicate values captured in the meta-analysis. Shaded circles indicate imputed values missing to the left of the mean due to publication bias. Open diamonds indicate weighted mean ORs before adjusting for publication bias. Shaded diamonds indicates weighted mean ORs after adjusting for publication bias.

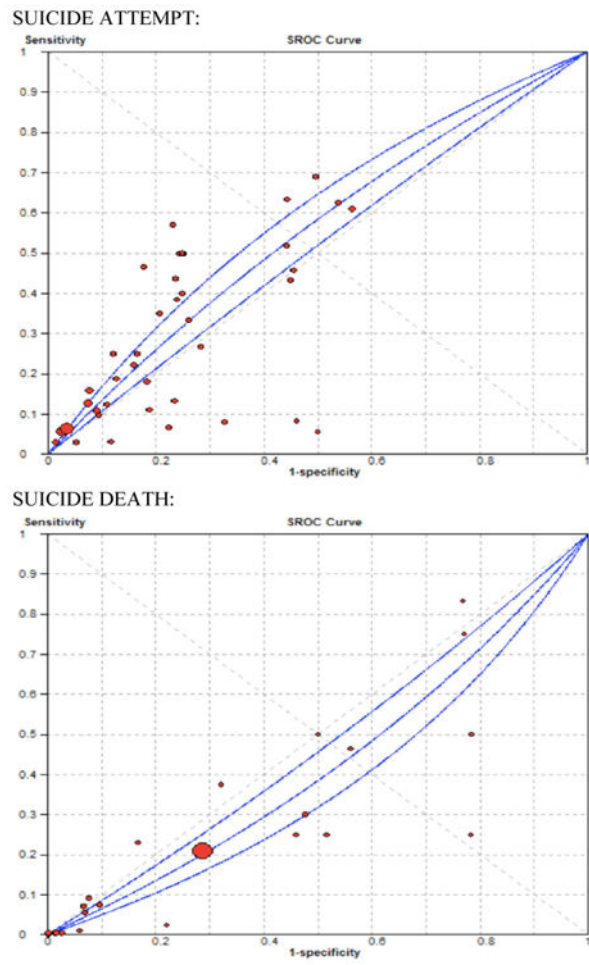


Fig. 4. ROC curves for anxiety predicting suicide attempt and death.

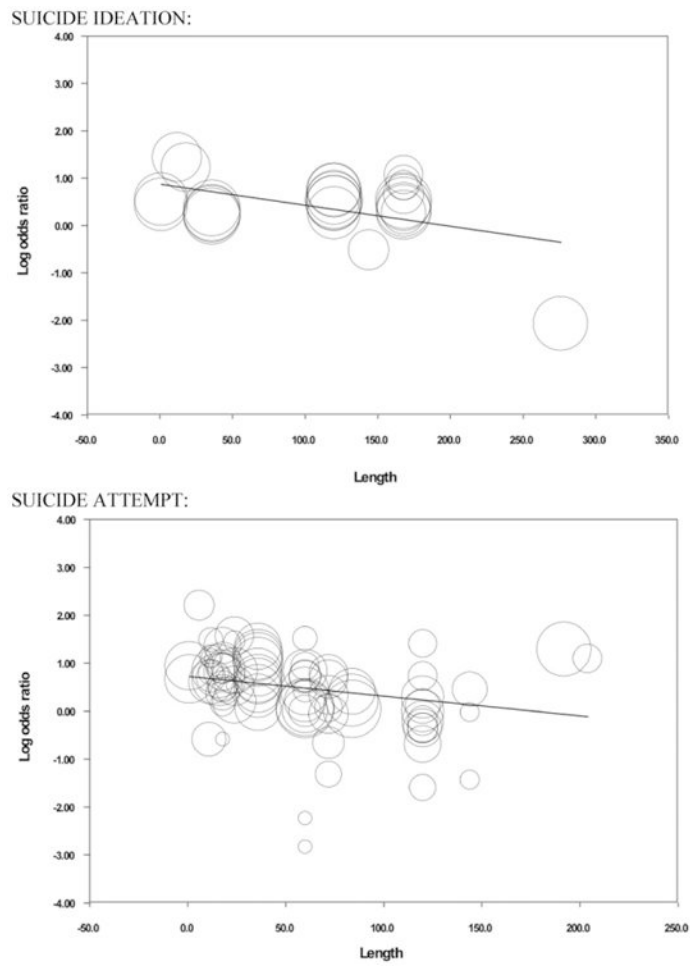


Fig. 5. Moderation effect for length of follow-up period on suicide ideation and attempt.

Table 1

Description of included studies.

