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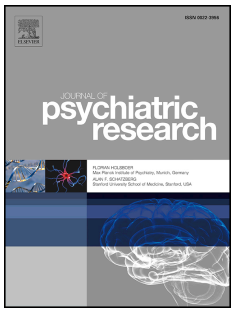

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What Distinguishes High and Low-Lethality Suicide Attempts in Older Adults? A Systematic Review and Meta-Analysis.

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Keywords

Elderly, suicide, lethality, review, meta-analysis

Abstract

Those making suicide attempts with highly lethal medical consequences are arguably the best proxy for those who die by suicide and represent a qualitatively different population from those making lower lethality attempts. Different factors influence the likelihood of a suicide attempt occurring and the lethality of that attempt. Both are important dimensions of risk. Older adults represent a distinct group in suicide research with unique risk factors that influence the lethality of their suicide attempts. This systematic review and meta-analysis summarises factors distinguishing those making high and low-lethality suicide attempts in older adults. Databases PsycINFO, PubMed (MEDLINE), Embase and CINAHL were systematically searched with seven of 1182 unique records included. Random effects meta-analyses were conducted on 18 variables in addition to a narrative synthesis regarding executive function. Only increased suicidal intent and planning meaningfully distinguished high from low-lethality attempters in meta-analyses. A large effect size was additionally observed for white ethnicity. Diminished alcohol use disorder prevalence and depression severity, and greater cognitive impairment, may be associated with high lethality attempters but further research is needed. Age and gender were not associated with lethality, contrary to adult populations. A narrative synthesis of studies exploring differences in executive functioning suggested high-lethality attempters were less likely to impulsively act on suicidal urges, allowing them to better plan suicide attempts that are more lethal, and are less likely to alter suicidal plans. Key limitations were that meta-analyses were underpowered to detect small effect sizes, and samples were largely white and limited to the US.

Death by suicide accounted an estimated 700,000 deaths worldwide in 2020 (World Health Organisation; WHO, 2021). Despite an exponential increase in the breadth of factors found to be predictive of suicide, suicide prediction remains little better than chance (Lindh et al., 2020). Furthermore, suicide rates remain stubbornly high worldwide (ONS, 2021) indicating the advances in research have not translated to clinical practice.

A confound of suicide research is the comparison of non-suicidal to suicidal individuals. A meta-analysis (May & Klonsky, 2016) found that most established risk factors for suicide are mediated by the presence of suicidal ideation, meaning they can predict suicidal ideation but do not differentiate those who think about suicide from those who act on suicidal thoughts. As such, when supporting a patient expressing suicidal thoughts, clinicians can draw on limited empirical insight when evaluating suicide attempt risk.

A second difficulty in interpreting risk factor research is the heterogeneity of suicide attempters. Suicide attempts occur on a continuum of lethality (the medical harm resulting from the attempt) with high-lethality attempters consistently shown to differ from low-lethality attempters (Gvion & Levi-Belz, 2018). For example, female sex, younger age, and higher impulsivity are associated with low-lethality attempts while the opposite characteristics are associated with high-lethality attempts (Baca-García et al., 2001; Levi-Belz, Gvion & Apter, 2020). Research that amalgamates suicide attempers as a homogenous group is therefore unable to differentiate key risk factors for the most medically serious suicide attempts, which arguably are the most accurate proxy for those who die by suicide (Gvion & Levi-Belz, 2018). As index suicide attempt lethality has been shown to be predictive of both likelihood and lethality of future suicide attempt in its' own right (Rojas et al., 2018), research that compares high to low-lethality attempters directly is vital, and the introduction of lethality risk factors into clinical risk assessment has been called for (Levi-Belz et al., 2020).

The twin confounds of the ideation-action gap and heterogeneity of suicide attempters by lethality highlight that suicide should be conceptualised along a continuum of suicidal behaviours which each have overlapping, but heterogenous risk profiles. As such, suicide attempters should not be considered a homogenous group (DeJong et al., 2010).

A group that is comparatively neglected in suicide research is older adults (WHO, 2020). The risk of suicide increases with age and the rate of suicide deaths in adults over 70 has been shown to be more than double that of 15-49 year-olds (Roth et al., 2018; WHO,

2016). The true scope of suicidality is likely to be underestimated, as older adults are less likely to report suicidal ideation and have their suicidal behaviour recognised by clinicians (Brenes et al., 2015; Schmutte & Wilkinson, 2020). Given, the ageing populations in most developed countries (Lee et al., 2018), they represent an important population for research.

In addition to the risk conferred by their age, older adults face distinct stressors comparative to their younger counterparts. Murphy et al. (2015) found proximal stressors in older adult suicide attempters included bereavement, loss of physical or cognitive function, reduced personal dignity, and financial loss. These factors are mirrored in risk factors for suicide attempts in older adults, which include disability (Cabello et al., 2020), severe physical illness (Pashkovskiy et al. 2017), and impaired decision-making and cognition (Clark et al., 2011; Jackson et al., 2020). Similarly, suicide risk factors for older adults include dementia (Choi et al., 2021), living alone (De Leo et al., 2001) and lack of a relative or friend to confide in (Turvey et al., 2002).

Relative to their middle-aged counterparts, older adults who attempt suicide have higher suicidal intent, more severe physical illness, lower quality of life, and higher likelihood of separation, divorce or widowhood (Jackson et al., 2020; Nieto et al., 1992; Pashkovskiy et al., 2018; Wiktorsson et al., 2021; Zhao et al., 2010). They have also been found to be less likely to have ingested alcohol or misuse substances prior to their attempt, and less likely to have a psychiatric diagnosis (Crandall et al., 2007; Wiktorsson et al., 2021). Impulsive and aggressive traits have also been found to be less predictive of suicide attempts in older, compared to younger, adults (McGirr et al., 2012). Additionally, Kim et al. (2021) found the most common reason given for suicide attempt in adults over 65 was physical illness, with interpersonal problems most cited in adults under 65. As such, older adults represent a distinct group with some unique suicidal risk factors and thus warrant age-specific research.

