University of Glasgow

Stopforth, Daniel Jon (2022) *Investigating the role of alcohol-related factors on suicide.* D Clin Psy thesis.

https://theses.gla.ac.uk/82907/

Investigating the role of alcohol-related factors on suicide.

Daniel Jon Stopforth, BSc Hons, MSc, PgCert.

Submitted in partial fulfilment of the requirements for the degree of

Doctorate in Clinical Psychology

Institute of Health and Wellbeing

College of Medical, Veterinary and Life Sciences

University of Glasgow

May 2022

Contents

Lists of Tables

List of Figures

Acknowledgements

I would like to give very special thanks to Dr Jack Melson who was wonderfully supportive, considerate, and reassuring throughout. I am also grateful to Professor Rory O'Connor who provided valuable comments at such short notice.

I would not have made it through training without my beautiful fianceé, Tonje. Thank you.

And finally thank you to my friends and family who have supported me on this long journey.

Alcohol-related psychological factors and suicide risk: a systematic review

Prepared in accordance with the author requirements for BMC Psychiatry

(Appendix 1.1; https://bmcpsychiatry.biomedcentral.com/submission-guidelines/aims-and-scope)

Abstract

Background: There is a strong association between alcohol misuse and suicide. A number of psychological models of suicide propose different alcohol-related psychological factors that may account for this association. However, the extent to which these factors have been empirically tested is unclear.

Aims: To systematically review and synthesise findings reported in peer-reviewed articles which investigate alcohol-related psychological factors and their relationship with suicide outcomes.

Methods: An electronic database search was performed using Medline, PsycInfo and PsycArticles from date of inception to 6th of August 2021, using key words synonymous with alcohol misuse, alcohol-related suicide outcomes, and suicide ideation and suicide. A range of inclusion and exclusion criteria were applied and the 'Appraisal tool for Cross-Sectional Studies' was used to assess study quality.

Results: A total of 25 studies were included in the review, reporting 11 different alcohol-related psychological factors in relation to suicide outcomes (suicidal ideation, attempts, planning, and suicide death). Alcohol-related psychological factors included drinking motives, alcohol-related problems, and alcohol-expectancies. Drinking to cope was most studied with prospective findings suggesting it can predict suicide attempt through depressive symptoms. Alcohol-related problems were the second most common factor but were mostly studied in relation to non-specific measures of suicide (e.g., suicidality) limiting the specificity of the synthesis for more specific suicide outcomes.

Conclusion: Most empirical research is on drinking to cope motives and alcohol-related problems. Research is lacking on other alcohol-related psychological factors including alcohol expectancies. Limitations of the evidence base and implications for future research and clinical practice are discussed.

Introduction

What is suicide?

Suicide refers to 'an act with fatal outcomes which the deceased, knowing or expecting potentially fatal outcomes, had initiated and carried out with the purpose of bringing about wanted changes' (de Leo et al., 2006, p. 12). Suicide is a major global health problem which consistently ranks among the top 10 contributors to disease burden across regions (Naghavi, 2019). In Scotland the annual suicide rate fell by 3% in 2020 with 805 probable suicides reported, ending a 6-year trend of rising suicides (National Records of Scotland, 2020). A renewed national commitment on suicide prevention was published in 2018 which included the provision of tailored support for groups with elevated suicide risk in Scotland (Scottish Government, 2018) and a new suicide prevention action plan is due to be published in 2022.

Defining suicidal ideation, planning, and suicide behaviours

Suicide is the end point of a process involving suicide ideation, suicide planning, and a self-initiated behaviour with either fatal or non-fatal outcomes. Suicide ideation is a broad term which captures preoccupations with suicide (Harmer et al., 2021). Suicide planning refers to the cognitive 'formulation of a programme of action that can lead to self-injury' (Silverman et al., 2007, p. 265). Regarding non-fatal suicide behaviours, a clear definitional consensus has not been reached. Some argue that an individual's intention to die differentiates between a suicide attempt and acts of self-harm (e.g., Silverman et al, 2007), whereas others suggest that it is the lethality associated with the suicide plan that differentiates between a suicide attempt and self-harm (e.g., Hawton et al., 2012). The umbrella term non-fatal suicide behaviours has been suggested to capture self-harm, suicide attempt, and other parasuicidal behaviours (de Leo et al, 2006). This reflects current clinical guidance in the UK which defines self-harm as 'any act of self-poisoning or self-injury carried out by a person, irrespective of their motivation' (NICE, 2012, p. 14). However, there remains a lack of consistency in how non-fatal suicide outcomes are conceptualised in suicide research (Oquendo et al., 2011) which continues to pose challenges in synthesising findings across studies.

Models of suicide

The aetiology of suicide is multifactorial and involves mental health symptoms, personality factors, cognitive factors, social aspects, and negative life events (O'Connor & Nock, 2014). Psychiatric disorders are usually present when somebody dies by suicide (Cavanagh et al., 2003) and negative life events are common in the preceding year (Liu & Miller, 2014). Various psychological risk factors for suicide have also been identified. These include hopelessness, decision-making impulsivity,

mental pain, aggression, and cognitive rigidity (O'Connor & Nock, 2014; Gvion & Levi-Belz, 2018). Empirical research has led to the development of several prominent psychological models of suicide, which provide overarching theories and frameworks to incorporate these disparate risk factors (Barzilay & Apter, 2014). These models offer testable hypotheses of how multiple risk factors may coalesce and lead to suicide ideation or suicide behaviours and may ultimately lead to better screening of at-risk individuals and inform future suicide prevention interventions.

Limitations with current state of suicide research

Despite these advances in the understanding of why people die by suicide, our ability to predict suicide remains no better than chance (Franklin et al., 2017). Without a clearer understanding of how psychological risk factors lead to suicide in at-risk groups, individual-level suicide prevention strategies may be limited to detecting and treating mental disorders such as depression (Cavanagh et al., 2003). Furthermore, it is unlikely that the risk factors already identified for suicide would adequately predict suicide in different at-risk populations (Franklin, 2017). It is important therefore to refine models of suicide in at-risk populations and further our understanding of factors specific to these populations that elevate suicide risk. Individuals who misuse alcohol are known to be one such group at an elevated risk of suicide (Brady, 2006).

Alcohol as a risk factor for suicide

Clarifying the link between alcohol misuse and suicide outcomes is complicated as the definitions and associated lexicon of alcohol misuse vary considerably across research. Broad conceptualisations of alcohol misuse, including abuse/dependence (American Psychiatric Association, 2000) or Alcohol Use Disorders (AUD; American Psychiatric Association, 2013), are often studied in relation to suicide ideation and behaviour, despite the existence of more specific components or patterns of alcohol misuse (see Appendix 1.2). Research has shown that alcohol misuse elevates an individual's risk of suicide ideation, suicide attempt, and suicide death (Darvishi et al., 2015; Amiri & Behnezhad, 2020) and that the prevalence of any alcohol misuse in individuals who died by suicide is as high as 61% (Norström & Rossow, 2016). Research using broad measures of alcohol misuse (such as diagnoses) have certain weaknesses. Firstly, they do not reflect contemporary psychological models of alcohol-related suicide, which suggest that alcohol use can elevate suicide risk in short-term timeframes (such as via the acute effects of alcohol intoxication) as well as in longer-term, chronic use timeframes (e.g., Hufford, 2001). There is a near seven-fold increase in the risk of suicide attempt when individuals report drinking alcohol in the preceding 3-24 hours, compared with those who did not drink alcohol during the same reference period (Borges et al., 2017). Second, it has been

suggested that for some individuals, alcohol misuse may precede suicide risk rather than elevate suicide risk (Bagge & Sher, 2008). Thirdly, broad measures of alcohol misuse prevent us from developing a more nuanced understanding about what alcohol-related psychological factors are elevating suicide risk. For instance, it is not possible to infer which aspect of the alcohol-dependent experience leads to an elevated risk of suicide from the diagnosis of alcohol dependence alone. At present, we know there is a strong association between alcohol use and suicide however our understanding of how and why is more limited. Without developing our understanding of how different features of alcohol misuse elevate suicide risk, as well as how suicide risk may in turn play a role in alcohol misuse, our interventions to support this at-risk group will lack empirical grounding.

Alcohol-related psychological risk factors

Several alcohol-related psychological factors may explain why and how alcohol and suicide risk are associated. These factors can be grouped and presented differently depending upon the proposed mechanism of effect, i.e., whether alcohol misuse represents a diathesis which predisposes suicide risk, or whether suicide risk precedes and then predisposes alcohol misuse. In their review of the literature on suicide and alcohol misuse, Pompili et al (2010) synthesise their findings in this way. They first describe factors involved in alcohol misuse increasing suicide risk, categorising these as the direct factors (i.e., those related to the state of intoxication itself, such as more depressive thoughts and greater impulsivity), indirect factors (i.e., those related to alcohol increasing risk through an intermediary factor, such as drinking as a form of self-medication for depression), neurotoxic factors (i.e., those related to brain changes due to alcohol use such as alcohol-induced mood disorders), or social factors (i.e., those related to the negative social impact of alcohol misuse such as interpersonal strain, loneliness, employment difficulties). Factors are then described which explain how suicide risk influences alcohol misuse, such as the cognitive expectancy that drinking alcohol will anesthetize the pain of suicide, meaning those without historical alcohol misuse may drink alcohol to facilitate a planned suicide attempt.

Bagge & Sher (2008) also subcategorise alcohol-related psychological factors depending upon the timeframe. For example, proximal factors explain the association between alcohol misuse and suicide outcomes when they both occur within a relatively short time span (i.e., during acute alcohol intoxication). Longer-term factors on the other hand relate to when alcohol use and suicide outcomes both occur over a relatively longer time span, such as when chronic alcohol misuse leads to familial and peer breakdown which may elevates suicide risk.

Alcohol-related models of suicide

Several theoretically grounded psychological models of alcohol-related suicide have incorporated alcohol-related psychological factors for adult (Hufford, 2001; Conner & Ilgen, 2011; Lamis & Malone, 2012) and adolescent populations (Bagge & Sher, 2008). It has been suggested that these models reveal several potential pathways to alcohol-related suicide with several mediating and moderating effects that warrant additional research (Lamis & Malone, 2012). Despite the sophistication of these models, the alcohol-related factors within them and the proposed interrelationships with other suicide risk factors, have often not been subject to adequate empirical testing (Bagge and Sher, 2008; Norström & Rossow, 2016). This is a gap in our understanding of which alcohol-related psychological factors may play a role in suicide and cannot contribute to improved public health initiatives and clinical practice.