Author(s), year	Total N	Sample type ^a	Sample population ^b	Length of follow-up (in months)	Anxiety predictor(s)	Suicide-related outcome(s)
Allgulander et al. (1992)	80,790 Swedish discharged inpatients	Clinical	Adolescent and adult	168	Anxiety neurosis ^c	Death
Alonso et al. (2010)	218 Spanish psychiatric patients	Clinical	Adult	120	OCD duration and symptoms	Attempt
Angst & Calyton (1998)	62 deceased Swiss males from general community	General	Adult	204	Any anxiety diagnosis	Death
Bakken & Vaglum (2006)	160 Norwegian patients with substance abuse	Clinical	Adult	72	AG, GAD, OCD, PTSD, SOC, SOM, SPEC	Attempt
Beautrais (2004)	302 New Zealand patients with prior attempt	History of SITBs	Adolescent and adult	60	Any anxiety diagnosis	Attempt, death
Berglund (1984)	1,312 Swedish inpatients with alcohol abuse	Clinical	Adult	384	Any anxiety diagnosis	Death
Berglund & Nilsson (1987) (a)	700 Swedish female inpatients with mood disorder	Clinical	Adult	324	Any anxiety diagnosis	Death
Berglund & Nilsson (1987) (b)	500 Swedish male inpatients with mood disorder	Clinical	Adult	324	Anxiety symptoms	Death
Blumenthal et al. (1989)	36 German psychiatric patients	Clinical	Adult	60	Any anxiety diagnosis	Death
Bolton et al. (2010)	5,972 general community	General	Adult	36	Any anxiety diagnosis, GAD, PD, PTSD, SOC, SPEC	Attempt
Borg & Ståhl (1982)	68 Swedish psychiatric patients	General	Adult	24	Anxiety symptoms, OCD symptoms	Death
Borges et al. (2008)	5,001 general community	General, History of SITBs	Adolescent and adult	120	Any anxiety diagnosis, AG, GAD, PD, PTSD, SOC, SPEC	Ideation, gesture, plan, attempt
Brådvik et al. (2010)	85 Swedish general community	General	Adolescent and adult	708	ADJ, ANX-NOS, OCD, PDA, SOC, SOM	Death
Breslau et al. (2012)	1,186 general community	General	Adult	24	Any anxiety diagnosis	Attempt
Britton, et al. (2012)	381 veteran suicide descendants	History of SITBs	Adult	1	Anxiety symptoms	Death
Brown et al. (2000)	6,891 psychiatric outpatients	Clinical	Adult	288	Anxiety symptoms, PD	Death
Bryan et al. (2014)	176 veteran outpatients	History of SITBs	Adult	14	PTSD symptoms	Attempt
Cedereke & Öjehagen (2015)	178 Swedish psychiatric patients	Clinical	Adult	11	ADJ	Attempt
Chan et al. (2014)	66 inpatients with depression	Clinical	Adult	12	Any anxiety diagnosis	Attempt
Clarke et al. (2010)	1,292 general community	General	Adult	276	Any anxiety diagnosis	Ideation

Author(s), year	Total N	Sample type ^a	Sample population ^b	Length of follow-up (in months)	Anxiety predictor(s)	Suicide-related outcome(s)
Conner et al. (2012)	309,861 members	General	United States Air Force	72	Any anxiety diagnosis	Death
Cogle et al. (2009)	2,551 females	General	in general community	12	PTSD	Ideation
Courtet et al. (2003)	76 West European patients with prior attempt	History of SITBs		12	AG, GAD, PD, SOC	Attempt
Cullberg et al. (1988)	163 Swedish general community with prior attempt	History of SITBs		120	ADJ ^d	Death
Darke et al. (2005)	495 Australian patients with substance use disorder	Clinical		12	PTSD	Attempt
Dennehy et al. (2011)	4,360 patients with bipolar disorder	Clinical		16	Any anxiety diagnosis, PD	Attempt, death
Desai et al. (2005)	121,933 Dept. of Veterans Affairs psychiatric patients	Clinical		48	PTSD	Death
Fawcett et al. (1990)	954 inpatients with mood disorder	Clinical		120	Anxiety symptoms, OCD symptoms	Attempt
Flensborg-Madsen et al. (2009)	18,146 general Danish community	General		312	Any anxiety diagnosis	Attempt
Fridell et al. (1996)	42 Swedish inpatients with prior attempt	History of SITBs		60	Any anxiety diagnosis, ADJ	Attempt
Gallagher et al. (2014)	144 inpatients	Clinical		18	Social anxiety symptoms	Ideation
Goldstein et al. (2011)	413 patients with bipolar disorder	Clinical		60	Any anxiety diagnosis, PD	Attempt
Goldston et al. (2009)	180 inpatients	Clinical		168	GAD, PD, SPEC	Attempt
Hayashi et al. (2012)	106 Japanese inpatients with prior self-injury	History of SITBs		24	Any anxiety diagnosis	Attempt
Holma et al. (2010)	249 Finnish patients with MDD	Clinical		60	Any anxiety diagnosis, anxiety symptoms	Attempt
Hung et al. (2015)	102,454 general elderly Chinese community	General		60	Anxiety symptoms	Death
Keane et al. (1996)	134 American Indian high school students	General		6	Anxiety symptoms	Attempt
Keilp et al. (2008)	26 patients with MDD and prior attempt	History of SITBs		24	PTSD	Attempt
Kovacs et al. (1993)	183 inpatients	Clinical		144	ADJ	Ideation, attempt
Laan et al. (2011)	129,781 general Dutch community	General		120	Any anxiety diagnosis	Death
Leadholm et al. (2013)	34,671 patients with depression	Clinical		204	Any anxiety diagnosis	Death
Lewinsohn et al. (2001) (a)	539 Danish females in general community	General		144	Any anxiety diagnosis	Attempt

