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The death-implicit association test and suicide attempts: a systematic review and meta-analysis of discriminative and prospective utility

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Abstract

Suicide risk assessment involves integrating patient disclosure of suicidal ideation and non-specific risk factors such as family history, past suicidal behaviour, and psychiatric symptoms. A death version of the implicit association test (D-IAT) has been developed to provide an objective measure of the degree to which the self is affiliated with life or death. However, this has inconsistently been associated with past and future suicidal behaviour. Here, we systematically review and quantitatively synthesize the literature examining the D-IAT and suicide attempts. We searched psychINFO, Medline, EMBASE, and the Cochrane Central Register of Controlled Trials (CENTRAL) from inception until 9 February 2021 to identify publications reporting D-IAT scores and suicide attempts (PROSPERO; CRD42020194394). Using random-effects models, we calculated standardized mean differences (SMD) and odds ratios (ORs) for retrospective suicide attempts. We then calculated ORs for future suicide attempts. ORs were dichotomized using a cutoff of zero representing equipoise between self-association with life and death. Eighteen studies met our inclusion criteria ($n = 9551$). The pooled SMD revealed higher D-IAT scores in individuals with a history of suicide attempt (SMD = 0.25, 95% CI 0.15 to 0.35); however, subgroup analyses demonstrated heterogeneity with acute care settings having lower effect sizes than community settings. Dichotomized D-IAT scores discriminated those with a history of suicide attempt from those without (OR 1.38 95% CI 1.01 to 1.89) and predicted suicide attempt over a six-month follow-up period (OR 2.99 95% CI 1.45 to 6.18; six studies, $n = 781$). The D-IAT may have a supplementary role in suicide risk assessment; however, determination of acute suicide risk and related clinical decisions should not be based solely on D-IAT performance.

Introduction

Suicide is a major public health problem, accounting for a significant portion of potential years of life lost and an annual estimated mortality of 800, 000 (WHO, 2020). Suicide risk assessment relies on a combination of non-specific risk factors and the individual's self-reported suicidal ideation and intent. As such, suicide risk assessment is often imprecise and malleable. More importantly, in the absence of an objective measure, determining suicide risk relies on accurate and complete disclosure of internal processes and intent. This is important because some individuals are unaware of their own thoughts of death and suicide, or conversely, there are circumstances in which a high degree of intent may be dissimulated (Busch, Fawcett, & Jacobs, 2003; Wilson, 2009). Indeed, suicide can occur despite individuals denying suicidal thoughts or intent to health care professionals (Busch et al., 2003).

These limitations highlight the need for objective means of assessing suicide risk and internal state to complement existing suicide risk assessment tools (Roos, Sareen, & Bolton, 2013). One approach that has gained increasing research attention utilizes the principle of implicit association to identify bias using abstract mental representations (Greenwald, McGhee, & Schwartz, 1998). The psychometric principles of implicit association tests (IAT) rely on reaction times, with stronger implicit associations showing shorter latencies (Greenwald et al., 1998). Though controversial (Jost, 2019), IATs have been extensively utilized in social psychology to reveal socially unacceptable and disavowed forms of bias (for a review see: Oswald, Mitchell, Blanton, Jaccard, & Tetlock, 2013).

Nock et al. (2010) developed an IAT that assesses individual differences in associating the self with concepts of life and death. The Death-IAT (D-IAT) measures differences in reaction

times between target-concepts (Life/Death) and attribute dimensions (Self/Other) to provide a composite implicit association with death versus life, known as the difference or D-score (D-IAT score) (Greenwald, Nosek, & Banaji, 2003; Nock et al., 2010). Several studies have used the D-IAT to determine its ability to detect past and future suicidal behaviour; however, the literature is mixed. Specifically, while the majority of individuals have stronger implicit associations with life (Harrison et al., 2020), differences have been found in the strength of this association between suicide attempters and non-attempters, with non-attempters showing stronger associations with life (Glenn et al., 2017b; Harrison, Stritzke, Fay, Ellison, & Hudaib, 2014; Millner, Coppersmith, Teachman, & Nock, 2018; Podlogar, Gutierrez, & Joiner, 2020; Wang et al., 2020). However, others have failed to find a difference between D-IAT scores in suicide attempters and non-attempters (Barnes et al., 2017; Dickstein et al., 2015; Millner et al., 2019; Rath et al., 2021; Tello, Harika-Germaneau, Serra, Jaafari, & Chatard, 2020). Here, we report a systematic review of the literature examining the D-IAT and suicidal behaviour, both past and future, as well as a quantitative synthesis of this data.

Methods

This protocol was registered in the international register of prospective systematic reviews (PROSPERO; CRD42020194394 – updated 18 November 2020) and was conducted according to the Preferred Reporting Items for Systematic Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, and Altman, 2009) guidelines.

Search strategy

We searched the PsychINFO, Medline, EMBASE, and Cochrane Central Register of Controlled Trials (CENTRAL) databases from inception until 9 February 2021 (Figs. S1–S4). The search strategy included the use of the keywords 'suicide AND implicit association'. We also reviewed the reference lists of included studies to identify studies that were not captured by our search.