Furthermore, systematic review of alcohol-related psychological factors is lacking. Related reviews of the literature to date have mainly focused upon i) the prevalence of alcohol misuse among suicide decedents and ii) the estimation of relative risk of suicide in individuals with alcohol dependence or in cases of alcohol intoxication at time of death (Norström & Rossow, 2016). Several reviews of the literature on individual-level, alcohol-related psychological factors have been presented to support proposed psychological models, however these have lacked systematic methods (e.g., Bagge & Sher, 2008). This means these reviews are more subjective and prone to bias as they are not required to formally present their search strategy and inclusion criteria for peer review or appraise and synthesis findings using relevant methodological appraisal tools. Extensively cited reviews, such as Hufford (2001) are also not informed by the most up to date research.

Whilst a consistent group of alcohol-related factors have been posited in theoretical accounts and non-systematic literature reviews, to my knowledge, there has been no systematic review in this area. The evidence in relation to alcohol-related psychological factors has not been rigorously reviewed and synthesised to form a coherent body of work. A systematic review in this area could strengthen alcohol-related models of suicide by identifying alcohol-related psychological factors with the most robust evidence and provide recommendations on future research directions.

Aims

The overarching aim of this study is to carry out a systematic review and synthesis of findings from peer-reviewed studies which investigate alcohol-related psychological factors and their relationship with suicide risk. Specific aims are to identify and describe alcohol-related psychological factors, synthesise the available findings and evaluate the strength of evidence for each alcohol-related

psychological factor and suicide outcomes. This review will also undertake a critical review of research methodology in the area.

Method

<u>Pre-registration of review protocol</u>

This review follows the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines (Page et al., 2021). A review protocol was registered on PROSPERO (registration number: CRD42021243993: accessible at https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=243993) prior to searching for papers. The PROSPERO record was later amended, removing 'self-harm' from the list of domains to be studied. This reflected an earlier plan for the systematic review and its inclusion was an oversight.

<u>Search strategy</u>

Both qualitative and quantitative peer-reviewed empirical research studies were considered. Medline, PsycInfo and PsychArticles were searched from date of inception to 06/08/21. These databases were chosen as they provide extensive coverage of the medical and clinical psychological literatures. A scoping search of relevant literature revealed that various terms are used to describe alcohol-related psychological factors, such as mechanisms, pathways, alcohol-effects, and that often, researchers introduce and name an alcohol-related psychological factor without using any such term. To overcome this, a broad search strategy, prioritising sensitivity, was devised which would cover alcohol use and suicide outcomes contingent upon alcohol. The search terms used were: (alcohol use OR alcohol abuse OR alcohol dependenc* OR alcohol-related OR alcohol-related suicide OR alcohol-related self-harm) AND (Suicide* OR self-harm OR non-suicidal self-injur*). Searches covered titles and abstracts.

The author screened all titles and abstracts of identified studies once duplicates were removed. A selection of ten studies were independently reviewed by a fellow trainee to assess agreement when applying eligibility criteria. A hand search of the reference lists of included studies was then conducted. Google Scholar was also used to search the citations of included papers for further eligible papers.

<u>Eligibility criteria</u>

Inclusion

The main inclusion criteria were:

- articles which report on a measure of alcohol-related psychological factors and suicide outcomes. Alcohol-related psychological factors are defined as individual-level behaviours, emotions, thoughts, and experiences related to alcohol use. Suicide outcomes were operationalised as follows: suicide ideation, suicide attempt, and suicide death.

- any study design and any population.

- qualitative studies were eligible if the aim of the study was to investigate alcohol and suicide and an alcohol-related psychological factor was described in the findings.

Exclusion

The exclusion criteria were:

- all book chapters, reviews, commentaries, conference abstracts and non-peer reviewed papers, as well as studies that were not published in English.

- articles reporting population prevalence estimates or risk estimates of alcohol use and suicide without further studying a potential alcohol-related psychological factor

- articles reporting on an association between alcohol use in one individual and suicide risk in another (e.g., in a spouse)

- articles reporting factors not contingent upon alcohol use

- articles where the specific effect of an alcohol-related psychological factor on suicide risk could not be determined (e.g., where broad diagnostic categories or total sum scores of multi-dimensional scales were used). These articles were excluded as these constructs often lack specificity in the context of the current review.

- articles with only self-harm outcomes.

Data extraction

The key aspects extracted from each study were the population and sample, the alcohol-related psychological factor studied including its measure, the suicide outcome, and key findings.

Quality assessment

Based on scoping reviews of the literature, it was anticipated most studies would be cross-sectional. The Appraisal tool for Cross-Sectional Studies (AXIS; Downes et al., 2016) was used to assess the methodological quality and risk of bias of the included studies. The AXIS is a 20-item measure

designed to be an accessible tool that can be used across disciplines (see Appendix 1.3). Most items cover methods (e.g., sample size justification), results (e.g., presented analysis outlined in methods), and discussion (e.g., limitations discussed). Each item is answered 'Yes', 'No', Don't know/Comment'. The AXIS does not yield a numerical score that corresponds to "cut offs", although higher scores generally indicate higher study quality. To aid comparison of included studies, each 'yes' was scored as 1 while 'no' and 'don't know' were scored as 0. A total score was then calculated with scores between 0-9 rated poor, 10-15 rated fair, and 16-20 rated good. Numerical summary scores do not always reliably differentiate between high- and low-quality studies (Jüni et al., 1999) and do not reflect the relative importance of different study design elements (Siddaway et al., 2019). The AXIS will primarily be used to identify shared areas of methodological weakness in the included studies, rather than rank studies via numerical score.

In addition to the appraisal based on the AXIS, articles were also critically evaluated with reference to key recommendations provided by authors of alcohol-related models of suicide (e.g., Bagge & Sher, 2008; Lamis & Malone, 2012).

Results

Results of the search

A total of 5009 articles were retrieved from database searches (see Prisma flow chart Figure 1). After duplicates were removed and eligibility criteria applied, 25 studies were identified. Of the ten studies independently reviewed by a fellow trainee, initial agreement was reached on 6/10 studies. Three out of the four disagreements were easily resolved through discussion. One paper (Marschall-Lévesque et al., 2017) was reviewed by the research supervisor as its inclusion remained contentious. All four papers were included in the review in line with original decision of the author.

The most common reason for exclusion were articles reporting on factors non-contingent upon alcohol use. An additional two studies were found by searching the citations of each of the included studies on Google Scholar, which brought the total number of studies included in the review to 25 (see Figure 1).
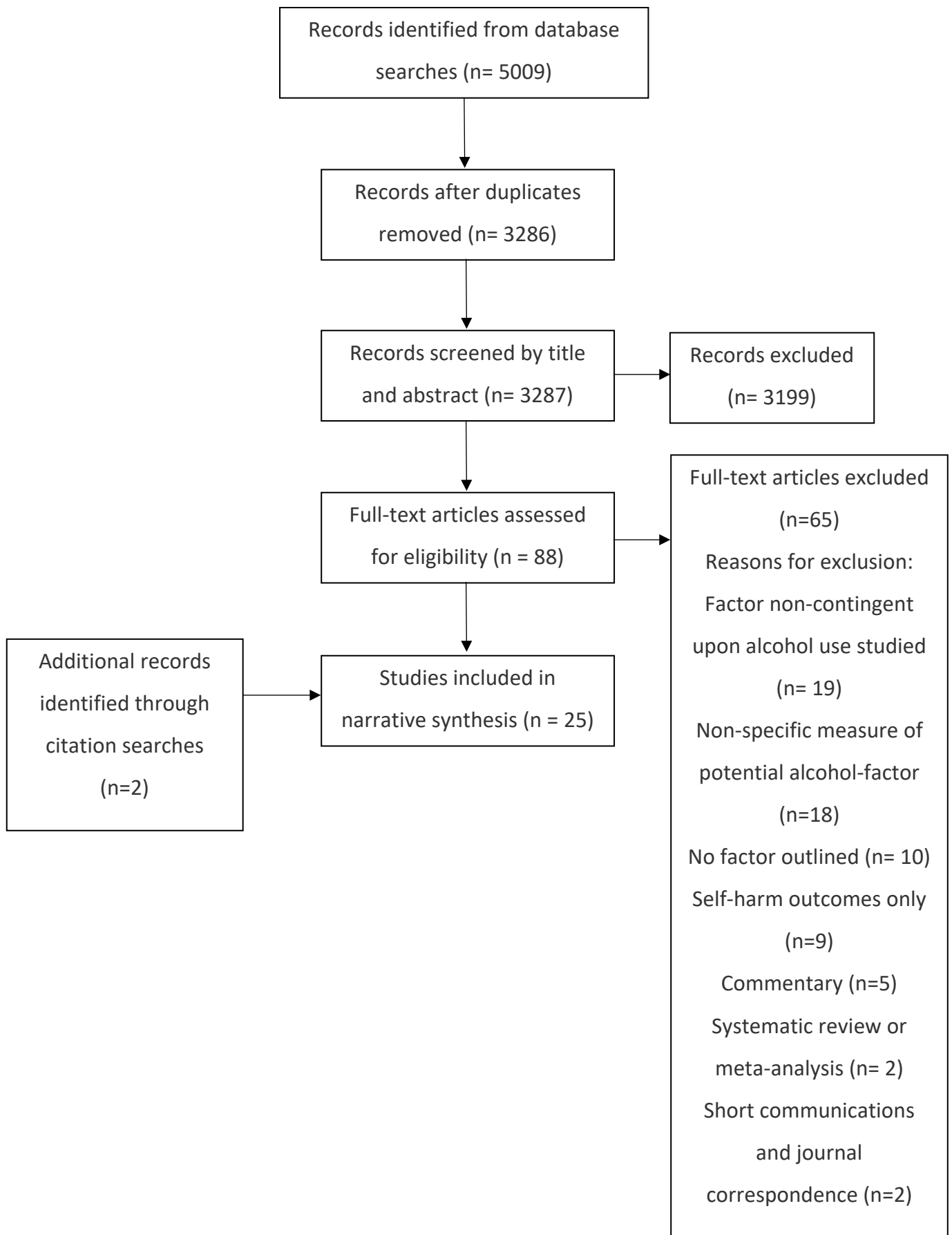
Figure 1. Flow chart of systematic search process and study selection based on PRISMA 2020 template

Data synthesis

Due to significant heterogeneity of the included articles (e.g., different types of alcohol misuse and alcohol-related psychological factors) a narrative synthesis of included studies was preferred to meta-analysis. The narrative synthesis proceeds with a summary of the methodological appraisal using the AXIS quality appraisal tool followed by key characteristics of included studies (See Table 1 for a summary of included studies). In addition to the summary of the quality assessment, the findings of the AXIS will be used to aid interpretation of the results within the main synthesis. Finally, based upon Pompili et al (2010) and Bagge and Sher (2008), a synthesis of alcohol-related psychological factors will be presented according to the direction of effect (i.e., alcohol misuse leading to suicide risk, or suicide risk leading to alcohol misuse) and timeframe (i.e., proximal, or distal timeframes).