Beghi et al.'s (2021) review highlighted that the risk factors for non-fatal and fatal suicide attempts in older adults are not equivalent. Males were more likely to die by suicide, whereas females were more likely to make non-fatal suicide attempts. Almeida et al. (2016) found the most common method for fatal suicide attempt was hanging (50.7%), compared to overdose in non-fatal attempted suicide (85%), and that a history of a previous suicide attempt predicted attempted suicide but not death by suicide. Furthermore, factors such as impulsivity have been shown to be positively correlated with suicide attempt likelihood but

inversely correlated with lethality (Branley-Bell et al., 2019). As such, the risk factors for the likelihood of a suicide attempt, and the lethality of that attempt are not homogenous.

Risk is conceptualised as the likelihood of an adverse outcome combined with the perceived severity of harm (Haimes, 2009). Recent reviews have explored the risk factors for the likelihood of suicide attempts, both within general older adult populations (Troya et al., 2019), and specific older adult groups (Fässberg et al., 2016; Lutz and Fiske, 2018; Murphy et al., 2015; Szücs et al., 2018). Beghi et al. (2021) additionally reviewed the literature on fatal and non-fatal suicide attempts in older adults, but again through the framework of likelihood. The present article therefore summarises the current literature regarding the risk factors for the second dimension of suicide attempt risk (lethality), adding to the existing research base on likelihood.

The primary aim of this review was to explore the degree to which a range of studied variables could distinguish those making low and high-lethality non-fatal suicide attempts. For this review high-lethality attempts are defined as scoring four or more on the Beck Lethality Scale (BLS; Beck et al., 1975) or equivalent measure in line with convention (Szanto et al., 2015). Only studies that compare more lethal non-fatal suicide attempts to less lethal suicide attempts were included to allow identification of lethality-specific risk factors. Studies were restricted to those specifically targeting older adults who are likely to represent a distinct population. Meta-analyses were employed to synthesise findings with an additional narrative synthesis provided pertaining to executive function.

Method

This systemic review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (Moher et al., 2009) and was pre-registered on PROSPERO: the international prospective register of systematic reviews (National Institute for Health Research & University of York, 2016) registration CRD42021236552.

Search Strategy

Studies were included if a) participant's mean age was 60 or above (WHO, 2017), b) studies reported an inferential statistical group, comparison of high lethality to low-lethality non-fatal suicide attempters as distinguished by a cut-off of four on the BLS (Beck, 1975), or equivalent definition, and c) work was original and available in English language. Unpublished studies, case studies, and studies absent of peer-review were excluded. Studies

comparing non-fatal suicide attempters to fatal suicides were excluded. This decision was taken as those who make fatal and non-fatal suicide attempts have been evidenced to represent overlapping but non-homogenous groups (Han et al., 2016). As such, while a key future research question, the comparison of non-fatal to fatal suicide attempers was beyond the scope of this reviews aims.

A mean age of 60 was selected over an absolute cut-off to ensure all relevant literature was captured. The databases PsycINFO, PubMed (MEDLINE), Embase and CINAHL were searched with the search strings outlined in table 1, and concepts combined with the Boolean operator AND. Reference lists and authors of studies included in the full text review stage were additionally hand searched. Final searches were conducted in March 2022 with no publication date restrictions.