Selection criteria

Inclusion

(1) All sexes
(2) Any age
(3) Included the D-IAT
(4) Reported data on suicide attempts
(5) Peer reviewed
(6) English language
(7) Minimum sample of $n = 5$ per group

Exclusion

(1) Studies that did not present primary data or we were unable to obtain the data after correspondence with the author

Risk of bias

The Risk of Bias In Non-randomized Studies of Interventions (ROBINS-I; Sterne et al., 2016) grading scale was used to assess bias in cross-sectional and prospective studies. Bias due to missing data was assessed separately for baseline and follow-up measures.

Data collection

Data were extracted from eligible studies by two independent reviewers (AM and MS). Discrepancies were resolved by consensus or a third reviewer (CM). We systematically extracted the following data items:

(1) Study design
(2) Participant characteristics (e.g. age, sex)
(3) Sample size
(4) Study definition of suicide attempts
(5) Study setting (i.e. community/acute care)
(6) Prospective studies: duration of follow-up period
(7) Outcome measures:

(a) D-IAT scores (means and standard deviations) for individuals with and without a history of suicide attempt
(b) Number of participants with D-IAT scores $\geqslant 0$ with and without a history of suicide attempt
(c) Number of participants with D-IAT scores $\geqslant 0$ who attempted or did not attempt suicide over a follow-up period of six-months

(1) Percentage of population with a depressive disorder at the study level
(2) Interventions

Data analysis

Meta-analyses were performed using Comprehensive Meta-Analysis 2.0 (Biostat, USA). Analyses were conducted using random-effects models since it can be expected that the true effect of each study differs due to methodological differences such as study setting, primary diagnosis, and age of the population (Deeks, Higgins, & Altman, 2020). These models were used to pool standard mean differences (SMD) with a 95% confidence interval (95% CI) of D-IAT scores from participants with and without a history of a suicide attempt. An SMD is an effect size equivalent to Cohen's D (Faraone, 2008), where the mean difference between suicide attempters and non-attempters in each study and the pooled standard deviation are used to calculate the individual study SMD for inclusion in the random-effects model. For most studies, D-IAT < 0 represented a stronger association with life; however, in two studies the composite score was calculated differently such that D-IAT < 0 represented a stronger association with death (Harrison et al., 2014, 2018). These effect sizes were reverse coded so that here, all D-IAT scores < 0 represent a stronger association with life. A random-effects model was also used to pool categorical outcomes (D-IAT $\geqslant 0$ representing a greater association with death or < 0 representing a greater association with life, and the converse for reverse coded studies) and compute odds ratios (ORs and 95% CI) for suicide attempters both retrospectively and prospectively. *A priori* subgroup analyses examining acute care versus community settings and paediatric verusus adult samples were performed using the Q-statistic. Meta-regression analyses were conducted to assess the effect of the sex distribution and the proportion of the sample with a depressive diagnosis. The heterogeneity of studies included in these meta-analyses was assessed using Q (significance level: 0.1) and I^2 (homogenous: $< 40\%$, heterogenous: $\geqslant 40\%$) statistics (Higgins & Thompson, 2002). Publication bias was assessed qualitatively using Funnel plots and quantitatively using Egger's linear regression intercept (Egger, Smith, Schneider, & Minder, 1997).

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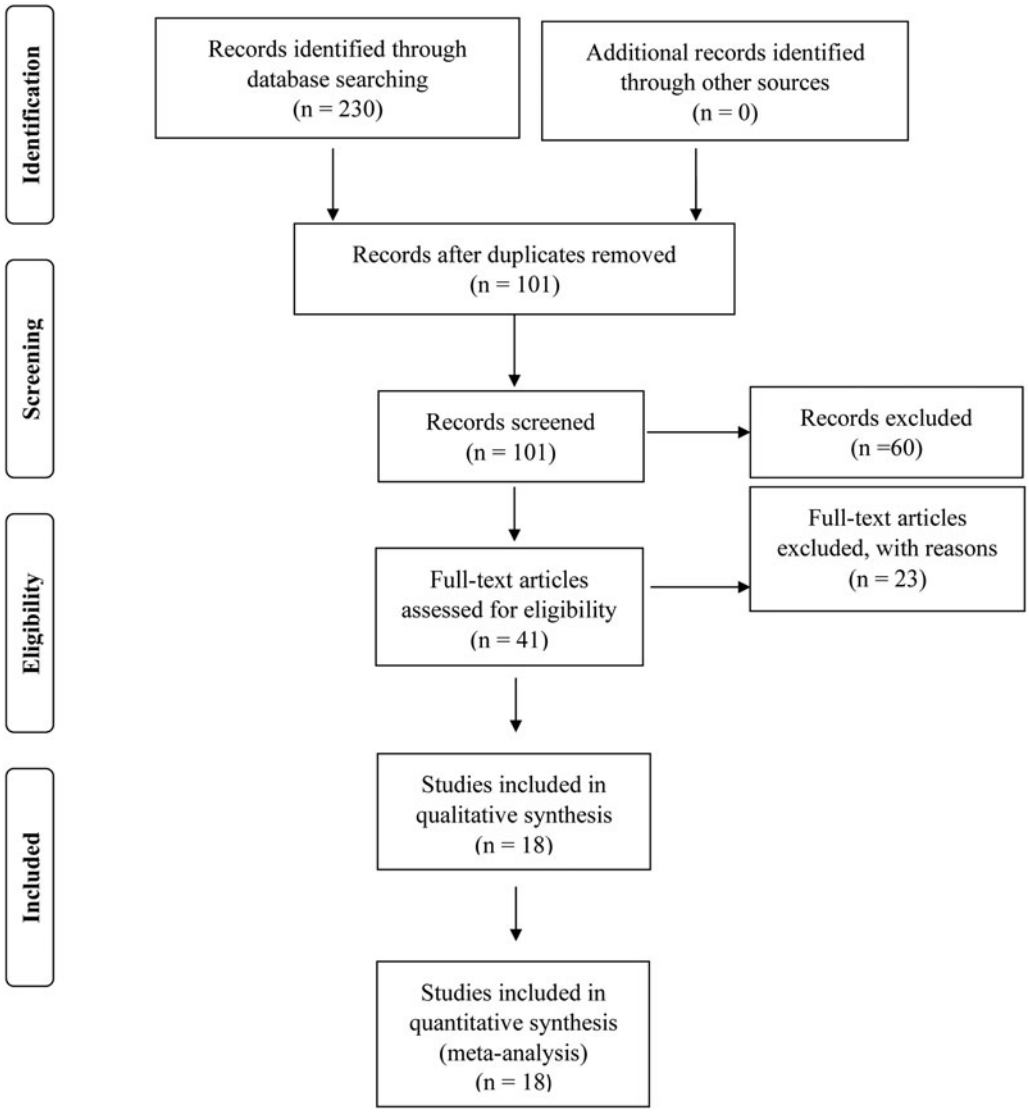