Author(s), year	Total N	Sample type ^a	Sample population ^b	Length of follow-up (in months)	Anxiety predictor(s)	Suicide-related outcome(s)
Lewinsohn et al. (2001) (b)	402 Danish males in general community	General	Adolescent	144	Any anxiety diagnosis	Attempt
Links et al. (2013)	180 Canadian patients with BPD	Clinical	Adult	24	PTSD	Attempt
May et al. (2012)	49 psychiatric patients with suicide ideation	History of SITBs	Adult	120	Any anxiety diagnosis	Attempt
Monnin et al. (2011)	273 French psychiatric patients with prior attempt	History of SITBs	Adult	24	PTSD	Attempt
Nimeus et al. (2000)	191 Swedish psychiatric patients with prior attempt	History of SITBs	Adult	12	ADJ	Death
Nordström et al. (1996)	54 Swedish inpatients with prior attempt	History of SITBs	Adult	72	Anxiety symptoms	Death
Preuss et al. (2003)	1,237 general community with alcohol abuse or family member with alcohol abuse	Clinical	Adult	60	PD	Attempt
Rao et al. (1993)	281 patients with depression and/or anxiety, or controls	Clinical	Adolescent	156	Any anxiety diagnosis	Death
Reinherz et al. (1995) (a)	193 females in general community	General	Adolescent	168	PTSD, SOC, SPEC, anxiety symptoms	Ideation
Reinherz et al. (1995) (b)	185 males in general community	General	Adolescent	168	PTSD, SOC, SPEC, anxiety symptoms	Ideation
Ribeiro et al. (2012)	239 psychiatric outpatients with suicidality	History of SITBs	Adult	1	PTSD, anxiety symptoms	Ideation, attempt
Riihimäki et al. (2013)	134 Finnish patients with mood disorder	Clinical	Adult	60	Any anxiety diagnosis, GAD, PD, SOC, SOM, anxiety symptoms	Attempt
Sanchez-Gistau et al. (2013)	82 Spanish patients with first-episode psychosis	Clinical	Adolescent	24	Any anxiety diagnosis	Attempt
Sani et al. (2011)	4,441 Italian psychiatric patients	Clinical	Adult	420	GAD, OCD, PD	Death
Schneider et al. (2001)	278 German patients with MDD	Clinical	Adult	60	Any anxiety diagnosis, PD, anxiety symptoms	Death
Sokero et al. (2005)	198 Finnish patients with MDD	Clinical	Adult	18	Any anxiety diagnosis AG, GAD, OCD, PD, PTSD, SOC, SPEC, anxiety symptoms	Attempt
Tidemalm et al. (2014) (a)	3,678 Swedish females with bipolar disorder	Clinical	Adult	84	Any anxiety disorder	Attempt
Tidemalm et al. (2014) (b)	2,408 Swedish males with bipolar disorder	Clinical	Adult	84	Any anxiety disorder	Attempt

Author(s), year	Total N	Sample type ^a	Sample population ^b	Length of follow-up (in months)	Anxiety predictor(s)	Suicide-related outcome(s)
Tejedor et al. (1999)	150 Spanish patients with prior attempt	History of SITBs	Adult	120	Any anxiety diagnosis, ADJ, anxiety symptoms	Attempt, death
Tuisku et al. (2014)	137 Finnish patients with mood disorder	Clinical	Adolescent	84	Anxiety symptoms	Attempt
Valtonen et al. (2006)	160 Finnish patients with bipolar disorder	Clinical	Adult	18	Any anxiety diagnosis, anxiety symptoms	Attempt
Valtonen et al. (2008)	176 Finnish patients with bipolar disorder	Clinical	Adult	18	Any anxiety diagnosis	Attempt
Wedig et al. (2012)	231 patients with BPD	Clinical	Adult	192	PTSD	Attempt
Wenzel et al. (2011)	297 inpatients with suicidality	History of SITBs	Adult	360	Any anxiety diagnosis	Death
Wolk, Weissman (1996)	226 patients with depression and/or anxiety, or controls	General	Adolescent	204	Any anxiety diagnosis	Attempt, death
Yaseen et al. (2012)	2,864 patients with past year major depressive episode	Clinical	Adult	36	GAD, SOC, SPEC, panic attack	Ideation, attempt
Yen et al. (2003)	578 patients with personality disorder	Clinical	Adult	24	PD, PTSD	Attempt