Table 1

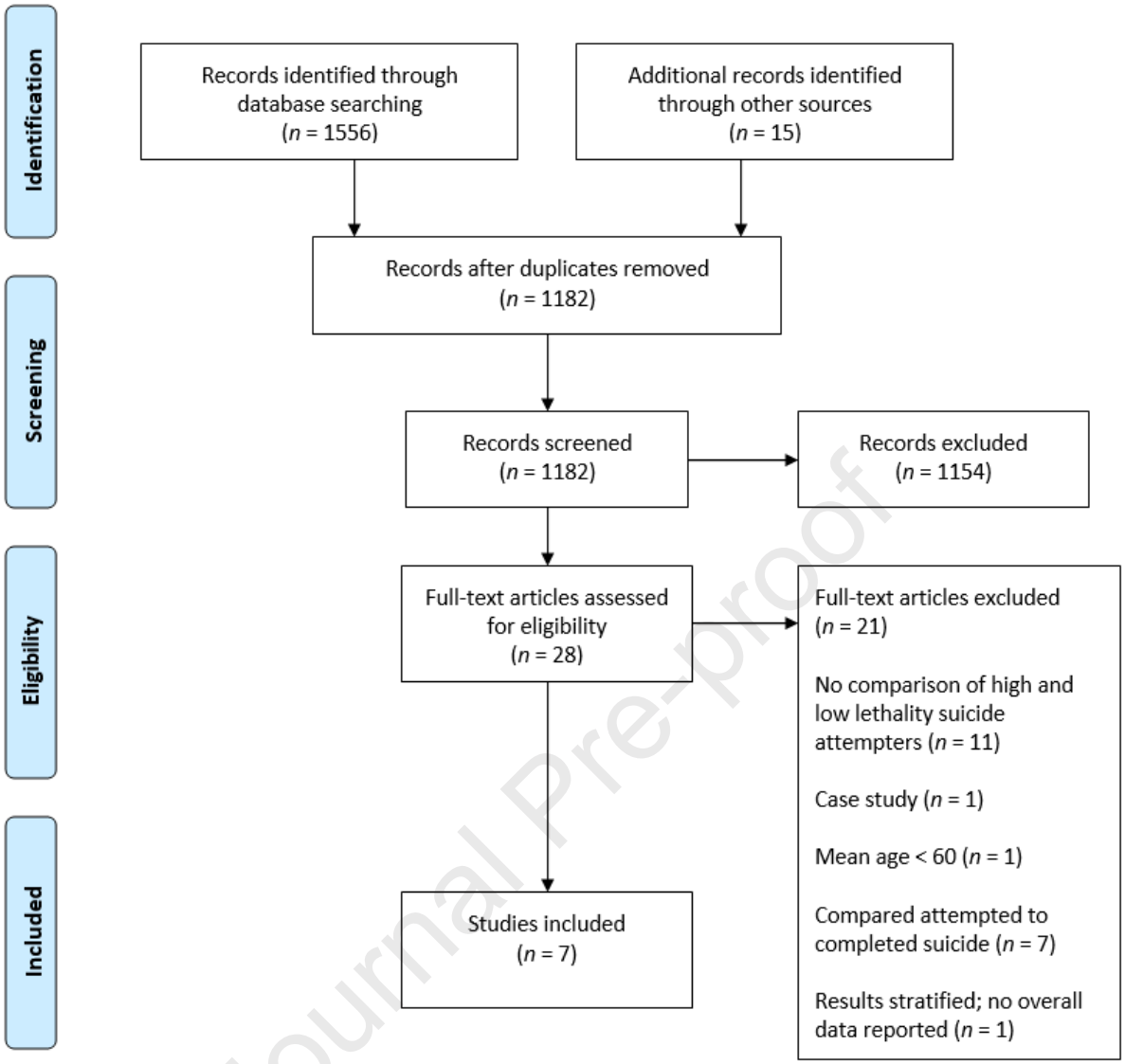
Key concepts and search terms

Concept	Search terms	Location
Suicide attempt	Suicide* N1 attempt* OR lethal* N4 self-harm OR lethal* n4 self harm OR successful N2 suicid*	Title
Lethality	(Lethal* OR sever* OR serious* OR death* OR die* OR committed or completed) N4 suicid*	Abstract
Older adult	Older adult* OR elderly OR old* age OR later N2 life	Full text

Titles and abstracts were screened by the first author with clearly irrelevant articles discarded. Full text screening, according to outlined eligibility criteria, was conducted by the first and second authors independently with 100% agreement.

Figure 1

PRISMA diagram



Appraisal of Selected Studies

No validated gold standard tool exists for quality rating or bias risk assessment in cross-sectional studies and quality rating has been shown to differ based on the tool selected (Moskalewicz & Oremus, 2020). Study quality and risk of bias was assessed using both the Newcastle-Ottowa scale (NOS; Wells et al., 2013) adapted for case control studies, in line with previous research (Herzog et al., 2013), and the Joanna Briggs Institute Critical Appraisal Checklist for Analytical Cross-Sectional Studies (Vardell & Malloy, 2013; JBI). The NOS is the most utilised quality-rating tool for non-randomised studies (Farrah et al., 2019) and the JBI is recommended specifically for cross-sectional studies (Ma et al., 2020).

The revised NOS scale was initially piloted on a randomly selected study and refined accordingly through discussion. In line with Cochrane guidance (Higgins et al., 2019), included studies were independently rated by the first and second authors. Cohen's Kappa above .80 was observed for all variables on both the NOS and JBI, indicating substantial inter-rater agreement (Cohen, 1988). Disagreements were resolved by discussion.

Statistical Analysis

Where two or more studies examining the same variable were identified, a meta-analysis was conducted following Valentine et al.'s (2010) recommendation. Data was extracted pertaining to the degree to which variables distinguished low and high-lethality suicide attempters. Effect sizes were either extracted directly or calculated from means and standard deviations, or proportions, and sample sizes. Data extraction was checked by the second author, with 100% agreement.

Meta-analysis was conducted using the software MAVIS (1.1.3). A more conservative random effects model was used as this approach accounts for true differences between studies in addition to differences between their sampled populations (Schmidt et al., 2009). Outliers were screened using visual inspection of forest plots and, where appropriate, sensitivity analysis was conducted by rerunning the meta-analysis excluding outliers. The I^2 statistic was used to assess heterogeneity for each study. An I^2 statistic of below 50% suggests little difference between studies, 50-75% percent suggests some difference and above 75% suggests considerable differences (Higgins et al., 2003). An $I^2 > 75\%$ (von Hippel, 2015) was considered unacceptable and precluded a meaningful meta-analysis.

A two-tailed retrospective power calculation for each meta-analysis was conducted using the software R (4.1.2) to provide the minimum effect size that would have been required to achieve a power of $b = 0.80$, considered adequate by convention (Valentine et al., 2010). This represents the smallest effect size required for a meta-analysis to be capable of rejecting the null hypothesis 80% of the time if an effect of that magnitude truly existed. Non-significant meta-analyses with inadequate power ($b < .80$) to detect medium ($d = .50$) effect sizes were considered inconclusive, with this threshold set a-priori.

Results

Study Characteristics

All studies were cross-sectional, dichotomously grouping high and low-lethality suicide attempters. Six studies from the USA used a cut-off score of four on the Beck Lethality Scale (Beck et al., 1975, BLS) to group participants, based on their most serious attempt. Wiktorsson et al. (2016) used hospitalization for at least 24 hours as a lethality threshold pertaining to a recent suicide attempt (median 11 days). Studies included 202 low-lethality attempters and 163 high-lethality attempters in total. Overall, 52.61% of participants were male and the mean age was 68.74.

Table 2

Study characteristics

Study (Country) Setting	Study Design	*n* Participants	Mean Age (σ) and Lower Bound Recruitment Cut-off	Variables Studied	Key Findings	Quality Rating
Dombrovski et al. 2011 (USA) Community	Cross-sectional	LLA = 14 HLA = 15	LLA = 66.1 (8.1) HLA = 67.4 (7.1) > 60 years	Decision making biases Suicidal ideation Psychiatric morbidity Global cognitive functioning Suicidal stressors Suicide attempt history	HLA scored significantly higher on suicidal intent and planning subscales, were more willing to delay future rewards and attempt planning was associated with willingness to delay rewards.	NOS: Good (8) JBI: 7
McGirr et al. 2012 (USA) Inpatient psychiatric hospital	Cross-sectional	LLA = 20 HLA = 14	LLA = 66.80 (8.15) HLA = 68.86 (7.53) > 60 years	Cognitive flexibility Suicidal ideation Global cognitive functioning Psychiatric morbidity	HLA exhibited poorer cognitive flexibility	NOS: Very good (9) JBI: 8