Fig. 1. PRISMA study selection chart.

Results

Literature search

The results of our literature search are detailed in online Supplementary Figs S1–S4 and summarized in Fig. 1. Reasons for full-text exclusions are presented in online Supplementary Table S1. We identified 18 studies that measured D-IAT scores and reported a history of suicide attempt cross-sectionally. Of these, seven studies also assessed the association between D-IAT scores and future suicidal behaviour and suicide attempts at three- (two studies, $n = 195$) and six-months (six studies, $n = 781$). One study only followed up at three-months (Millner et al., 2019) whereas the other followed up at both three- and six-months (Harrison, Stritzke, Fay, & Hudaib, 2018). We selected the six-month time point for meta-analysis as this represented the time point with the largest dataset for quantitative synthesis.

Characteristics of included studies

The characteristics of the 18 studies ($n = 9551$) that met our inclusion criteria are detailed in Table 1. Assessment of study quality according to ROBINS-I is presented in online Supplementary Table S2. These comprise 13 adult and 5 adolescent studies that took place in either acute care or community settings. Included studies defined a suicide attempt using the Self-Injurious Thoughts and Behaviours Interview (SITBI or SITBI-German; Barnes *et al.*, 2017; Bender *et al.*, 2019; Dickstein *et al.*, 2015; Fischer *et al.*, 2014; Glenn *et al.*, 2017a, 2017b; Harrison *et al.*, 2014, 2018; Millner *et al.*, 2018, 2019; Nock *et al.*, 2010; Nock, Holmberg, Photos, & Michel, 2007; O'Shea, Glenn, Millner, Teachman, & Nock, 2020; Rath *et al.*, 2021), the Columbia Suicide Severity Rating Scale (CSSRS; Ellis, Rufino, & Green, 2016; Posner *et al.*, 2011), or a combination of the Beck Scale for Suicidal Ideation (BSI; Beck, Brown, and Steer, 1997) and the suicidal thoughts and behaviours questionnaire-revised (SBQ-R or SBQ-R German; Glaesmer *et al.*, 2018; Osman *et al.*, 2001; Podlogar *et al.*, 2020; Rath *et al.*, 2021). Other studies defined suicide attempt based on self-report corroborated through medical records (Wang et al., 2020) or endorsement of an actual attempt on the Kiddie-Scale for Affective Disorders and Schizophrenia-Present and Lifetime (Ho et al., 2021; Kaufman et al., 1997).

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Table 1. Characteristics of included studies ($n = 18$)