Quality appraisal using AXIS

Scoring by the AXIS can be found in Appendix 1.4. Most of the studies were rated 'Fair' 20/25. Wolford-Clevenger et al (2020) and Bhattacharjee et al (2012) were rated 'Poor' and studied alcohol expectancies and alcohol use prior to a suicide attempt respectively. Marschall-Levesque et al (2016) Grazioli et al (2018) and Ehlers et al (2018) were rated 'Good' and all studied Drinking to Cope (DTC). Elhers et al (2018) also investigated alcohol-induced low mood. Common methodological problems included lack of justification for sample sizes and lack of clarity on non-response/drop-out rates.

Sample size

Whilst many included articles employed sophisticated methods to recruit large samples (e.g., Sunami et al 2019, and Choi et al, 2018), only one study (Ehlers et al, 2018) justified the sample size by presenting a power analysis to support their primary statistical analysis plan. Underpowered analyses were noted as limitations to detecting potentially important differences between groups (Bagge et al, 2014) and testing more comprehensive theoretical models of alcohol-related suicide (Grazioli et al, 2018). As well as increasing the risk of type 2 errors, low powered analysis will not be able to robustly test models with multiple risk factors as advised by Franklin (2017).

Non-response

Of the quantitative studies, only four made attempts to address and categorise non-responders or consider missing data. Mash et al. (2016) reported that they accounted for sampling and non-response through survey weighting and Wolford-Clevenger et al., (2020) reported the refusal rate by gender alone. In the prospective studies that considered non-response, Marschall-Levesque et al.,

(2016) present analysis to suggest data was missing at random and compare the included sample to the original cohort to rule out selection bias. Grazioli et al (2018) present analysis to suggest that the magnitude of differences between non-responders and the included sample were small. As most studies did not present data on non-response it was difficult to determine response-rate bias across studies.

<u>Characteristics of included studies</u>

Alcohol-related psychological factors and suicide outcomes

Eleven alcohol-related psychological factors in total were identified across studies (see Table 1): drinking motives (n= 13 studies), alcohol-related problems (7), alcohol-related aggression (2), alcohol consumption to facilitate, gain courage, or anaesthetize suicide attempt (3), alcohol-induced depression (2), alcohol consumption which impaired judgement, reality testing and diminish responsibility prior to suicide attempt (1), alcohol-expectancies (1), alcohol-induced disinhibition (1), alcohol consumption as suicide method (1), and chronic alcohol use impairing ability to withstand stress (1).

Ten studies investigated the relationship between an alcohol-related psychological factor and suicidal ideation. Suicide planning was investigated in three studies and communicating suicide ideation to somebody was assessed in one study. Suicide attempt was investigated in nine studies. A distinction between a premeditated and unpremeditated suicide attempt was made in one study and a planned versus unplanned suicide attempt in another. Suicide death was investigated in one study. Composite outcomes of suicide were used in five studies: suicide proneness in three and suicidality in two.

Sample characteristics

All studies but two recruited working age adult samples (>18 years of age). Marschall-Levesque et al, (2016) studied adolescents over a 2-year period from 13 to 15 years of age and Windle (2004) studied adolescents over a 2-year period aged 17-19.

Most studies (n=16) recruited from a community population. Of the nine studies which recruited from clinical populations, three studies used recently hospitalised individuals following a suicide attempt (Bhattacharjee et al., 2012; Bagge et al., 2015; Gauthier et al., 2019), two studies used a sample diagnosed with alcohol dependence (Conner et al., 2006; Conner et al., 2007), two studies recruited individuals diagnosed with AUD (Ehlers et al, 2018; Gonzalez & Halvorsen, 2021), one study

interviewed spouses of suicide decedents (Kizza et al, 2012), and one study recruited individuals with body dysmorphic disorder (BDD) (Kelly et al., 2017).

Undergraduate samples (aged >18) were used in nine studies (Lamis et al, 2010; Lamis & Malone, 2011; Lamis et al, 2014; Gonzalez & Hewell, 2012; DeCou & Skewes, 2016; Sunami et al, 2019; Gonzalez, 2019; Gonzalez et al, 2009; and Windle, 2004) although across all studies diverse populations were recruited from, e.g., South Korean adults (Choi et al., 2018), Swiss male young adults (Grazioli et al., 2018), hospitalised adults in India (Bhattacharjee et al., 2012), adults from native American ancestry (Ehlers et al., 2019) and adults from internal displacement camps in North Uganda (Kizza et al., 2012).

Study design

Most studies (n= 22) were cross-sectional. Three studies employed prospective designs (Marschall-Levesque et al, 2016; Grazioli et al, 2018, and Windle, 2004) with follow up periods that ranged 15-months to 24-months.

Measures of alcohol-related psychological factors

Generally, well-established psychometric tools were used to measure alcohol-related psychological factors, such as the Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994) or the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006). However novel or single item-measures were used for less researched alcohol-factors, e.g., alcohol-induced disinhibition (Choi et al, 2018), alcohol-related aggression (Conner et al, 2007), alcohol use to facilitate suicide attempt (Bagge et al, 2015), and alcohol-induced negative affect (Ehlers et al, 2018). See Table 1 for list of measures used. All measures used for the alcohol-related psychological factors relied on self-report.

Table 1: The characteristics and key findings included studies

Study	Population and sample	Alcohol-related psychological factor and measure	Suicide outcome	Findings
Choi et al., (2018)	9461 South Korean adults (>18 years)	**Alcohol-induced disinhibition (AID)** based on any positive response to either "Did you frequently get into physical fights while drinking while under the influence of alcohol?" or "Were you arrested for disturbing the peace or driving while under the influence of alcohol?"	Lifetime SI, suicide planning, and SA.	AID group significantly higher number of lifetimeSI (27.0% vs 15.8%; χ2 = 47.90, p < 0.001), plan (8.5% vs 3.3%; χ2 = 41.50, p < 0.001), attempt (9.6% vs 3.3%; χ2 = 60.82, p < 0.001), and multiple attempts (4.4% vs 1.2%; χ2 = 40.81, p < 0.001) than the non-AID group. AID and MDD were significantly associated with lifetime SA and lifetime multiple SA, respectively and interactively, after controlling for covariates.
Lamis & Malone, (2011)	996 US Undergraduates (>18 years)	**Alcohol-related problems** measured using Rutgers Alcohol Problems Index (RAPI; White & Labouvie, 1989)	Suicide Proneness	Alcohol-related problems correlated significantly with suicide proneness (r= .41, ps < .001.) Total effect of alcohol problems on suicide proneness was positive and significant, with a point estimate of 1.16, 95%CI 0.99–1.34, and standardised estimate of 0.42.
Grazioli et al., (2018)	5987 Swiss young men (mean age=20) at baseline. 4617 at 15-month follow up.	**Coping drinking motives** using the Drinking Motives Questionnaire Revised Short Form (DMQ-R Kuntsche & Kuntsche, 2009)	SA since baseline.	The total prospective associations between coping drinking motives at baseline and suicide attempts at follow-up were significant. The indirect associations through depressive symptoms were also significant, indicating that coping drinking motives at baseline were positively related to depressive

				symptoms, which were in turn associated with a greater likelihood to report suicide attempt at follow-up.
Lamis et al., (2010)	709 American undergraduate women who are victims of intimate partner abuse (>18 years)	**Alcohol-related problems** measured using Rutgers Alcohol Problems Index (RAPI; White & Labouvie, 1989).	Suicide Proneness	Alcohol-related problems significantly correlated with suicide proneness (r= .42, ps < .001.) The direct effect between alcohol-related problems and suicide proneness was significant, b = 0.99, SE = 0.11, Est./SE = 9.09, p < .001. A significant indirect effect of psychological abuse involvement on suicide proneness, through alcohol-related problems, was found. Point estimate 0.41, 95%CI 0.29 – 0.55.
Gonzalez & Halvorsen (2021)	96 American adults aged 18-47 the majority of whom (98%) have AUD	**Drinking motives (social, coping, enhancement)** using The Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994) **Excessive drinking to cope** measured with Drinking Context Scale (DCS; O'Hare, 2001)	SI	Drinking excessively to cope significantly mediating suicidal ideation to solitary alcohol consumption (B= .42, 95%CI .16, .77) and solitary heavy episodic drinking (B=12. 95%CI .04, .22). Drinking coping motives not significantly associated with social alcohol use.
Kelly et al (2017)	101 American adults (>18) with BDD diagnosis	**Drinking motives (social, coping, enhancement)** using The Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994).	Lifetime SA	In BDD sample, coping, enhancement, and social motive scores were 1.6, 1.1, and 0.5 standard deviation (SD) units above community sample scores, respectively. Coping motives were the only drinking motive that was positively associated with attempted suicide (B=.36, SE= .14, p=.011).