Richard-Devantoy et al. 2015 (USA) Psychiatric inpatient and community	Cross-sectional	LLA = 14 HLA = 17	LLA = 64.4 (3.5) HLA = 69.3 (6.5) > 60 years	Cognitive inhibition Global cognitive functioning Suicidal ideation Suicidal stressors Psychiatric morbidity	No significant differences observed between HLA and LLA attempters across any variable	NOS: Good (8) JBI: 8
Szanto et al. 2014 (USA) Psychiatric inpatient and community	Cross-sectional	LLA = 20 HLA = 26	LLA = 62.5 (6.4) HLA = 62.8 (10.1) > 42 years	Cognitive control in social decision making Suicidal ideation Impulsivity Suicidal stressors Global cognitive functioning Psychiatric morbidity	HLA exhibited higher suicidal intent HLA did not differ in rejection of high and low magnitude offers but LLA did, being less likely to reject higher magnitude offers	NOS: Good (8) JBI: 8
Szanto et al. 2015 (USA) Psychiatric inpatient and community	Cross-sectional	LLA = 29 HLA = 31	LLA = 62.0 (7.4) HLA = 64.0 (9.6) > 42 years	Susceptibility to decision biases Psychiatric Morbidity Global cognitive functioning Impulsivity Suicidal stressors Suicidal ideation Suicide attempt history	LLA more susceptible to sunk cost than HLA	NOS: Good (7) JBI: 8
Vanyukov et al. 2017 (USA) Community	Cross-sectional	LLA = 32 HLA = 32	LLA = 61.25 (7.1) HLA = 65.50 (11.0) > 42 years	Perceived burdensomeness Suicidal stressors Suicidal ideation Impulsivity Executive function Suicide attempt history Psychiatric morbidity	Perceived burdensomeness was higher in LLA HLA exhibited higher suicidal intent	NOS: Good (8) JBI: 7
Wiktorsson et al. 2016	Cross-sectional	LLA = 73 HLA = 28	LLA = 79.8 HLA = 79.5	Suicidal stressors	HLA were more likely to attribute the reason for their suicide attempt	NOS: Satisfactory (6)

(Sweden) Emergency department	σ not reported > 70 years	Global cognitive functioning Psychiatric morbidity Suicide attempt history	to social problems or impaired autonomy LLA were more likely to not give a specific reason for their suicide attempt or report wanting to die or sleep HLA had higher anxiety severity and lower global cognitive functioning	JBI: (6)

Note. LLA = low lethality suicide attempt, HLA = high lethality suicide attempt. NOS = Newcastle Ottowa Scale adapted for cross-sectional studies, an overall score of 0-4 points is equivalent to unsatisfactory, 5-6 equivalent to satisfactory, 7-8 equivalent to good and 9-10 equivalent to very good. JBI = Joanna Briggs Institute Critical Appraisal Checklist for Analytical Cross-Sectional Studies (range 0 – 8 points).

Five studies reported on ethnicity (table 3), classifying participants as white or non-white. Szanto et al. (2015) and Vanyukov et al. (2017) found a higher percentage of participants in the high-lethality group were white with large effect sizes ($p < .001$, $d = 1.14$, and $p = .003$, $d = .78$, respectively). Three further studies reported fewer white participants in the low-lethality group but as all high-lethality participants were white, effect sizes (and therefore meta-analysis) were incalculable.

Table 3

Ethnicity of participants by lethality

Study	LLA % white (n)	HLA % white (n)
Dombrovski et al., 2011	71.43 (10)	100 (15)
Richard Devontoy et al., 2015	85.71 (12)	100 (17)
Szanto et al., 2015	79.31 (23)	96.77 (30)
Szanto et al., 2014	85.00 (17)	100 (26)
Vanyukov et al., 2017	78.13 (25)	93.75 (30)
Overall	79.82 (87)	97.52 (118)

Note. LLA = low-lethality attempter, HLA = high-lethality attempter

Study Quality and Risk of Bias

Study quality ranged from very good to satisfactory on the NOS, and from six to eight points on the JBI (table 2). Only McGirr et al. (2012) justified sample size with a power calculation and only Wiktorsson et al. (2016) provided data on response rates and non-responders. The classification of suicide attempts into high- and low-lethality groups was corroborated with medical records in five studies with Szanto et al. (2015) and Wiktorsson et al. (2016) not specifically reporting attempt history corroboration. Validated instruments were used to measure primary outcomes in all studies except Wiktorsson et al. (2016) who used semi-structured interview. All studies incorporated sensitivity analysis or controlled for confounding variables. Four studies specified 60 or over as a minimum age with the means and standard deviations of the remaining three studies suggesting some adults under 60 were included.

Meta-analyses of Lethality Correlates

Results of meta-analyses are presented in table 4. The reported meta-analyses data represent the ability of each variable to distinguish high-lethality from low-lethality suicide attempters with a positive effect size indicating that the high lethality group returned a higher score on the variable studied. Meta-analyses were feasible for a total of 18 variables, 16 of which pertain to the date of assessment, with only suicidal intent and planning explored relative to the participant's suicide attempt. Meta-analyses were powered to detect a minimum of small to medium effect sizes in all variables other than intelligence, impulsivity, substance use disorder, alcohol use disorder, intensity of pharmacotherapy and planning. No analysis was powered to detect effect sizes smaller than $d = .30$.