Study	Design	Population	*n* (follow up *n*)	Setting	Sex (% female)	Mean age (years)	Depressive disorder (%)
Nock et al. (2010)	Cross-sectional & prospective	Adult	157 (91)	Acute care	38.2	35.5	73.9
Harrison et al. (2014)[a]	Cross-sectional	Adult	408	Community	69.9	20.4	Didn't report
Dickstein et al. (2015)	Cross-sectional	Adolescent	136	Acute care	63.3	15.7	35.6
Ellis et al. (2016)[a]	Cross-sectional	Adult	418[b]	Acute care	56.5	34.51	71.7
Barnes et al. (2017)[a]	Cross-sectional & prospective	Adult	173 (163)	Acute care	6.4	46.5	78.6%
Glenn et al. (2017a)[a]	Cross-sectional	Adolescent	276	Acute care	71.0	15.5	62.7
Glenn et al. (2017b)[a]	Cross-sectional	Adult	1970	Community	66.9	27.3	Didn't collect
Harrison et al. (2018)[a]	Cross-sectional & prospective	Adult	128 (24)	Acute care	61.7	Majority 18–34	52.3
Millner et al. (2018)[a]	Cross-sectional	Adult	1855	Community	69.6	41.1	Didn't collect
Millner et al. (2019)[a]	Cross-sectional	Adolescent	65	Acute care	67.9	15.0	84.9
Bender et al. (2019)[a]	Cross-sectional	Adult	142	Community	67.3	19.3	10.0
Glenn et al. (2019)[a]	Cross-sectional & prospective	Adolescent	141 (131)	Community	85.1	17.5	48.3
Podlogar et al. (2020)[a]	Cross-sectional	Adult	382	Community	23.6	46.2	Didn't report
Tello et al. (2020)[a]	Cross-sectional & prospective	Adult	162 (102)	Acute care	50.9	42.6	84.2
O'Shea *et al.* (2020)[a]	Cross-sectional	Adult	2533	Community	71.4	25.7	Didn't collect
Wang et al. (2020)	Cross-sectional	Adult	255	Community	71	24.8	51
Ho et al. (2021)[a]	Cross-sectional	Adolescent	53	Community	66	16.3	100
Rath et al. (2021)[a] (1)	Cross-sectional	Adult	71	Acute care	73	37.4	100
Rath et al. (2021)[a] (2)	Cross-sectional & prospective	Adult	226	Acute care	57	35.9	77

Note. Prospective studies had a follow-up period of six-months. Sample sizes are those used in meta-analysis (i.e. attempters and non-attempters) if that number differed from the full sample.
[a]Indicates data was obtained through contact with the authors. Rath (1) and (2) were published in the same manuscript.
[b]Ellis et al. (2016) presented $n = 124$ in their manuscript, the extra *n* was obtained through contact with the authors. Demographics are those presented in their manuscript since this information was unavailable for the larger sample.

All studies performed cross-sectional assessments. Six studies also explored the relation between the D-IAT and prospective suicide attempts six-months later (Barnes et al., 2017; Glenn et al., 2017a; Harrison et al., 2018; Nock et al., 2010; Rath et al., 2021; Tello et al., 2020). At follow-up, the SITBI was re-administered over the phone (Glenn et al., 2019a; Nock et al., 2010; Tello et al., 2020) and medical records were assessed (Nock et al., 2010; Tello et al., 2020). The method of follow-up was not reported in Rath et al. (2021). In two studies, follow-up characterization was limited to individuals who initially presented with suicide attempts (Nock et al., 2010; Tello et al., 2020). A total of 100 suicide attempts (12.80%; $n = 781$) were reported over the follow-up period. Online Supplemental Table S3 reports the mean D-IAT scores of suicide attempter and non-attempter groups. Across groups, only 19.44% ($n = 1767/9091$) of individuals had stronger associations with death compared to life (D-IAT $\geqslant 0$).

D-IAT scores and previous history of suicide attempts

The pooled SMD ($n = 18$ studies, $n = 9551$) revealed higher D-IAT scores in those who had attempted suicide compared to non-attempters, representing a stronger association with death (SMD = 0.25, 95% CI 0.15 to 0.35, $p < 0.001$; Fig. 2*a*). The majority of studies measured a history of suicide attempts, while one study defined suicide attempters as those who were currently presenting to the emergency department with a suicide attempt (Nock et al., 2010). Sensitivity analyses revealed a similar effect size estimate when this study is excluded (SMD = 0.24, 95% CI 0.14 to 0.35, $p < 0.001$).

There is evidence of significant heterogeneity between studies ($Q = 66.73$, $p < 0.001$, $I^2 = 71.53$). Subgroup analyses using the *Q*-statistic do not find significant heterogeneity between paediatric and adult samples ($Q = 2.41$, $p = 0.12$) but do find heterogeneity based on study setting ($Q = 14.24$, $p = 0.001$). Indeed, community settings show significant differences between suicide attempters and non-attempters (SMD = 0.40, 95% CI 0.31 to 0.50, $p < 0.001$), however, there is no evidence of the statistical separation between suicide attempters and non-attempters in acute care settings (SMD = 0.095, 95% CI −0.03 to 0.22, $p = 0.14$) (Fig. 2*b*). Meta-regression reveals a small but significant effect of sex distribution ($Q = 3.81$, $p = 0.05$), where studies with more female participants reported larger, positive SMDs. Too few studies reported psychiatric diagnoses to conduct this pre-planned comparison. Study estimate versus study precision is illustrated with a funnel plot (Fig. S5) revealing an asymmetric distribution. This is confirmed by Egger's regression intercept (Intercept = −2.16, 95% CI −3.40 to −0.93, $p = 0.002$), suggesting the presence of publication bias.