Conner at al (2006)	3788 U.S adults in treatment for alcohol dependence, recruited through COGA data set (Preuss et al., 2002)	**Alcohol-related aggression**, measured with 5 novel items. At least 3 times whilst drinking: (1) argued with others, (2) hit things or threw something, (3) hit a significant other or family member, (4) hit anyone else without getting into a fight, and (5) physically fought someone.	Lifetime SA SA premeditation, i.e., >6 concurrent days of SI preceding attempt	Alcohol-related aggression elevated among impulsive suicide attempters compared with non-attempters (OR = 1.33, CI: 1.21-1.46). Pre-contemplated attempts showed less alcohol-related aggressive behavior compared with impulsive attempters (OR = 0.79, CI: 0.69-0.89).
Bhattacharjee et al (2012)	200 patients admitted to hospital in India for SA	**Enough alcohol prior to SA to impair judgement, reality testing and diminish responsibility.** **Intentional intake of alcohol to facilitate SA.** Both measured with item 19 "Other aspect" of the Beck Suicide Intent Scale (Beck et al., 1974)	Recent SA	17% of sample reported alcohol intake prior to the SA. 12.5% alcohol which impaired judgement and 3% reported intentionally drinking alcohol to facilitate SA.
Gonzalez & Hewell, (2012)	109 U.S college students (18-25-)	**Drinking motives** measured with five-item Negative Coping subscale of the Drinking Context Scale (O'hare, 1997)	SI	SI significantly associated with DTC after accounting for related variables (impulsivity, NMRE, coping skills; R2=.06, p=.003).
DeCou & Skewes (2016)	298 U.S Undergraduate (>18 years)	**Alcohol-related problems** measured by Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006)	Lifetime SI	Alcohol dependence (OR = 1.88, p < .05), but not alcohol-related consequences (OR = 1.01, p = .95), emerged as an independent predictor of SI status beyond depression and alcohol consumption.
Sunami et al., (2019)	88,568 undergraduate students selected from 158 U.S colleges & Universities	**Alcohol-related problems** as latent variables comprised 'Regret', 'Forget', and 'Police', measured with 3 items from the ACHA–NCHA II (American College Health Association, 2015).	Suicidality as latent variable comprised self-injury, suicide ideation, and suicide attempt, measured with 3	Alcohol-related problems explained 17% of variance in suicidality. Partial mediation model significantly better fit than no mediation model, Δχ2 (1) = 96.34, p < .001, with

			items from the ACHA–NCHA.	Intimate partner abuse involvement indirectly associated with suicidality via alcohol-related problems, β = .03, b = 0.026, p < .001, 95% CI [0.021, 0.031].
Conner et al (2007)	3729 U.S adults in treatment for alcohol dependence, recruited through COGA data set.	**Alcohol-related aggression**, measured with 5 novel items in Conner et al, (2006).	SI, planned SA, unplanned SA.	Alcohol-related aggression shows association with transition to unplanned attempt (OR=1.34, 95%CI 1.16-1.56). Each one-unit increase on aggression scale is associated with a 34% (16%-56%) greater likelihood of transition to unplanned suicide attempt, suggesting a strong association. Other associations of alcohol-related aggression and transitions were either weaker or nonsignificant. Alcohol-related aggression shows a strong association with a history of unplanned suicide attempts (1.37 [1.20-1.56]), shows a lesser association with planned suicide attempt (1.12 [1.03-1.22]).
Marschall-Levesque et al (2016)	238 adolescents taking part in Canadian prospective study	**Alcohol use as "self-medication"**	SA	Only significant regression paths from peer victimisation at age 13 years to suicide ideation at 14 years (OR, 1.82; p < .05); and from suicide ideation at 14 years with higher alcohol use frequency at 15 years (β = .13, p < .01).
Kizza et al (2012)	16 alcohol-related suicide decedents from internally displaced people's camps in North Uganda	**The role of alcohol in suicide**	Suicide death	Themes from qualitative analysis: - Alcohol to cope with psychological distress - Alcohol to cope with stress - Alcohol for courage/ anaesthesia to facilitate suicide - Alcohol consumption as suicide method - Alcohol lowering ability to manage stress

Mash et al (2016)	3813 US active military personnel	**Drinking motives** measured with Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994).	Suicidality, comprised of last year SI and lifetime SA.	Drinking to avoid rejection was associated with suicidality (overall χ 2 [2] = 11.15, p < 0.01). Drinking for pleasure seeking/enjoyment was associated with suicidality (overall χ 2 [2] =8.22, p = 0.016).
				Individual with highest drinking to avoid rejection motives 1.78 times more likely to report suicidality (Wald χ2[1] =4.70, p = 0.03) than those who did not report conformity related drinking reasons.
				Heavy drinkers who were lower in pleasure-seeking/enjoyment motives were at a higher risk for suicidality, compared with heavy drinkers with medium and high pleasure-seeking motives.
Gauthier et al (2019)	130 US adults hospitalised for suicide attempt	**Drinking motives** measured with Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994).	SA	Any alcohol use prior to SA was significantly associated with past-year heavy drinking frequency (r=.31, p < .01), coping motives (r=.27, p <.01), and enhancement motives (r=.24, p=.01).
				Both past-year heavy drinking frequency (OR=1.36, p < .01) and coping motives (OR=1.69, p=.03) increased the odds of heavy acute drinking prior to SA compared with no alcohol use.
Gonzalez (2019)	381 US emerging adults (18- to 25-year-old) recruited from student population	**Drinking motives** measured with mean scores from Drinking Context Scale's (DCS; O'Hare, 2001), the Drinking Motives Questionnaire-Revised's (DMQ-R; Cooper, 1994), and Labouvie and Bates's (2002) suppression (i.e., coping) reasons subscale.	SI	SI significantly positively correlated with DTC (r=0.31, p=<.001) however the direct association between SI and DTC was small and non-significant once their shared associations with problem-solving skills, avoidant coping, and negative urgency controlled.
				Problem solving deficits show significant negative indirect effects with alcohol-related problems through avoidant coping and DTC (β = −.17, p = .001).

		Alcohol-related problems measured with Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006)		
Lamis et al., (2014)	1100 US undergraduate students	**Alcohol-related problems** measured with Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989)	Suicide proneness	Alcohol-related problems significantly correlated with suicide proneness (r=0.32, p< .05). Alcohol-related problems made unique contribution to suicide proneness (B= 0.36, SE=0.104, p<.01). The indirect effect of alcohol use on depression via alcohol-related problems was significant (est. = 0.040, 95% CI: 0.025, 0.054). Majority of variance (80%) in the direct path between alcohol use and suicide proneness was accounted for by the three mediators (i.e., alcohol-related problems, negative life events, and depressive symptoms).
Gonzalez et al (2009)	91 US students with history of passive SI	**Drinking motives,** measured with Drinking Context Scale (O'Hare, 2001). **Alcohol-related problems** measured with YAACQ (Read et al., 2006)	SI	DTC (*r*=.49, *p*= <.001) and alcohol problems (*r*=.33, *p*=<.01) correlated with SI. Greater SI was significantly associated with greater alcohol problems (B =.15 [.05], β =.31, p <.01). Greater SI was significantly associated with greater DTC (B =.07 [.02], β =.46). DTC positively associated with alcohol problems (Path *b*; B = 1.15 [.33], β =.38). Full statistical mediation supported as direct relationship between SI and alcohol problems not significant when controlling for DTC.
Bagge et al (2015)	324 US adults presenting at	**Suicide Facilitative Drinking Motives,** measured with novel Suicide Facilitative	SA	Problematic alcohol use was lower in the NON-FAC group (OR = 0.97, p = .08) compared with the FAC group.

	hospital with 24 hours of suicide attempt	Drinking Motives Scale (SFDMS), informed by the Drinking Motives Questionnaire (DMQ; Cooper et al., 1992).		Shorter proximal suicide premeditation (ORs range from 2.11 to 3.82, ps ≤ .10) and lower suicide intent (OR = 0.47, p = .10) was found in the NON-FAC group compared to FAC. Short proximal suicide decision and planning (ORs range from 2.28 to 4.46, ps ≤ .10) were greater in the NON-FAC compared with the FAC group.
Ehlers et al (2019)	Three US samples with AUD (1663 European American, 905 Mexican American, 905 American ancestries Indian)	"Dark side" of addiction symptoms, i) **drinking to relieve negative affect associated with withdrawal**, and ii) **drinking which causes significant depression and uninteres**t which impacts functioning measured with SSAGA; Hesselbrock et al., 1999)	Lifetime suicidal behaviours (ideation, plans, attempts)	Endorsing affective symptoms when cutting down on drinking was significantly associated with suicidal plans (P < 0.001, OR = 3.1) and attempts (P < 0.0001, OR = 3.25). Individuals reporting 24 hours of depression when drinking was significantly associated with all three suicidal behaviours: having suicidal ideation (P < 0.001, OR = 2.0), suicidal plans (P < 0.003, OR = 2.7) and attempts (P < 0.0001,OR = 4.7).
Wolford-Clevenger et al (2020)	444 US participants court-ordered to domestic violence intervention	**Alcohol expectancies.** Modified Effects of Drinking Alcohol Scale (EDAS; Leigh, 1989). Three AEs: disinhibition and negative mood AEs; positive mood AEs; cognitive and physical effects AEs).	Suicidal ideation	Problematic drinking was non-significantly, negatively associated with SI at low levels of disinhibition and negative mood expectancies. As these AEs increased, the association between problematic drinking and SI became significantly more positive. Problematic drinking was negatively associated with SI at high levels of positive mood expectancies. As these AEs increased, the association between problematic drinking and SI became significantly more negative.

Windle (2004)	1216 US high school students (age, m= 17.3)	**Drinking motives** measured with novel items "consistent with Cooper (1992)"	SI, told somebody about SI, SA	Coping motives significantly associated with depression and binge drinking. Depression then association with all 3 suicide outcomes. Binge drinking then associated with SA only.
Conner et al., (2015)	100 US adults enrolled in residential substance misuse programme, who attempted suicide within 90 days of admission.	**Alcohol-induced depression** measured with Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA).	SA	No difference found between alcohol-induced depression and independent depressive episode and risk of suicide attempt or greater suicide intent or planning. Alcohol-induced depression more common in suicide attempters (60%) compared with non-suicidal AUD controls (35%). PAR estimates suggest that 44% of suicide attempts were attributable to SID and 12% to IND
Preuss et al., (2002)	371 US alcohol-dependent adults with history of depression and suicide attempt	**Alcohol-induced depression**, measured with Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA), compared with independent depression	SA	Independent depression group had higher number of suicide attempts and earlier age of ideation and first attempt. Independent group less likely to have consumed alcohol during attempt. Had fewer dependence symptoms, and fewer substance misuse issues (outwith alcohol). No differences emerged on severity of suicide attempt.

Note: Alcohol-related psychological factor in **bold**, SI = suicide ideation, SA= suicide attempt, MDD=major depressive disorder, OR = odds ratio, COGA = collaborative study on the genetics of alcoholism, DTC = drinking to cope, NMRE = negative mood regulation expectancies, ACHA-NCHA= American college health association national college health assessment, FAC = suicide facilitative alcohol use, SSAGA = semi-structured assessment for the genetics of alcoholism, PAR = population-level attributable risk

Alcohol related psychological factors

Alcohol-related psychological factors were grouped based on Pompili et al (2010) and Bagge and Sher (2008), with a synthesis of key findings presented.