Table 4

Meta-analysis of extracted variables

Variable	*k* Studies	*n* LLA	*n* HLA	Weighted Effect Size (*d*) [95% confidence interval]	*P* Value	% I^2	Smallest Reliably Detectable Effect size (*d*)
Age	7 Dombrovski et al., 2011 McGirr et al., 2012	202	163	0.22 [.02, .44]	.039	0.00	.30

	Richard-Devantoy et al., 2015 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017 Wiktorsson et al., 2016						
Alcohol use disorder	2 McGirr et al., 2012 Wiktorsson et al., 2016	93	42	-.33 [-.70, .04]	.080	0.00	.54
Burden of medical illness	4 Richard-Devantoy et al., 2015 Vanyukov et al., 2017 Dombrovski et al., 2011 Wiktorsson et al., 2016	133	92	-.12 [-.39, .16]	.619	0.00	.39
Depression severity	7 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017 Dombrovski et al., 2011 McGirr et al., 2012 Richard-Devantoy et al., 2015 Wiktorsson et al., 2016	202	163	-.19 [-.41, .03]	.090	5.38	.31
Education years	6 McGirr et al., 2012 Richard-Devantoy et al., 2015 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017 Dombrovski et al., 2011	129	135	-.23 [-.49, .04]	.097	14.86	.38
Gender (Male)	7 Wiktorsson et al., 2016 Dombrovski et al., 2011 McGirr et al., 2012 Richard-Devantoy et al., 2015 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017	202	163	.06 [-.15, .27]	.575	0.00	.40
Global cognitive functioning	7 Szanto et al., 2014 Szanto et al., 2015 McGirr et al., 2012 Richard-Devantoy et al., 2015 Dombrovski et al., 2011 Vanyukov et al., 2017 Wiktorsson et al., 2016	202	163	-.19 [-.45, .07]	.155	29.86	.42

Impulsivity	3 Szanto et al., 2014 Vanyukov et al., 2017 Szanto et al., 2015	81	89	-.09 [-.49, .32]	.637	43.47	.59
Intelligence	2 Szanto et al., 2015 Vanyukov et al., 2017	61	63	-.02 [-.37, .33]	.918	0.00	.51
Intensity of pharmaco-therapy	4 Wiktorsson et al., 2016 Dombrovski et al., 2011 McGirr et al., 2012 Szanto et al., 2015	136	88	.16 [-.25, .58]	.441	51.66	.57
Interpersonal aggression	3 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017	81	89	-.16 [-.47, .14]	.287	0.00	.44
Interpersonal ambivalence	3 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017	81	89	-.10 [-.40, .20]	.512	0.00	.44
Interpersonal sensitivity	3 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017	81	89	-.20 [-.50, .10]	.200	0.00	.44
Substance use disorder (at assessment)	3 Szanto et al., 2015 Dombrovski et al., 2011 McGirr et al., 2012	63	60	-.17 [-.53, .19]	.353	0.00	.52
Substance use disorder (lifetime)	4 Richard-Devantoy et al., 2015 Santo et al., 2015 Vanyukov et al., 2017 Dombrovski et al., 2011	89	95	-.12 [-.41, .17]	.409	0.00	.42
Suicidal ideation	5 Szanto et al., 2014 Szanto et al., 2015 Vanyukov et al., 2017 McGirr et al., 2012 Richard-Devantoy et al., 2015	115	120	.14 [-.12, .40]	.283	0.00	.37
Suicidal intent	6 Richard-Devantoy et al., 2015 Szanto et al., 2015	129	135	.69 [.33, 1.05]	<.001	50.02	.49

	McGirr et al., 2012 Dombrovski et al., 2011 Szanto et al., 2014 Vanyukov et al., 2017						
Suicidal planning	3 Dombrovski et al., 2011 Vanyukov et al., 2017 Szanto et al., 2015	75	78	.73 [.40, 1.06]	<.001	0.00	.80

Note. LLA = low lethality suicide attempter, HLA = high lethality suicide attempter. d > 0 indicates a higher weighted mean variable score in the HLA group. Large effects are indicated by d ≥ .80, with medium, small and negligible effects corresponding to .50 - .79, .20 - .49 and ≤ .20 respectively (Cohen, 1988).

Sociodemographic Characteristics

Meta-analyses found no significant difference between high and low-lethality groups for gender. As only one study (Wiktorsson et al., 2016) found a greater proportion of females in the high-lethality group, meta-analysis was repeated with this study excluded. Gender remained un-associated with lethality (p = .235, d = .15 [-.10, .39], I^2 = 0%). High-lethality attempters were older with a small effect size. Meta-analyses of pre-morbid intelligence and education years were underpowered and non-significant. However, effect size confidence intervals suggested high-lethality attempters had attended more education years with a negligible to small effect.

Psychiatric Morbidity

Effect size confidence intervals suggested lower depression severity in high-lethality attempters, ranging from a negligible to small effect, although not reaching statistical significance. Meta-analyses of intensity of pharmacotherapy and prevalence of alcohol and substance use disorders (both lifetime and at assessment) were underpowered (and non-significant), but confidence intervals suggested a reduced prevalence of alcohol use disorder in high-lethality attempters, with a negligible to medium effect size range.

Global Cognitive Functioning and Impulsivity

Effect size confidence intervals suggested poorer global cognitive functioning in high-lethality attempters with a negligible to small effect size range, although not reaching statistical significance. Four studies (Szanto et al., 2014, Szanto et al., 2015, McGirr et al., 2012 and Richard Devontay et al., 2015) excluded participants based on low mini mental state examination scores (< 24). To investigate the possibility of a threshold effect, meta-analysis was repeated including only the three studies with no cognitive exclusion criteria

(Dombrovski et al., 2011, Vanyukov et al., 2017 and Wiktosson et al., 2016). The pattern of results did not differ (p = .207, d = -.28 [-.60, .001], I^2 = 48.92%) indicating a negligible to medium effect size range. Meta-analysis of trait impulsivity was underpowered with a negligible effect size.

Suicidal Ideation

Suicidal ideation was measured at the time of assessment with the Scale of Suicidal Ideation (Beck et al., 1979) by all included studies. Suicidal intent was measured pertaining to participants most lethal lifetime suicide attempt using the Suicidal Intent Scale (Beck et al., 1974) with the planning subscale specifically reported in three studies. Meta-analyses found suicidal ideation was not associated with lethality but both suicidal intent and planning scores were higher in high-lethality attempters with medium effect sizes.