We computed ORs for previous suicidal behaviour according to the cutoff of zero, representing equipoise between life and death, for the 15 studies ($n = 9000$) for which this data was either published or obtained through contact with the authors (Table 1). Dichotomized data were unavailable for three studies (Dickstein

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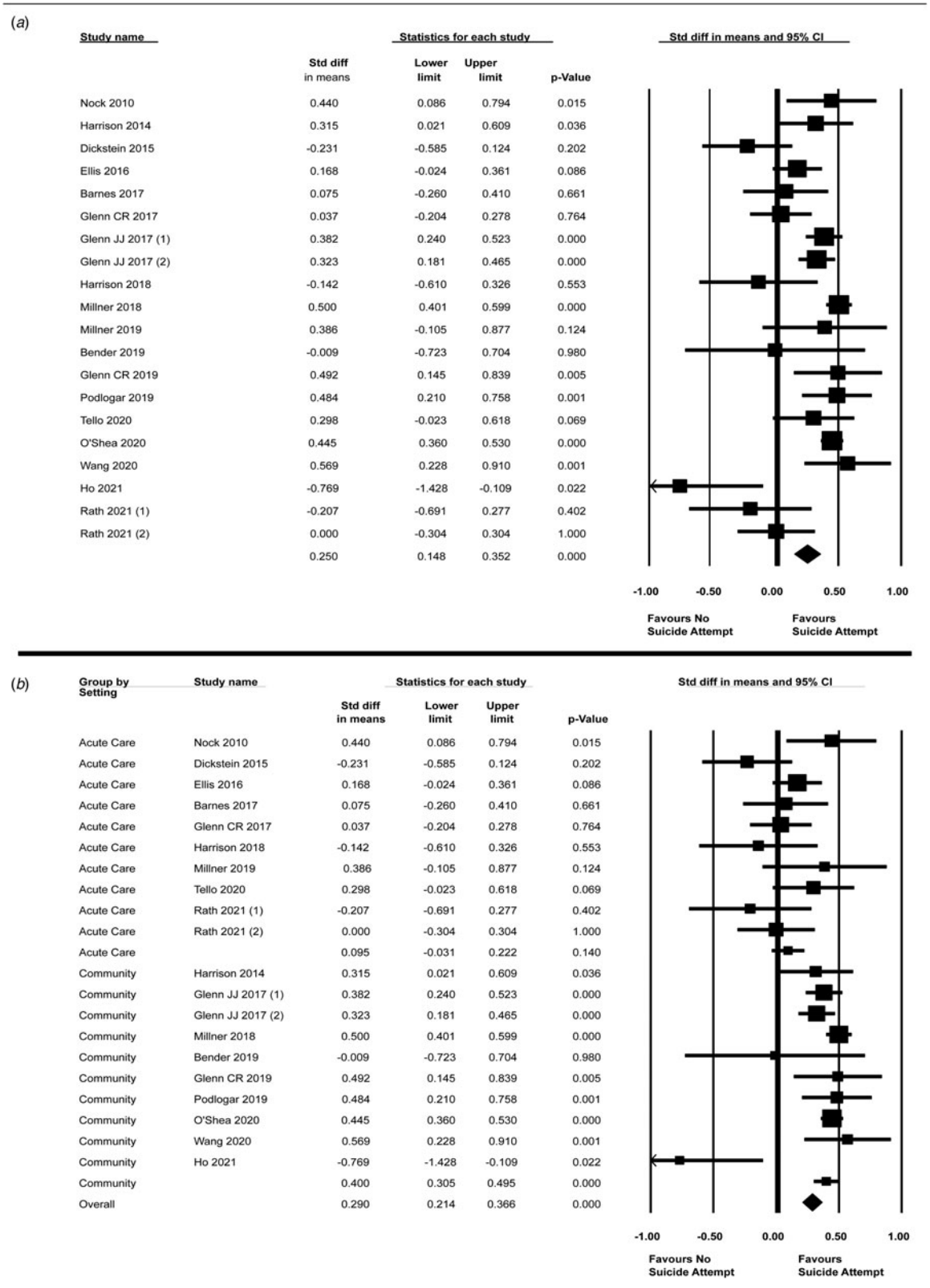

Fig. 2. Mixed-effects meta-analysis of (a) the standard mean difference (SMD) between lifetime suicide attempter and non-attempter D-IAT scores on the death implicit association test (SMD = 0.25, 95% CI 0.15 to0.35, $p < 0.001$) (b) subgroup analysis of SMD in acute care (SMD = 0.095, 95% CI −0.3 to 0.22, $p = 0.14$) *v.* community (SMD = 0.40, 95% CI 0.31 to0.50, $p < 0.001$) settings ($Q = 14.24$, $p = 0.001$). *Glenn JJ 2017 (1) and (2) represent the main and replication samples from Glenn et al. (2017b). Rath 2021 (1) and (2) represent the two samples presented in the manuscript Rath et al. (2021). D-IAT scores from Harrison et al. (2014, 2018) were reverse coded such that D-IAT < 0 represents a stronger association with life.