Alcohol-related psychological factors which increase suicide risk during acute alcohol use

Alcohol-related aggression/disinhibition

Alcohol-related aggression was found to be higher in alcohol-dependent individuals who reported a history of impulsive suicide attempts versus precontemplated attempts, i.e., suicide attempts that occurred without multiple days of prior suicidal ideation (Conner et al, 2006). Alcohol-related aggression also emerged as a significant risk factor for the transition to unplanned suicide attempt versus a planned suicide attempt in individuals with alcohol dependence (Conner et al, 2007). The conceptualisation of AID used by Choi et al (2018) has overlap with Conner and colleagues' conceptualisation of alcohol-related aggression and was associated with lifetime suicidal ideation, suicide planning, attempt, and multiple attempts in a south Korean community sample.

Alcohol consumption impairing judgement

Alcohol consumption which impaired judgement, reality testing and diminished responsibility prior to suicide attempt, was also associated with suicide attempts of greater lethality (Bhattacharjee et al 2012). This was one of the 2 studies which were rated 'poor' using the AXIS. The study did not describe the statistical analysis plan in its method section, presented its results in a way which hindered interpretation of this specific factor and the suicide outcome, and failed to present justification of sample size and analysis plan. It was also the only study to investigate this alcohol-related factor. In this context this finding should be interpreted with caution.

Drinking motives

Drinking to cope (DTC) was the most common drinking motive studied. Drinking motives are conceptualised as an individual's endorsed motivations that most proximally influence drinking behaviour (Cooper, 1994). Endorsing DTC motives were associated with suicide planning and suicide attempts in clinical samples (AUD, Ehlers et al, 2018; and BDD, Kelly et al, 2017). Along with past-year heavy drinking, DTC was also associated with heavy alcohol use prior to a suicide attempt (Gauthier et al, 2019). In the qualitative study (Kizza et al, 2012, p. 98), DTC was identified as a key theme following interviews with the spouses of individuals who died by alcohol-related suicide, whereby drinking to cope with distress, and later suicidal experiences, was reported "when he lost the case [the land], he was sorrowful, sometimes. . . he . . . could go and drink alcohol, whenever sober, his

head used to get down again but once drunk, his head was up, on and off until such a time that he could not stand it anymore and he committed suicide".

Two prospective studies suggested that DTC motives are an indirect risk factor for suicide attempt, through the emergence of depressive symptoms, particularly for adolescents transitioning into young adulthood (Grazioli et al., 2018; Windle, 2004).

The reported relationship between DTC and suicide attempt outcomes identified in this review is strengthened as these findings came from studies of 'Fair' quality and from 2 studies of 'good' quality, as scored by the AXIS. For example, in the studies of 'good' quality, "relief drinking" was associated with suicide attempts in a large cross-sectional study of individuals with AUD (Elhers et al, 2018) and in a large cohort study DTC indirectly predicted suicide attempt through depression (Grazioli et al., 2018).

Other drinking motives including DTC were the focus of three studies. In their study of active US military personnel, Mash et al., (2016) found that personnel who scored highest on conformity motives (to avoid rejection) were at significantly elevated risk of past-year suicidality compared with low scorers. They also found that heavy drinkers who scored lower on pleasure seeking/enjoyment motives were at a higher risk of suicidality, compared with heavy drinkers scoring with medium and high endorsement of pleasure seeking/endorsement. Kelly et al., (2017) found that of DTC, enhancement motives, and social motives, only DTC was associated with increased risk of suicide attempt. Gauthier et al., (2019) reported that neither enhancement motives nor social motives increased risk of heavy acute drinking prior to a suicide attempt when controlling for depression, whereas DTC did.

<u>Alcohol-related psychological factors which increase suicide risk during chronic alcohol use</u>

Neurotoxic factors

Ehlers et al (2018) sampled individuals with AUD and found that risk of suicidal ideation, suicidal plans, and attempts were all significantly elevated for those reporting alcohol-induced depressive episodes. In the only qualitative study to be included in the review, a theme emerged suggesting that longer-term alcohol misuse can also impair the ability to withstand stress, meaning smaller hassles would eventually trigger suicidal urges, "for him when he got drunk he could do anything stupid. What would make him go and try to kill himself used to be very simple things. . ." (Kizza et al, 2012, p. 100). Two studies investigated the difference between alcohol-induced depressive episodes and independent depressive episodes and suicide outcomes (Conner et al., 2015; Preuss et al, 2002). Both disorders were associated with to suicide ideation and suicide planning (Conner et al., 2015)

and no difference was noted between the severity of suicide attempts (Preuss et al, 2002). Individuals with alcohol-induced depression were more likely to have consumed alcohol before a suicide attempt, compared with independent depression suicide attempts (Preuss et al, 2002).

Alcohol-related life problems

Alcohol-related life problems (i.e., negative social, familial, educational, employment life events due to alcohol use) were investigated in seven cross-sectional studies. Two of these studies conceptualised suicide risk (suicidal ideation) preceding the emergence of alcohol-related problems, (Gonzalez et al., 2009; Gonzalez, 2019; discussed in section below). The other five studies assumed alcohol-related problems elevate suicide risk.

Lamis et al., (2010) found that alcohol-related problems were associated with suicide proneness and significantly mediated the association between intimate partner abuse and suicide proneness in female students. This finding was replicated in a larger student sample (Sunami et al, 2019) although the indirect effects in this study were smaller. DeCou & Skewes, (2016) reported conflicting findings, showing that symptoms of alcohol-dependence, not alcohol related life problems, emerged as a predictor of suicide ideation when alcohol consumption and depressive symptoms were controlled.

Alcohol expectancies

One study (Wolford-Clevenger et al., 2020) investigated alcohol-related expectancies (AEs), conceptualised as long-term memory structures, informed by past drinking experiences which influence current drinking patterns (Jones et al., 2001). This was one of the two studies rated as 'poor' by the AXIS. Areas of weakness include convenience recruitment of a sample convicted of domestic violence which limited generalisability and the use of a measure of AEs with psychometric problems including poor discriminative validity between expectancies. It reported an association between alcohol misuse and suicidal ideation which becomes more positive as disinhibition and negative mood AEs increase, and more negative as positive mood AEs increase. However, the association was non-significant. The authors of the included study also note weaknesses associated with mediation analysis in cross-sectional data and recommend longitudinal designs to advance understanding of AEs and suicide outcomes.

Alcohol-related psychological factors during acute alcohol use in those who are suicidal

Drinking motives

Drinking motives that were posited to propel suicidal individuals to misuse alcohol were the focus of three studies. Bagge et al, (2015) categorised 324 adults hospitalised for alcohol-related suicide

attempts by their endorsement of suicide-facilitative drinking motives prior to their attempt. A third reported alcohol prior to their suicide attempt with 27% reporting facilitative use. They found that those who drank alcohol prior to the attempt, but not for facilitative reasons, were more likely to have made the decision to kill themselves within 3 hours of the attempt (i.e., shorter decision making and planning timeframe; finding did not meet traditional significance level, p=0.05). Bhattacharjee et al, (2012) also reported that a minority of individuals endorsed suicide drinking motives. In their qualitative study, Kizza et al, (2012) described facilitative drinking motives such as 'alcohol used for courage' and 'alcohol as a 'means to an end', whereby alcohol consumption forms part of the suicide method, e.g., "... the boy went to the shop, bought waragi [local spirit] and yet he never used to drink alcohol and also bought sibacon and a battery cell, went down to [an isolated place] that side of the borehole, mixed those items and drunk." (Kizza et al, 2012, p. 100).

Suicide ideation was also found to be significantly associated with DTC when controlling for known non-alcohol related psychological risk factors (Gonzalez & Hewell, 2012). Drinking excessively to cope also emerged as a significant pathway from suicidal ideation to solitary heavy episodic drinking (Gonzalez & Halvorsen, 2021). However, Gonzalez (2019) found that in conceptual models featuring non-alcohol related risk factors for suicide ideation (problem solving deficits, avoidant coping, and negative urgency) the direct association between suicide ideation and DNT was non-significant.

In one of the longitudinal studies, rated as 'good' methodological quality by the AXIS, Marschall-Levesque et al (2016) used cross-lagged SEM modelling to examine the regression paths between reported alcohol consumption, suicidal ideation, and victimisation over 3 years in a sample of Canadian adolescents. They found that the only significant associations to emerge were from reported victimisation at 13 years of age to suicidal ideation at 14, and from suicidal ideation at 14 to higher alcohol use at 15. The authors suggest this supports alcohol use as "self-medication".

Alcohol-related life problems

One study included analysis of how suicide risk (suicide ideation) may lead to alcohol-related problems. Gonzalez et al (2009) included a mediation model which revealed that greater suicidal ideation was significantly associated with greater DTC and that greater DTC was significantly associated with greater alcohol-related problems. The authors conclude that DTC acts as a complete statistical mediator between suicide ideation and alcohol-related problems.

Discussion

The primary aim of this review was to synthesize current research findings on the alcohol-related psychological factors which explain the association between alcohol misuse and suicide outcomes.

Alcohol-related psychological factors

The key finding from this review is that 11 different alcohol-related psychological factors were identified across included studies. Drinking to cope motives and alcohol-related problems have received the most attention to date. Most studies investigated alcohol-related psychological factors in analyses which posit that alcohol misuse elevates suicide risk. In the context of DTC however, based on cross-sectional and prospective design studies of good methodological quality, this factor may be involved when alcohol misuse precedes suicide risk, and when suicidal individuals go on to misuse alcohol. This might be influenced by the age and developmental stage of individuals. Other drinking motives, such as suicide facilitative drinking motives, also emerged as potential risk factors to explain why suicidal individuals misuse alcohol. However other drinking motives showed weaker and non-significant associations with suicide outcomes. Alcohol-related problems were found to be associated with suicide risk in studies of 'fair' methodological quality; however, most studies used a composite measure of suicide (discussed later). Alcohol dependence also significantly mediated the association between suicide ideation and heavy solitary drinking (Gonzalez & Halvorsen, 2021). Negative life events are an established predictor of suicide (Foster, 2011; Li et al., 2020) however this review finds that role of negative life events due to drinking on the emergence of suicide ideation or suicide behaviour is not yet clear.