Stressors

Meta-analysis suggested no association between medical illness burden and lethality with an additional study by Szanto et al. (2014) reporting no effect of medical illness burden. Meta-analyses found no significant association between lethality and the three subscales of the Inventory of Interpersonal Problems (IIP-15, Horowitz et al., 1988) although all suggested greater interpersonal impairment in low-lethality attempters, with effect size confidence intervals ranging from negligible to medium for the interpersonal sensitivity dimension. Interpersonal sensitivity refers to affectivity and reactivity, for example struggling to tolerate rejection or criticism (Pilkonis et al., 1996). Interpersonal ambivalence indicates a difficulty in collaboration, tolerating authority or supporting other's achievements while interpersonal aggression refers to overt or covert hostility towards others.

Narrative Synthesis of Executive Function

Six studies explored distinct facets of executive functioning. Conceptually, the heterogeneity of the sub-dimensions that were explored suggested there was little value in a combined meta-analysis. Indeed, for the five studies reporting data that could be practically included in a meta-analysis (Dombrovski et al., 2011, McGirr et al., 2012, Richard-Devontoy et al., 2015, Szanto et al., 2015 and Vanyukov et al., 2017), an unacceptable degree of heterogeneity (I^2 = 87.45) existed, suggesting studies could not be meaningfully combined. Therefore, a narrative synthesis was conducted.

Vanyukov et al. (2017) compared scores on the Executive Interview (Royall et al., 1992; EXIT), a broad assessment of executive functioning, and found no difference between high and low lethality suicide attempters (p = .298, d = 0.26). McGirr et al. (2012) used the Wisconsin Card Sorting Test (Kongs et al., 2000), finding low-lethality attempters made fewer errors and fewer preservative errors. High-lethality attempters were less able to flexibly shift their responses to adapt to new rules and demonstrated poorer conceptual understanding of the task.

Szanto et al. (2015) examined susceptibility to decision biases using the Adult-Decision Making Competence Scale (de Bruin et al., 2007). They found that that low-lethality attempters were more susceptible to sunk cost biases, chasing unrecoverable losses (p < .002, d = .84). As the test of sunk cost bias is more influenced by negative affect such as anger and anxiety (Coleman, 2010; Moon et al., 2003) than the three other decision domains investigated, the authors concluded that high-lethality attempters were less influenced by negative affect in their decision-making process.

Dombrovski et al. (2011) found that high lethality attempters exhibited a greater preference for larger but delayed financial rewards, compared to low lethality attempters who preferred immediate but smaller rewards (p < .001, d = 1.37), using Kirby's Monetary Choice Questionnaire (Kirby, 1999; MCQ). Richard Devontay et al. (2015) utilised the Color-Word Interference (CWIT) subtest of the Delis–Kaplan Executive Function System (Delis, 2001, DKEFS), finding that high-lethality attempters took longer to complete the inhibition condition but with fewer uncorrected errors but that these differences did not reach significance.

Szanto et al. (2014) investigated differences in self-perceived unfairness in decision making between high and low-lethality attempers using the ultimatum game paradigm (Güth et al., 1982; UG). An interaction between group and offer magnitude suggested that while low-lethality attempters were less likely to reject unfair offers as the total reward increased, high lethality attempters continued to reject unfair offers regardless of the total reward (p < .001). High-lethality attempters consequently received less rewards than their low-lethality counterparts. Post-hoc analysis found that low but not high-lethality attempters perceived higher magnitude offers as fairer.

Discussion

This review aimed to explore the degree to which a range of studied variables could distinguish those making low and high-lethality non-fatal suicide attempts. Study quality was generally rated as high, and risk of bias was well accounted for by a combination of statistical analysis of cofounds in individual studies and sensitivity analysis within meta-analytical review. Candidate lethality risk factors are summarised, drawing upon both meta-analyses and a narrative synthesis of studies exploring executive function.

Summary of Lethality Risk Factors

Meta-analyses statistically significantly distinguished high and low-lethality attempters on only three variables: age (small effect) and suicidal intent and planning (medium effects). White ethnicity was also consistently associated with high-lethality attempters with a large effect size in all studies identified in this review. Although not reaching statistical significance, meta-analysis confidence intervals suggested lower alcohol use disorder prevalence, more impaired global cognitive functioning, lower depression severity, fewer education years and less severe interpersonal difficulties may be associated with higher lethality attempts. Meta-analyses suggested no association between lethality and gender, substance use disorder prevalence, or medical illness burden, while meta-analyses of intelligence, impulsivity and pharmacotherapeutic intensity were underpowered, limiting the interpretability of non-significant findings.

A narrative synthesis of studies exploring executive function found differences between high and low-lethality attempters across a range of domains, with high-lethality attempters less prone to emotional biases and better able to delay gratification, while also displaying poorer performance in flexibility with deficits observed in the ability to shift their thinking and responses to adapt to new information.

Implications for Theory and Directions for Future Research

Sociodemographic Variables

Two sociodemographic characteristics differentiated low and high-lethality attempters, age and ethnicity. High lethality attempters were older, although this effect was small. In adults, those who die by suicide have been shown to be older than those making non-fatal suicide attempts (Beautrais, 2001), and adolescents and young adults have been shown to make less lethal attempts than their middle-aged counterparts (Fushimi et al., 2006). However, Kim et al. (2021) found attempt lethality did not differ in those over verses under 65 and both Kang et al. (2019) and Jackson et al. (2020) found ageing did not predict lethality

in older adults specifically (but did in middle aged adults). However, in these studies, and in our review, age refers to the time of participation rather than the age at which the attempt occurred. Given the average age of participants in our review was 68.74, and three studies included participants under 60, it is possible that the small effect of age is explained by attempts that occurred before the age of 60. As such, there is little evidence that lethality continues to increase with age in older adulthood.