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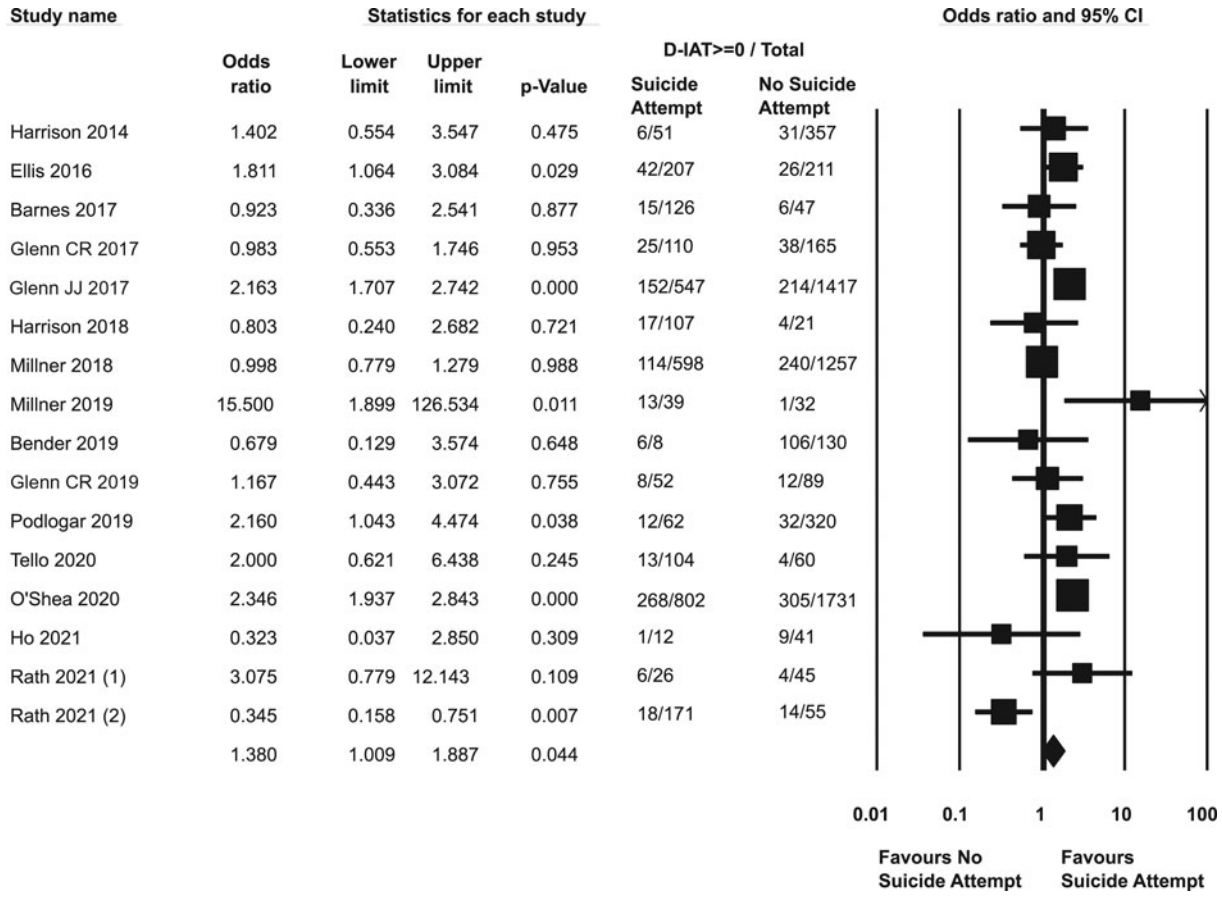

Fig. 3. A mixed-effects meta-analysis assessing the retrospective odds ratio (OR) of a lifetime suicide attempt (OR 1.38, 95% CI 1.01 to 1.89, $p = 0.04$) when D-IAT scores fall above or equal to zero. *Data for Rath 2021 (1) and (2) were presented in the same manuscript. Data from Harrison et al. (2014, 2018) was reverse coded such that D-IAT < 0 represents a stronger association with life.

et al., 2015; Nock et al., 2010; or Wang et al., 2020). Dichotomously defined D-IAT scores weakly discriminated individuals with ($n = 3022$, 33.58%) and without ($n = 5978$, 66.42%) a history of suicide attempts (OR 1.38, 95% CI 1.01 to 1.89, $p = 0.04$; Fig. 3). There was evidence of heterogeneity across studies ($Q = 64.70$, $p < 0.001$, $I^2 = 76.82$), however, subgroup analyses do not identify heterogeneity based on sample age ($Q = 0.01$, $p = 0.91$) or setting ($Q = 0.29$, $p = 0.59$). Meta-regression does not reveal significant effects of sex distribution ($Q = 0.86$, $p = 0.35$). Study estimate versus study precision for dichotomized D-IAT scores is illustrated with a funnel plot (Fig. S6) revealing an asymmetric distribution. Egger's regression intercept, however, did not reveal a significant bias (Intercept = −0.95, 95% CI −2.65 to 0.74, $p = 0.25$).