In the study of acute effects of alcohol increasing suicide risk, alcohol-induced aggression and alcohol-induced disinhibition emerged as promising factors to explain suicide outcomes during intoxication. However, there was conceptual overlap noted in how these studies measured aggression and disinhibition. As a result, the construct validity of these factors if considered as entirely separate constructs is questionable. It is not yet clear if trait impulsivity or a form of AID is associated with elevated suicide risk for individuals who misuse alcohol (Choi et al, 2018). Similarly, further research has been called for to clarify whether alcohol-related aggression relates to a disinhibited anger triggered by consuming alcohol, or whether it is a subtype of "reactive aggression" (see Bridge et al., 2006), present in certain individuals before consuming alcohol (Conner et al, 2007).

Evidence for the role of neurotoxic alcohol-related factors on suicide outcomes suggests that individuals with alcohol-induced depression are more likely to have consumed alcohol prior to a suicide attempt and choose suicide attempts of similar severity. In AUD samples, alcohol-induced negative affect/disinterest was also associated with suicide ideation, planning, and attempt (Ehlers et al, 2018). This is an important finding as it goes beyond diagnostic criteria and seeks to establish specific aspects of the clinical AUD experience which may elevate suicide risk.

The subcategorizations of alcohol-related psychological factors used by Pompili et al 2010 and Bagge & Sher (2008) appear to be useful frameworks as researchers largely adhere to them when explaining how alcohol-related psychological factors are associated with suicide outcomes. As summarised above, some alcohol-related psychological factors have received more empirical attention than others, with several components of alcohol-specific models of suicide yet to be tested.

Alcohol-related models of suicide

With reference to alcohol-related models of suicide, some of the key proposed relationships between alcohol-related psychological factors and suicide may warrant further research. For example, impulsivity and aggression feature in several models, both as trait aggression/impulsivity (Conner & Ilgen, 2011) and as an intoxication state which elevates suicide behaviour risk (Bagge & Sher, 2008). It is somewhat surprising then that relatively few studies investigated this alcohol-related psychological factor given its proposed theoretical importance in explaining suicide risk in this population. There remains a gap in our understanding as to how acute alcohol use interacts with supposed traits of impulsivity and aggression to elevates risk of a transition from suicide ideation to suicide behaviour.

Similarly, alcohol-related negative life events feature in alcohol models of suicide as mechanisms which elevates suicide risk over time (Bagge & Sher, 2008). Lamis & Malone (2012) theorise that interpersonal difficulties, negative life events, other alcohol-related problem (termed life strains) can either cause depressive symptoms and lead to suicide behaviours or lead directly to suicidal behaviours. Currently, however, there is a gap in the literature on the role of alcohol-related problems and how these may influence the emergence of suicide ideation over time or influence suicide behaviour.

Various suicide-specific AEs were outlined by Hufford (2001), however only one study investigated non-suicide specific AEs and suicide outcomes and reported non-significant findings. This study was rated "low" by the AXIS however which suggests further methodologically rigorous studies may be needed to determine whether AEs are associated with elevated suicide risk related to alcohol use. A recent study of self-harm AEs suggest that self-harm specific AEs hold potential to differentiate between individuals who think about self-harm only versus individuals who engage in self-harm (Melson & O'Conner, 2018). Attempts to replicate this finding by introducing suicide-specific AEs may be a way to advance the literature.

Drinking motives which may elevate suicide risk in suicidal individuals have been suggested by Bagge & Sher (2008). In this review, qualitative analysis was able to identify several of these suicide drinking

motives through interview with the spouses of suicide decedents. Survivors of serious suicide attempts are suggested to be good proxies for suicide decedents (Gvion & Levi-Belz, 2018), meaning qualitative research in this population may be helpful to explore the potentially diverse array of drinking motivations endorsed by suicidal individuals.

Finally, no studies investigated how a suicide history (e.g., multiple suicide attempts) may cause increased alcohol misuse and exacerbate suicide risk over time. Potential alcohol-related factors may be drinking due to lowered self-esteem, increased social isolation, or increased life problems following repeated suicide attempts (Begge & Sher, 2008).

Limitations of this review

There are several limitations of this review. Due to the wide range of different terms used to describe alcohol-related psychological factors in the literature, it is possible the search strategy employed in this review has missed relevant studies. Efforts were however made to ensure the search strategy was sufficiently broad and contained a range of terms synonymous with alcohol misuse and suicide outcomes. Whilst a fellow trainee was involved in screening eligible studies to ensure eligibility criteria were being applied consistently, only the primary author was involved in the systematic rating of studies using the AXIS. It is therefore possible that the primary author's decisions when applying the AXIS scoring criteria may lack reproducibility or consistency. Involving a 2nd rater would have allowed an inter-rater reliability score to be calculated which would have increased confidence that the AXIS was being used as it was designed to be. Establishing adequate inter-rater reliability on the AXIS would also have strengthened its validity in this review, which would have increased confidence that the scores are accurately representing methodological quality (Downing, 2003). Scoping searches of the literature conducting during the early phase of the review retrieved cross-sectional studies, which informed the original decision to use the AXIS (a tool designed for use in cross-sectional, quantitative study designs). However, as a minority of studies included in this review used qualitative and prospective designs, some of the AXIS items were not applicable. Furthermore, important indicators of study quality specific to qualitative designs were not assessed (see NICE, 2012). This means that this review may not have provided a balanced assessment of methodological quality across all included studies and comparison of study quality between cross-sectional and other designs may lack utility.

Future research

Future research which aims to test alcohol-specific models of suicide will require large samples due to the low prevalence rates of suicide attempt and particularly suicide death. This review highlights

that underpowered analysis is a common methodological problem when studying alcohol-related psychological factors and suicide outcomes. Furthermore, contemporary models of suicide generally agree that risk factors load onto suicidal ideation and suicidal behaviour in differing degrees (Turecki & Brent, 2016), consistent with ideation-to-action models of suicide (e.g., O'Connor & Kirtley, 2018). However only one study aimed to establish if alcohol-related psychological factors were associated with the transition from suicide ideation to attempt (Conner et al, 2007). Relatedly, many studies used a latent, composite variable such as suicidality as its main outcome. As this prevents the reader from inferring which part of the suicide pathway may be most associated with alcohol-related psychology factors, future research should investigate specific outcomes that can map onto ideation to action frameworks.

Future research should also address the trait and state dimensions of aggression or impulsivity in relation to alcohol misuse and suicide and address the conceptual overlap between them. The conceptualisation of "reactive aggression" may be of value here, defined as the of impulsive, angry responses to perceived threats (Dodge and Coie, 1987). As a trait it has been incorporated into alcohol-related suicide models as a longer-term risk factor increasing social disruption over time (Conner & Duberstein, 2004) however future research could seek to understand how this trait interacts with alcohol intoxication and suicide risk. This will help differentiate longer-term risk factors (trait) from risk-factors related to intoxication (state).

Most studies in the review were cross-sectional. A weakness of this approach is that interactions between acute alcohol use and alcohol-related psychological factors in real-time cannot be assessed. For example, drinking motives may arise out of a real-time interaction between an individual, their environment, and the emotions they are currently feeling, which then may mediate the relationship between AEs and suicide outcomes (Kuntsche et al., 2014). A challenge for future research will be effectively tapping into drinking motives and other state-dependent factors, in real time, as they proximally interact with affect, suicide ideation, and suicidal behaviours. Case-cross over and ecological momentary analysis designs are advantageous (Bagge & Sher, 2008) and could be further supported using smartphone technology to continuously measure relevant suicide risk factors (Franklin, 2017).

Prospective studies with adult community and clinical samples are also lacking. Given the high prevalence of alcohol misuse and psychiatric disorders (Flensborg-Madsen et al., 2009), alcohol-related psychological factors such as DTC could be explored across disorders to further our understanding of how alcohol interacts with psychiatric symptoms to elevate suicide risk over time.

Finally, novel risk factors based on compelling suicide theory should be investigated to improve our models (Franklin, 2017). A potential candidate would be suicide-specific AEs, which may require psychometrically reliable and valid measures to be developed.

<u>Clinical implications</u>

The literature on alcohol-related psychological factors and suicide is growing and some components of alcohol-related models of suicide have received more extensive empirical investigation than others. However, the evidence base for many factors may not be sufficiently developed to recommend changes in current clinical practice.

Prospective studies suggest that drinking to cope can predict suicide risk and that young, suicidal adolescents may be vulnerable to turning to alcohol to cope (i.e., self-medication). Findings in clinical samples (AUD, BDD) highlight the potential role of drinking to cope with psychiatric symptoms and the increased risk of suicide ideation and attempt. Whilst more research is needed, it seems sensible to suggest that routine assessment of individuals with psychiatric disorders should enquire if alcohol is used as a coping mechanism. For young adolescents who are unlikely to have well-developing coping repertoires, suicide prevention interventions in the future may benefit from teaching adaptive coping skills and working with parents and caregivers to limit access to alcohol.

<u>Conclusions</u>

This review found a wide range of alcohol-related psychological factors have been studied although much of this research has examined drinking to cope motives and alcohol-related problems. The current evidence suggests that drinking to cope motives may hold promise for enhancing understanding of the role of alcohol-related psychological factors and suicide risk. Conceptualisations of alcohol-related psychological factors proposed by Pompili et al, (2010) and Bagge & Sher, (2008) appear to be helpful theoretical frameworks adopted by researchers in the field. However, research using contemporary ideation to action models of suicide are lacking. Future research with larger samples is recommended to investigate if alcohol-related psychological factors can differentiate between suicide ideation and individuals who attempt suicide. Innovative research designs such as case-cross over and ecological momentary analysis hold promise for monitoring the acute effects of alcohol and how this may elevate suicide risk.