The overall proportion of participants with white ethnicity followed population trends for low-lethality participants given 59.8% of the US population is white (US Census Bureau, 2021) and suicide rates in over 65s of white ethnicity were 1.12 times higher than the population overall (Centers for Disease Control and Prevention). However, the high lethality group was almost entirely white representing a large effect size. Attitudes, expression of ideation, stigma, stressors, and protective factors have been shown to vary across cultures (Stack & Kposowa, 2016), with different meanings attached to suicidal behaviours. For example, the moral acceptability of suicide has been shown to predict suicidal plans, suicide attempts and suicide deaths and individual and national levels (Cutright & Fernquist, 2004; Joe et al., 2007; Feigelman et al., 2014). It would therefore be unlikely that these cultural variations would not play a role in the development of suicidal intent and planning in older adults, which the present review did find to be associated with lethality. Given the lack of ethnic diversity in included studies, further research exploring cultural risk factor interactions, and lethality risk factors in non-white populations is indicated.

Male sex showed negligible and non-significant association with lethality in the present meta-analysis. Conversely, suicide death rates have been found to be higher in adult males compared to females and males have been found to make more lethal attempts in adulthood (Choo et al., 2019; Han et al., 2016). By way of explanation, one might expect a relatively greater proportion of the most serious male suicide attempters to have died before older adulthood, either from suicide directly or from the plethora of poor health outcomes related to serious suicide attempts (Demesmaeker et al., 2021). This is plausible given that men make disproportionately more lethal attempts in adulthood (Pavarin et al., 2014) and index attempt lethality is associated with future death by suicide and future attempt lethality (Giner et al., 2014; Trakhtenbrot et al., 2016). As such, the association of sex with suicide attempt lethality may be expected to weaken with age as found in our analysis.

Given male gender does not appear to differentiate high and low-lethality attempters in older adulthood but is considerably more common in those who die by suicide (Beghi et

al., 2021), the risk of suicide conferred by male sex appears to be operationalised in the transition from serious attempt to suicide death. Furthermore, the majority of those who die by suicide do so on their first attempt (Yook et al., 2021), and are therefore not included in studies of suicide attempters. As such, suicidal behaviours should be conceptualised as non-homogenous, with distinct risk profiles predicting the transition from low-lethality to high-lethality attempt, and from high-lethality attempt to death by suicide. Research considering the mechanisms underlying the discrepancy between the ability of gender to differentiate those who attempt, and die by, suicide, and inability to differentiate those making low and high-lethality suicide attempts is warranted. Furthermore, the exemplar of gender poses the question of the generalisability of other trait suicide risk factors from adults to older adults, as the more lethal or prevalent the risk factor, the less likely those individuals may be to survive into older adulthood; a paradigm warranting additional focus.

Psychiatric Morbidity and Suicidal Stressors

No measure of psychiatric morbidity or distress was associated with increased lethality in our meta-analysis. Indeed, confidence intervals suggested depression severity and alcohol use disorder prevalence may be lower in high-lethality attempters. Although caution should be taken in the weight given to underpowered null findings, the observed pattern is consistent with contemporary ideation-action theories of suicide that suggest the presence and intensity of internal psychological distress contributes to the development of suicidal ideation but does not predict the transition to suicide attempt (Joiner; 2005; O'Connor, 2011). Congruently, in the present meta-analysis, suicidal ideation was not associated with lethality although it should be caveated that suicidal ideation was measured at the time of assessment, rather than being relative to the index attempt used to group participants by lethality.

Alcohol use disorder has been consistently associated with increased suicide and suicide attempt risk comparative to non-suicidal controls (Levi-Belz et al., 2020), and differentiated ideators and attempters in May and Klonsky's (2016) meta-analysis. However, a review by Gvion et al. (2018) highlighted a lack of research directly comparing more to less lethal suicide attempters. Connor et al. (2003) found elevated levels of alcohol dependency in both medically serious suicide attempters, and suicide deaths compared to non-suicidal controls, but that a lower proportion of those dying by suicide were alcohol dependant than those making medically serious, non-fatal attempts. As such, alcohol use disorder may represent a risk factor for the likelihood of a suicide attempt, but attempts influenced by alcohol may be relatively less lethal in older adults; contrary to the dominant contemporary

narrative (Gvion et al., 2018). However, given the paucity of studies, further research is needed.

Meta-analysis found physical illness burden did not differ between high and low lethality attempters despite being cited as an explanation for the increased suicide rates in older adults. Meta-analysis confidence intervals did however suggest a greater degree of impairment in global cognitive functioning in high-lethality attempters, possibly suggesting that cognitive, but not physical, impairment may be a driver of lethality.

Meta-analyses suggested interpersonal difficulties, and interpersonal sensitivity (increased affectivity and reactivity to interpersonal cues) in particular, may be more pronounced in low lethality attempters. This may suggest that those making low-lethality attempts more often do so in response to intense interpersonal distress. Vanyukov et al. (2017) found perceived burdensomeness, a key hypothesised driver of acting on suicidal thoughts (Joiner et al., 2005) was lower in high lethality attempters and was negatively correlated with planning. This suggests that low lethality attempters may reactively attempt unplanned (and therefore less lethal) suicide in response to more intensely experienced interpersonal distress while high-lethality attempters make less reactive and better planned attempts. This is congruent with the high prevalence of non-fatal suicide attempts observed in individuals diagnosed with personality disorders, characterised by interpersonal and emotional reactivity, relative to the finding that up to 80.2% of those making a fatal suicide attempt do so on their first attempt (Söderholm et al., 2020; Yook et al., 2021). However, as few studies were available, research testing the hypothesis that interpersonal distress is more likely to drive low-lethality attempts specifically is required.