D-IAT and future suicide attempts

Data were synthesized from six studies ($n = 781$) that included a prospective examination of the D-IAT and suicide attempts ($n = 100$, 12.80%) at a six-month follow-up point (Barnes et al., 2017; Glenn, Millner, Esposito, Porter, & Nock, 2019; Harrison et al., 2018; Nock et al., 2010; Rath et al., 2021; Tello et al., 2020). These analyses revealed that D-IAT scores $\geqslant 0$ are associated with a suicide attempt over a follow-up period of six--months (OR 2.99, 95% CI 1.45 to 6.18, $p = 0.003$; Fig. 4). There is evidence for heterogeneity between studies ($Q = 8.92$, $p = 0.11$, $I^2 = 43.93$). A sensitivity analysis excluding the two studies that only followed up with suicide attempters (Nock et al., 2010; Tello et al., 2020) revealed a smaller effect size (OR 2.01, 95% CI 0.88 to4.60, $p = 0.10$) and no significant heterogeneity ($Q = 4.45$, $p = 0.22$, $I^2 = 32.62$). Study estimate versus study precision is illustrated with a funnel plot (Fig. S7) revealing an asymmetric distribution, though Egger's regression intercept does not indicate significant publication bias (intercept = 0.65, 95% CI −5.96 to 7.26, $p = 0.80$).

Discussion

To our knowledge, this is the first systematic review and meta-analysis of suicide attempts and the D-IAT, a test designed to measure implicit associations of the self with life and death. Our analyses indicate that individuals with a lifetime history of suicide attempt score higher on the D-IAT than those without a history of suicide attempt, representing a stronger implicit association with death relative to life. We did, however, observe a larger difference between attempters and non-attempters when the task was completed in the community as opposed to acute care settings, where the effect size was substantially lower. When D-IAT scores were dichotomized according to the point of equipoise between life and death, we found evidence for an association with previous suicide attempts. Moreover, prospective evidence from six studies highlighted that this dichotomy was associated

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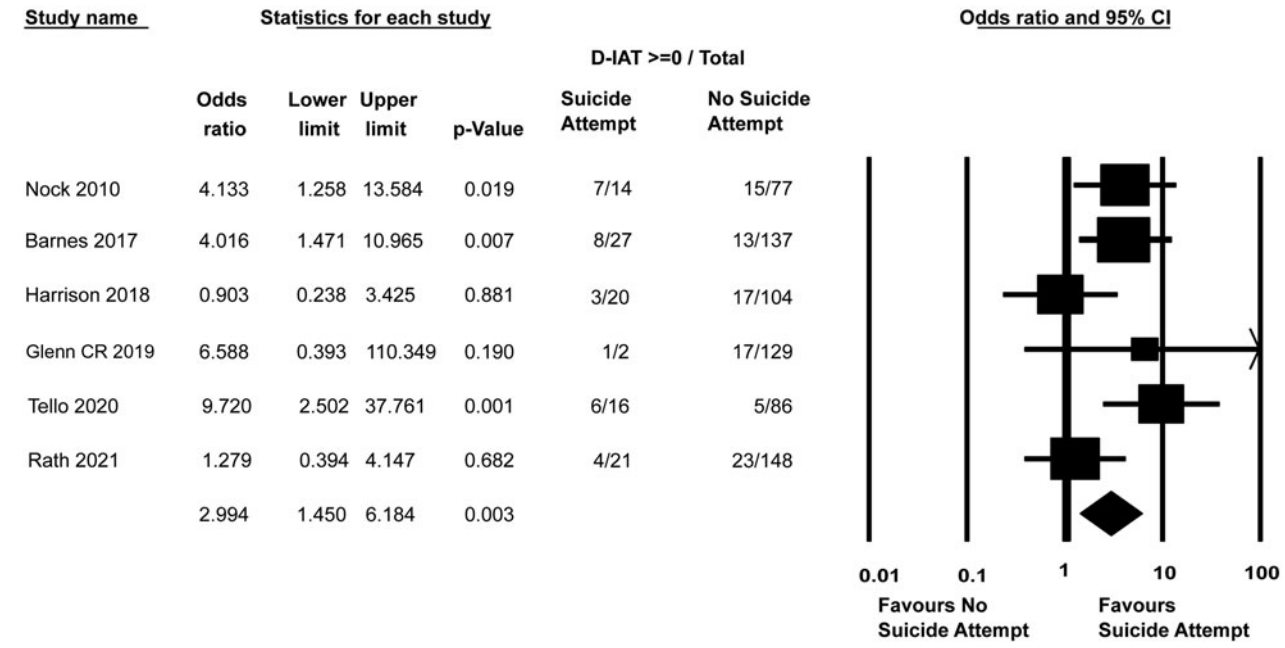

Fig. 4. A mixed-effects meta-analysis assessing the predictive odds ratio (OR) of a suicide attempt occurring within six-months when D-IAT scores fall above or equal to zero (OR 2.99, 95% CI 1.45 to 6.18, $p = 0.003$). Data from Harrison 2018 was reverse coded such that D-IAT < 0 represents a stronger association with life.

with increased odds of a suicide attempt within the next six-months.