Note. ADJ=adjustment disorder; AG=agoraphobia; ANX-NOS=anxiety disorder not otherwise specified; GAD=generalized anxiety disorder; OCD=obsessive-compulsive disorder; PD=panic disorder; PDA=panic disorder with agoraphobia; PTSD=posttraumatic stress disorder; SOC=social anxiety disorder; SPEC=somatic symptom disorder.

^a General=general community; Clinical=outpatient or inpatient sample; History of SITBs=history of suicidal or nonsuicidal self-injurious thoughts and/or behaviors.

^b Refers to age of sample at baseline.

^c Although no explicit definition was provided by study authors, anxiety neuroses were distinguished from other related disorder categories (e.g., affective disorders, substance use disorders).

^d Defined by study authors as acute crisis reaction.

Table 2

Overall effect sizes for any anxiety construct (diagnosis and symptoms) predicting suicide-related outcomes.

	# of included OR cases	Overall OR (95% CI)	p value	z	I^2 (%)	# of included HR cases	Overall HR (95% CI)	p value	z	I^2 (%)
Ideation	26	1.49 (1.18, 1.88)	<.01	3.39	85.57	–	–	–	–	–
Attempt	80	1.64(1.47, 1.83)	<.001	8.90	76.97	10	1.04 (0.96, 1.11)	.36	0.93	71.20
Death	39	1.01 (0.87, 1.18)	.88	0.16	46.95	10	1.52 (1.28, 1.81)	b.001	4.79	92.94

Note. There were no HR prediction cases for suicide ideation.

Table 3

Overall Odds ratios for anxiety symptoms predicting suicide-related outcomes.

	# of included cases	Overall OR (95% CI)	p value	z	I ² (%)
Ideation	7	1.54 (1.29, 1.84)	<.001	4.72	28.38
Attempt	9	1.39 (1.17, 1.65)	<.001	3.80	83.12
Death	12	1.20 (0.95, 1.52)	.13	1.51	6.40

Table 4

Overall odds ratios for anxiety diagnoses predicting suicide-related outcomes.

	# of cases	Overall OR (95% CI)	p value	z	I ² (%)
<i>Any type of anxiety diagnosis</i>					
Ideation	19	1.45 (1.05, 2.00)	<.05	2.26	89.00
Attempt	71	1.58 (1.36, 1.84)	<.001	5.90	69.77
Death	27	0.93 (0.77, 1.13)	.48	-0.70	54.44
<i>Adjustment disorder</i>					
Attempt	4	0.33 (0.16, 0.69)	<.01	-2.94	0.00
Death	5	0.24 (0.09, 0.67)	<.01	-2.74	0.00
<i>Agoraphobia</i>					
Attempt	4	0.99 (0.55, 1.78)	.98	-0.03	0.00
<i>GAD</i>					
Ideation	2	1.70 (1.18, 2.46)	<.01	2.84	53.84
Attempt	7	1.27 (0.78, 2.08)	.34	0.96	77.94
<i>OCD</i>					
Attempt	2	0.95 (0.28, 3.18)	.93	-0.08	0.00
Death	2	0.23 (0.03, 1.69)	.15	-1.44	0.00
<i>Panic disorder</i>					
Attempt	9	1.96 (1.38, 2.79)	<.001	3.76	41.55
Death	4	1.09 (0.39, 3.04)	.87	0.16	0.00
<i>PTSD</i>					
Ideation	4	2.25 (1.46, 3.47)	<.001	3.67	50.62
Attempt	10	2.07 (1.49, 2.88)	<.001	4.31	56.87
<i>Social anxiety disorder</i>					
Ideation	4	1.38 (1.10, 1.72)	<.01	2.83	0.00
Attempt	7	1.67 (1.25, 2.23)	<.01	3.45	0.00
<i>Somatic symptoms disorder</i>					
Attempt	2	1.85 (0.88, 3.90)	.11	1.62	0.00
<i>Specific phobia</i>					
Ideation	4	1.45 (1.16, 1.81)	<.01	3.26	0.39

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	# of cases	Overall OR (95% CI)	p value	z	I ² (%)
Attempt	5	1.43 (0.91, 2.24)	.12	1.55	50.49

Note. GAD=generalized anxiety disorder; OCD=obsessive-compulsive disorder; PTSD=posttraumatic stress disorder.