References

American Psychiatric Association. (2003). *Diagnostic and Statistical Manual of Mental Disorders DSM 4 TR (Text Revision)*. American Psychiatric Association.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5)*. American Psychiatric Association

Amiri, S., & Behnezhad, S. (2020). Alcohol use and risk of suicide: a systematic review and Meta-analysis. *Journal of Addictive Diseases*, *38*(2), 200–213. https://doi.org/10.1080/10550887.2020.1736757

Bagge, C. L., Conner, K. R., Reed, L., Dawkins, M., & Murray, K. (2015). Alcohol use to facilitate a suicide attempt: an event-based examination. *Journal of Studies on Alcohol and Drugs*, *76*(3), 474–481. https://doi.org/10.15288/JSAD.2015.76.474

Bagge, C. L., & Sher, K. J. (2008). Adolescent alcohol involvement and suicide attempts: Toward the development of a conceptual framework. *Clinical Psychology Review*, *28*(8), 1283–1296. https://doi.org/10.1016/j.cpr.2008.06.002

Barzilay, S., & Apter, A. (2014). Psychological models of suicide. *Archives of Suicide Research : Official Journal of the International Academy for Suicide Research*, *18*(4), 295–312. https://doi.org/10.1080/13811118.2013.824825

Beck, A. T., Schuyler, D., & Herman, I. (1974). *Development of suicidal intent scales*. In A. T. Beck, H. L. P. Resnik, & D. J. Lettieri (Eds.), The prediction of suicide (pp. 45-56). Bowie, MD: Charles Press.

Bhattacharjee, S., Bhattacharya, A., Thakurta, R. G., Ray, P., Singh, O. P., & Sen, S. (2012). Putative Effect of Alcohol on Suicide Attempters: An Evaluative Study in a Tertiary Medical College. *Indian Journal of Psychological Medicine*, *34*(4), 371. https://doi.org/10.4103/0253-7176.108224

Borges, G., Bagge, C. L., Cherpitel, C. J., Conner, K. R., Orozco, R., & Rossow, I. (2017). A meta-analysis of acute use of alcohol and the risk of suicide attempt. *Psychological Medicine*, *47*(5), 949–957. https://doi.org/10.1017/S0033291716002841

Bridge, J. A., Goldstein, T. R., & Brent, D. A. (2006). Adolescent suicide and suicidal behavior. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *47*(3–4), 372–394. https://doi.org/10.1111/J.1469-7610.2006.01615.X

Cavanagh, J. T. O., Carson, A. J., Sharpe, M., & Lawrie, S. M. (2003). Psychological autopsy studies of suicide: A systematic review. *Psychological Medicine*, *33*(3), 395–405. https://doi.org/10.1017/S0033291702006943

Choi, K. W., Na, E. J., Hong, J. P., Cho, M. J., Fava, M., Mischoulon, D., Cho, H., & Jeon, H. J. (2018). Alcohol-induced disinhibition is associated with impulsivity, depression, and suicide attempt: A nationwide community sample of Korean adults. *Journal of Affective Disorders*, *227*, 323–329. https://doi.org/10.1016/J.JAD.2017.11.001

Conner, K. R., & Duberstein, P. R. (2004). Predisposing and Precipitating Factors for Suicide Among Alcoholics: Empirical Review and Conceptual Integration. *Alcoholism: Clinical and Experimental Research*, *28*(5 SUPPL.), 6S-17S. https://doi.org/10.1097/01.ALC.0000127410.84505.2A

Conner, K. R., Gamble, S. A., Bagge, C. L., He, H., Swogger, M. T., Watts, A., & Houston, R. J. (2015). Substance-Induced Depression and Independent Depression in Proximal Risk for Suicidal Behavior. *Journal of studies on Alcohol and Drugs. Http://Dx.Doi.Org/10.15288/Jsad.2014.75.567, 75*(4), 567–572.

Conner, K. R., Hesselbrock, V. M., Meldrum, S. C., Schuckit, M. A., Bucholz, K. K., Gamble, S. A., Wines, J. D., & Kramer, J. (2007). Transitions to, and correlates of, suicidal ideation, plans, and unplanned and planned suicide attempts among 3,729 men and women with alcohol dependence. *Journal of Studies on Alcohol and Drugs*, *68*(5), 654–662. https://doi.org/10.15288/jsad.2007.68.654

Conner, K. R., Hesselbrock, V. M., Schuckit, M. A., Hirsch, J. K., Knox, K. L., Meldrum, S., Bucholz, K. K., Kramer, J., Kuperman, S., Preuss, U., & Soyka, M. (2006). Precontemplated and Impulsive Suicide Attempts Among Individuals With Alcohol Dependence. *Journal of Studies on Alcohol*, *67*(1), 95–101. https://doi.org/10.15288/jsa.2006.67.95

Conner, K. R., & Ilgen, M. A. (2011). Substance Use Disorders and Suicidal Behaviour. In *International Handbook of Suicide Prevention* (pp. 93–107). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119998556.ch5

Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, *6*(2), 117–128. https://doi.org/10.1037/1040-3590.6.2.117

Darvishi, N., Farhadi, M., Haghtalab, T., & Poorolajal, J. (2015). Alcohol-Related Risk of Suicidal Ideation, Suicide Attempt, and Completed Suicide: A Meta-Analysis. *PLOS ONE*, *10*(5), e0126870. https://doi.org/10.1371/JOURNAL.PONE.0126870

de Leo, D., Burgis, S., Bertolote, J. M., Kerkhof, A. J. F. M., & Bille-Brahe, U. (2006). Definitions of suicidal behavior: lessons learned from the WHo/EURO multicentre Study. *Crisis*, *27*(1), 4–15. https://doi.org/10.1027/0227-5910.27.1.4

DeCou, C. R., & Skewes, M. C. (2016). Symptoms of Alcohol Dependence Predict Suicide Ideation Among Alaskan Undergraduates. *Crisis*, *37*(3), 232–235. https://doi.org/10.1027/0227-5910/a000373

Downes, M. J., Brennan, M. L., Williams, H. C., & Dean, R. S. (2016). Development of a critical appraisal tool to assess the quality of cross-sectional studies (AXIS). *BMJ Open*, *6*(12), e011458. https://doi.org/10.1136/BMJOPEN-2016-011458

Downing, S. M. (2003). Validity: on the meaningful interpretation of assessment data. Medical education, 37(9), 830-837.

Ehlers, C. L., Gilder, D. A., Gizer, I. R., & Wilhelmsen, K. C. (2019). Indexing the "dark side of addiction": substance-induced affective symptoms and alcohol use disorders. *Addiction (Abingdon, England)*, *114*(1), 139–149. https://doi.org/10.1111/ADD.14431

Flensborg-Madsen, T., Mortensen, E. L., Knop, J., Becker, U., Sher, L., & Grønbæk, M. (2009). Comorbidity and temporal ordering of alcohol use disorders and other psychiatric disorders: results from a Danish register-based study. *Comprehensive Psychiatry*, *50*(4), 307–314. https://doi.org/10.1016/J.COMPPSYCH.2008.09.003

Foster, T. (2011). Adverse Life Events Proximal to Adult Suicide: A Synthesis of Findings from Psychological Autopsy Studies. *Archives of Suicide Research, 15(1), 1-15 Https://Doi.Org/10.1080/13811118.2011.540213*, *15*(1), 1–15.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., Musacchio, K. M., Jaroszewski, A. C., Chang, B. P., & Nock, M. K. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychological Bulletin*, *143*(2), 187–232. https://doi.org/10.1037/BUL0000084

Gauthier, J. M., Cole, A. B., & Bagge, C. L. (2019). A preliminary examination of the association between drinking as a typical coping strategy and level of acute alcohol consumption prior to a suicide attempt. *Psychiatry Research*, *282*. https://doi.org/10.1016/j.psychres.2019.112626

Gonzalez, V. M. (2019). Factors linking suicidal ideation with drinking to cope and alcohol problems in emerging adult college drinkers. *Experimental and Clinical Psychopharmacology*, *27*(2), 166–177. https://doi.org/10.1037/PHA0000242

Gonzalez, V. M., Bradizza, C. M., & Collins, R. L. (2009). Drinking to cope as a statistical mediator in the relationship between suicidal ideation and alcohol outcomes among underage college drinkers. *Psychology of Addictive Behaviors : Journal of the Society of Psychologists in Addictive Behaviors*, *23*(3), 443–451. https://doi.org/10.1037/A0015543

Gonzalez, V. M., & Halvorsen, K. A. S. (2021). Mediational Role of Drinking to Cope in the Associations of Depression and Suicidal Ideation with Solitary Drinking in Adults Seeking Alcohol Treatment. *Substance Use & Misuse*, *56*(5), 588–597. https://doi.org/10.1080/10826084.2021.1883661

Gonzalez, V. M., & Hewell, V. M. (2012). Suicidal ideation and drinking to cope among college binge drinkers. *Addictive Behaviors*, *37*(8), 994–997. https://doi.org/10.1016/J.ADDBEH.2012.03.027

Grazioli, V. S., Bagge, C. L., Studer, J., Bertholet, N., Rougemont-Bücking, A., Mohler-Kuo, M., Daeppen, J. B., & Gmel, G. (2018). Depressive symptoms, alcohol use and coping drinking motives: Examining various pathways to suicide attempts among young men. *Journal of Affective Disorders*, *232*, 243–251. https://doi.org/10.1016/J.JAD.2018.02.028

Gvion, Y., & Levi-Belz, Y. (2018). Serious suicide attempts: Systematic review of psychological risk factors. In *Frontiers in Psychiatry* (Vol. 9, Issue MAR). https://doi.org/10.3389/fpsyt.2018.00056

Harmer, B., Lee, S., Duong, T. vi H., & Saadabadi, A. (2021). Suicidal Ideation. *StatPearls*. http://search.ebscohost.com/login.aspx?direct=true&db=cmedm&AN=33351435&site=ehost-live

Hawton, K., Saunders, K. E. A., & O'Connor, R. C. (2012). Self-harm and suicide in adolescents. *The Lancet*, *379*(9834), 2373–2382. https://doi.org/10.1016/S0140-6736(12)60322-5

Herberman Mash, H. B., Fullerton, C. S., Ng, T. H. H., Nock, M. K., Wynn, G. H., & Ursano, R. J. (2016). Alcohol Use and Reasons for Drinking as Risk Factors for Suicidal Behavior in the U.S. Army. *Military Medicine*, *181*(8), 811–820. https://doi.org/10.7205/MILMED-D-15-00122

Hesselbrock, M., Easton, C., Bucholz, K. K., Schuckit, M., & Hesselbrock, V. (1999). A validity study of the SSAGA-a comparison with the SCAN. *Addiction*, *94*(9), 1361–1370. https://doi.org/10.1046/J.1360-0443.1999.94913618.X

Hufford, M. R. (2001). Alcohol and suicidal behavior. *Clinical Psychology Review*, *21*(5), 797–811. https://doi.org/10.1016/S0272-7358(00)00070-2

Jones, B. T., Corbin, W., & Fromme, K. (2001). A review of expectancy theory and alcohol consumption. *Addiction*, *96*(1), 57–72. https://doi.org/10.1046/J.1360-0443.2001.961575.X

Jüni, P., Witschi, A., Bloch, R., & Egger, M. (1999). The Hazards of Scoring the Quality of Clinical Trials for Meta-analysis. *JAMA*, *282*(11), 1054–1060. https://doi.org/10.1001/JAMA.282.11.1054

Kelly, M. M., Simmons, R., Wang, S., Kraus, S., Donahue, J., & Phillips, K. A. (2017). Motives to drink alcohol among individuals with body dysmorphic disorder. *Journal of Obsessive-Compulsive and Related Disorders*, *12*, 52–57. https://doi.org/10.1016/j.jocrd.2016.11.001

Kizza, D., Hjelmeland, H., Kinyanda, E., & Knizek, B. L. (2012). Alcohol and suicide in postconflict Northern Uganda: A qualitative psychological autopsy study. *Crisis: The Journal of Crisis Intervention and Suicide Prevention*, *33*(2), 95–105. https://doi.org/10.1027/0227-5910/a000119

Kuntsche, E., Knibbe, R., Engels, R., & Gmel, G. (2014). Drinking Motives as Mediators of the Link Between Alcohol Expectancies and Alcohol Use Among Adolescents. *Addictive Behaviour, 33(10), 1344-1352 Http://Dx.Doi.Org/10.15288/Jsad.2007.68.76*, *68*(1), 76–85.