Our analyses suggest that the D-IAT may be a useful tool for assessing suicide risk; however, the small effect size we observed, and no difference seen in acute care settings indicate that clinical decisions should not be based solely on the D-IAT in its current form. Indeed, our analyses suggest that the effect size in acute care settings is neither statistically nor clinically significant. Despite this, many of the samples followed in prospective studies in which a D-IAT score $\geqslant 0$ was associated with an increased risk of future suicide attempts were drawn from acute care settings. This apparent contradiction suggests that associating oneself with death relative to life may be a stable predictor of suicide risk, meanwhile, this reaction time-based tool may be less sensitive during a psychiatric crisis and not suitable as a dimensional indicator of suicide risk (Buyukdura, McClintock, & Croarkin, 2011; Erickson et al., 2005; Greenwald et al., 1998; Keller, Leikauf, Holt-Gosselin, Staveland, & Williams, 2019; Zhu et al., 2019). An alternative interpretation is that there is a selection bias and that the composition of acute care participants without a history of attempt nevertheless represent a population at higher risk for suicide, whereas community 'control' samples have a higher representation of individuals at low risk for suicide. In support of this, acute care control samples were predominantly composed of individuals with suicidal ideation or at high risk for suicide (Table S3). Similarly, the mental state of individuals in both attempter and non-attempter groups may differ by setting, influencing D-IAT scores. Notably, the impact of mood states on D-IAT scores has been experimentally demonstrated, with transient increases in D-IAT scores following a negative mood induction protocol (Cha et al., 2018). Accordingly, the D-IAT may be most useful to screen for suicide risk in community settings in order to identify those at risk for targeted treatment and suicide prevention.

If the D-IAT is a stable predictor of suicide risk, it may be a useful outcome for intervention studies. However, several studies suggest limited or no effect of existing treatments on D-IAT scores (Millner et al., 2019; Price, Nock, Charney, & Mathew, 2009, 2014). Though there is uncontrolled data suggesting that D-IAT scores decrease over the course of psychiatric hospitalization (Ellis et al., 2016; Glenn et al., 2017a), it is unclear whether this represents a treatment effect or practice effects. The strongest treatment data to date comes from a pair of ketamine infusion studies that suggest the D-IAT remains stable despite improvements in depressive symptoms and decreases in self-reported suicidal ideation. In an initial uncontrolled study, there was no change in D-IAT scores despite patient-reported improvements in depression and suicidal ideation after a single subanaesthetic ketamine administration (Price et al., 2009). This was followed by a randomized midazolam-controlled trial of intravenous ketamine treatment where again, D-IAT scores remained stable while explicit ratings of depressive symptoms and suicidal ideation decreased (Price et al., 2014).

As a marker of vulnerability for subsequent suicidal behaviour, future research should determine the neural basis of the D-IAT. This would inform the design of biological interventions that strengthen associations between the self and life and determine whether this is associated with lower rates of future suicidal behaviour. A limited number of studies have identified potential biomarkers of D-IAT scores (Ballard et al., 2019, 2020; Ho et al., 2018, 2021). For example, when completing the D-IAT during a functional MRI, healthy participants have higher blood-oxygen-dependent signal, during the death-me as compared to life-me blocks of the task (Ballard et al., 2019). This

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difference is largest in the bilateral anterior insula and inferior frontal gyri. Similarly, magnetic encephalography has shown differences in functional connectivity between individuals in suicidal crisis and healthy controls when associating the self with life compared to death (Ballard, Gilbert, Fields, Nugent, & Zarate, 2020). Another pair of studies demonstrated that smaller striatal grey matter volume is both negatively associated with current D-IAT scores and predicts higher D-IAT scores 2-years later (Ho et al., 2018, 2021). This literature is nascent, and future studies should consider investigating biological markers with the D-IAT to elucidate the neurobiological basis of suicide and test the malleability of D-IAT scores and subsequent suicidal behaviour.

Limitations

A significant limitation of this systematic review and quantitative synthesis is the preponderance of small studies and potential evidence of publication bias. Significant publication bias was only found for continuous reporting of the D-IAT, where smaller published studies were more likely to report small or null associations with suicide attempts (Fig. S5). Methodological and statistical heterogeneity is also observed in the included studies, in part accounted for by setting and sex distribution. By including pooled data from samples with different primary diagnoses, our pooled estimates lack specificity to one clinical population and generalizability remains to be determined. An important consideration for future individual patient data meta-analyses is to control for depressive symptoms (Ellis et al., 2016; Glenn et al., 2017a). Finally, the D-IAT provides a relative measure of association with life and death, which has certain psychometric limitations such that self-identifying with life or identifying others with death is represented similarly in the final D-IAT score. Alternative means of scoring the D-IAT to decompose 'Me' and 'Not Me' associations (O'Shea et al., 2020), and novel methods of decomposing implicit processes (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005), should be considered as this literature grows.

Conclusions

The D-IAT may have a role in supplementing suicide risk assessment, particularly in community settings where it may identify individuals to help inform suicide intervention and prevention efforts. In its current form, however, determination of acute suicide risk and related clinical decisions should not be based on the D-IAT. Additional research is required to determine whether D-IAT scores are modifiable by psychological, pharmacological, and somatic treatments, and whether this is associated with a change in suicidal behaviour.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S0033291721002117.

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Author contributions.
MS was involved in the conception of the study, performed the literature search, extracted data, contacted authors, performed meta-analyses, wrote the manuscript, and created figures. CM was involved in the conception of this study, resolved any discrepancies in studies to be included, and edited the manuscript. SB was involved in the conception of the study and edited the manuscript. AM is the guarantor, he was involved in the conception of the study, performed an independent review and extraction of the data, contacted authors, edited the manuscript, and created figures. All authors have read and approved the final manuscript.

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