Executive Function, Suicidal Intent, and Planning

Suicidal behaviour has previously been robustly linked to diminished problem-solving abilities, impaired executive function, and impaired decision making in older adults (Conejero et al., 2018; Perrain et al., 2021), while the suicidal act can be considered as a solution to unbearable internal distress (Gibbs et al., 2009; Harrison et al., 2010). Studies in our narrative synthesis examining executive function supported a two part-theory that a) high-lethality suicide attempters are less prone to acting on suicidal urges driven by emotional distress and thus, their attempts are likely to be better planned and more lethal and b) cognitive inflexibility in high-lethality attempters may leave them less likely to find

alternative solutions to their distress once a suicidal plan has been conceptualised, and less likely to alter their suicidal plan once it has been made.

Szanto et al. (2015) found attempters in the high-lethality group were less likely to be unduly influenced by negative affect (anger and anxiety) and were less likely to chase irrecoverable losses, which has been linked to rumination on painful past experiences (Van Putten et al., 2010). Dombrovski et al. (2011) found high-lethality attempters were also better able to delay gratification for greater future rewards, contrary to the immediate outcome focus exhibited by low-lethality attempters verses non-suicidal controls in Baek et al.'s (2017) study. As such, high-lethality attempters appear better able to resist both aversive and rewarding immediate behavioural drivers in the service of future goals. Given our meta-analytical finding that both suicidal intent and planning were associated with high-lethality attempters, and greater interpersonal sensitivity was associated with low-lethality attempters, we hypothesise that high-lethality attempters specifically, better resist immediate (emotional) suicidal urges; enabling delayed, better planned attempts that are more likely to be lethal. Congruent with this theory, persistence in painful tasks has been shown to be more pronounced in attempters compared to ideators (Anestis et al., 2016; Law et al., 2017), suggesting the ability to ignore aversive sensory and emotional experiences might move one further along the suicidal continuum.

Supportive of the second half of this theory regarding cognitive inflexibility in high lethality attempters, Szanto et al. (2014) found high lethality attempters did not adaptively alter their perception of fairness or rejection behaviour with offer magnitude, despite being less well rewarded. Congruently, McGirr et al. (2012) found high lethality attempters struggled to adapt to new task rules, further suggesting cognitive inflexibility and Richard-Devontay et al. (2015) found high lethality attempters made fewer errors but took longer in a task testing cognitive inhibition, suggesting a slower but more deliberate approach. Diminished problem solving (or generation of alternative solutions) has been consistently associated with suicidality (Conejero et al., 2018) and the inability to modify choices has been found in high-lethality verses low-lethality attempters specifically (Gvion and Levi-Belz, 2018). As such, we hypothesise once a suicidal plan has been made, high lethality attempters may be less likely to find an alternative solution to their distress and less likely to be dissuaded from their plan by emotional cues.

Further supporting this theorem, impaired decision-making (a component of executive functioning) has been found to be associated with more violent suicidal methods (Gorlyn et

al., 2013; Jollant et al., 2005; Wyart et al., 2016). Additionally, the association between executive function impairment and lifetime suicidality is strongest with task variations with more certain outcome probabilities (Deisenhammer et al., 2018), mirroring the certainty provided by the methods used in the most lethal and violent suicide attempts. Furthermore, Useda et al. (2007) evidenced that those making lethal suicide attempts had higher trait conscientiousness (associated with impulse control, planning and inflexibility) than treatment seeking suicide attempters in a sample of adults aged over 50. Sastre-Buades et al.'s (2021) review concludes impaired decision making in suicidal individuals is also stable trait, further suggesting high and low-lethality attempters are distinct populations with distinct attempt mechanisms. However, as participants were tested after their suicide attempt, one might argue that the suicidal act itself habituates one to emotional distress in line with acquired capability theories (Joiner, 2005). We therefore assert that the theory that high and low lethality attempters represent distinct populations with high lethality attempters making less reactive, better planned attempts that are less likely to be interrupted or aborted, represents an intriguing avenue for future research and may benefit from longitudinal exploration.

Clinical Implications

Clinicians should be aware that older adult suicide attempters are not a homogenous group. White ethnicity, suicidal intent, and planning may be risk factors for higher lethality attempts, while gender and further ageing may not increase suicide attempt lethality in older adults. Clinicians should be aware that lethality risk factors for older adults may not be equivalent to those in adults. Older adults who appear more reactive to situational or emotional stressors, or those with high levels of alcohol use or depression severity, may be more prone to lower lethality suicide attempts, while those most at risk of high-lethality attempts may appear less reactive and their risk underestimated.

Strengths and Limitations

This review benefitted from its systematic design, detailed review of included studies, and to the authors knowledge is the first review reporting a meta-analysis of lethality risk factors in older adults. Although variables that independently and meaningfully distinguished high and low lethality attempters are likely to have been captured, meta-analyses are limited in their ability to comment in detail on small effect sizes. While quality was generally high, the studies, and by extension the findings this review, are cross-sectional and have limited ability to infer causality. Furthermore, only suicidal intent and planning were explored

relative to the suicide attempt itself and all other variables refer to time of assessment rather than at the time of the attempt. Three studies included participants aged below 60 and the sample of high-lethality attempters was almost exclusively white, with six of seven studies from the USA, limiting the generalisability to non-white-American populations. Those dying by suicide were excluded by design and in the context of evidence that non-fatal and fatal suicide attempters are not homogenous groups, care should be taken in generalising these findings to suicide deaths.

Conclusions

Very few trait factors were associated with lethality. Male gender was not associated with lethality contrary to a higher male: female ratio in suicide deaths, indicating high lethality attempters and those dying by suicide are not homogenous groups. Increased suicide attempt lethality in older adults is unlikely to be explained by physical or mental disease burden. High lethality attempters were more likely to be white and endorse a higher degree of intent and planning in their attempt. High and low-lethality attempters may have different pathways to attempt with tentative evidence suggesting high lethality attempters may be less prone to acting impulsively on suicidal urges, and less likely to deviate from suicidal plans. Future research should strive to explore these theories, in addition to identifying what differentiates high and low-lethality attempts within an individual, exploring proximal risk factors, and aiming to incorporate cultural factors into contemporary models of suicide. Alcohol use disorder, depression severity, and global cognitive functioning are promising candidate variables for future research.

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Conflict of Interests Statement

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