Kuntsche, E., & Kuntsche, S. (2009). Development and Validation of the Drinking Motive Questionnaire Revised Short Form (DMQ–R SF). *J Clin Child Adolesc Psychol 38(6):899-908 Https://Doi.Org/10.1080/15374410903258967*, *38*(6), 899–908.

Lamis, D. A., & Malone, P. S. (2011). Alcohol-Related Problems and Risk of Suicide among College Students: The Mediating Roles of Belongingness and Burdensomeness. *Suicide and Life-Threatening Behavior*, *41*(5), 543–553. https://doi.org/10.1111/J.1943-278X.2011.00052.X

Lamis, D. A., & Malone, P. S. (2012). Alcohol Use and Suicidal Behaviors among Adults: A Synthesis and Theoretical Model. *Suicidology Online*, *3*, 4. /pmc/articles/PMC3519287/

Lamis, D. A., Malone, P. S., & Jahn, D. R. (2014). Alcohol Use and Suicide Proneness in College Students: A Proposed Model. *Mental Health and Substance Use : Dual Diagnosis*, *7*(1), 59. https://doi.org/10.1080/17523281.2013.781535

Lamis, D. A., Malone, P. S., & Langhinrichsen-Rohling, J. (2010). Involvement in Intimate Partner Psychological Abuse and Suicide Proneness in College Women: Alcohol Related Problems as a Potential Mediator. *Partner Abuse*, *1*(2), 169–185. https://doi.org/10.1891/1946-6560.1.2.169

Li, W., Dorstyn, D. S., & Jarmon, E. (2020). Identifying suicide risk among college students: A systematic review. *Death Studies*, *44*(7), 450–458. https://doi.org/10.1080/07481187.2019.1578305

Liu, R. T., & Miller, I. (2014). Life events and suicidal ideation and behavior: a systematic review. *Clinical Psychology Review*, *34*(3), 181–192. https://doi.org/10.1016/J.CPR.2014.01.006

Marschall-Lévesque, S., Castellanos-Ryan, N., Parent, S., Renaud, J., Vitaro, F., Boivin, M., Tremblay, R. E., & Séguin, J. R. (2017). Victimization, Suicidal Ideation, and Alcohol Use From Age 13 to 15 Years: Support for the Self-Medication Model. *The Journal of Adolescent Health : Official Publication of the Society for Adolescent Medicine*, *60*(4), 380–387. https://doi.org/10.1016/J.JADOHEALTH.2016.09.019

Naghavi, M. (2019). Global, regional, and national burden of suicide mortality 1990 to 2016: systematic analysis for the Global Burden of Disease Study 2016. *BMJ (Clinical Research Ed.)*, *364*, l94. https://doi.org/10.1136/bmj.l94

National Records of Scotland. (2020). *Probable Suicides: Deaths which are the Result of Intentional Self-harm or Events of Undetermined Intent: Main Points Report*. https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/deaths/suicides

Norström, T., & Rossow, I. (2016). Alcohol Consumption as a Risk Factor for Suicidal Behavior: A Systematic Review of Associations at the Individual and at the Population Level. *Archives of Suicide Research : Official Journal of the International Academy for Suicide Research*, *20*(4), 489–506. https://doi.org/10.1080/13811118.2016.1158678

NICE. (2012). Methods for the Development of NICE. Process and methods [PMG4]. Public Health Guidance.

O'Connor, R. C., & Kirtley, O. J. (2018). The integrated motivational-volitional model of suicidal behaviour. In *Philosophical Transactions of the Royal Society B: Biological Sciences* (Vol. 373, Issue 1754). Royal Society Publishing. https://doi.org/10.1098/rstb.2017.0268

O'Connor, R. C., & Nock, M. K. (2014). The psychology of suicidal behaviour. *The Lancet. Psychiatry*, *1*(1), 73–85. https://doi.org/10.1016/S2215-0366(14)70222-6

O'hare, T. (1997). Measuring excessive alcohol use in college drinking contexts: The drinking context scale. *Addictive Behaviors*, *22*(4), 469–477. https://doi.org/10.1016/S0306-4603(96)00050-0

O'Hare, T. (2001). The Drinking Context Scale: A confirmatory factor analysis. *Journal of Substance Abuse Treatment*, *20*(2), 129–136. https://doi.org/10.1016/S0740-5472(00)00158-6

Oquendo, M. A., Feldman, S., Silverman, E., Currier, D., Brown, G. K., Chen, D., Chiapella, P., Fischbach, R., Gould, M., Stanley, B., Strauss, D., Zelazny, J., & Pearson, J. (2011). Variability in the Definition and Reporting of Adverse Events in Suicide Prevention Trials: An Examination of the Issues and a Proposed Solution. *Achieves of Suicide Research 15*(1), 29–42.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*, *372*. https://doi.org/10.1136/BMJ.N71

Pompili, M., Serafini, G., Innamorati, M., Dominici, G., Ferracuti, S., Kotzalidis, G. D., Serra, G., Girardi, P., Janiri, L., Tatarelli, R., Sher, L., & Lester, D. (2010). Suicidal Behavior and Alcohol Abuse. *International Journal of Environmental Research and Public Health*, *7*(4), 1392. https://doi.org/10.3390/IJERPH7041392

Preuss, U. W., Schuckit, M. A., Smith, T. L., Danko, G. P., Dasher, A. C., Hesselbrock, M. N., Hesselbrock, V. M., & Nurnberger, J. I. (2002). A comparison of alcohol-induced and independent depression in alcoholics with histories of suicide attempts. *Journal of Studies on Alcohol 63*(4), 498–502. https://doi.org/10.15288/JSA.2002.63.498

Raskin White, H., & Labouvie, E. W. (1989). Towards the assessment of adolescent problem drinking. *Journal of Studies on Alcohol*, *50*(1), 30–37. https://doi.org/10.15288/JSA.1989.50.30

Read, J. P., Kahler, C. W., Strong, D. R., & Colder, C. R. (2006). Development and preliminary validation of the young adult alcohol consequences questionnaire. *Journal of Studies on Alcohol*, *67*(1), 169–177. https://doi.org/10.15288/JSA.2006.67.169

Scottish Government. (2018). Suicide Prevention Action Plan: Every Life Matters. https://www.gov.scot/publications/scotlands-suicide-prevention-action-plan-life-matters/

Self-Harm: Longer-Term Management. (2012). *National Collaborating Centre for Mental Health*, 415. https://www.ncbi.nlm.nih.gov/books/NBK126777/

Siddaway, A. P., Wood, A. M., & Hedges, L. v. (2019). How to Do a Systematic Review: A Best Practice Guide for Conducting and Reporting Narrative Reviews, Meta-Analyses, and Meta-Syntheses. *Annual Review of Psychology*, *70*, 747–770. https://doi.org/10.1146/ANNUREV-PSYCH-010418-102803

Silverman, M. M., Berman, A. L., Sanddal, N. D., O'Carroll, P. W., & Joiner, T. E. (2007). Rebuilding the tower of Babel: a revised nomenclature for the study of suicide and suicidal behaviors. Part 2: Suicide-related ideations, communications, and behaviors. *Suicide & Life-Threatening Behavior*, *37*(3), 264–277. https://doi.org/10.1521/SULI.2007.37.3.264

Sunami, N., Hammersley, J. J., & Keefe, K. M. (2019). The role of alcohol problems in the association between intimate partner abuse and suicidality among college students. *Psychology of Violence*, *9*(3), 319–327. https://doi.org/10.1037/VIO0000122

Turecki, G., & Brent, D. A. (2016). Suicide and suicidal behaviour. *The Lancet*, *387*(10024), 1227–1239. https://doi.org/10.1016/S0140-6736(15)00234-2

Windle, M. (2004). Suicidal behaviors and alcohol use among adolescents: a developmental psychopathology perspective. *Alcoholism, Clinical and Experimental Research*, *28*(5 Suppl). https://doi.org/10.1097/01.ALC.0000127412.69258.EE

Wolford-Clevenger, C., Bradizza, C., Parrott, D., Cropsey, K. L., & Stuart, G. L. (2020). The conditional association of problematic drinking with suicidal ideation by alcohol expectancies. *Addictive Behaviors*, *108*. https://doi.org/10.1016/J.ADDBEH.2020.106436

Chapter 2: Major Research Project

Investigating the role of alcohol-related factors on suicide

Prepared in accordance with the author requirements for BMC Psychiatry

(Appendix 1.1; https://bmcpsychiatry.biomedcentral.com/submission-guidelines/aims-and-scope)

Plain English Summary

Title: Investigating the role of alcohol-related psychological factors on suicide.

Background: Suicide is a global health problem. People who misuse alcohol are at a greater risk of dying by suicide, but our understanding of why they are at greater risk is poor. Researchers have proposed a number of different alcohol-related psychological factors which may help to explain why alcohol use and suicide are related. Greater insight into the role played by these alcohol-related psychological factors in suicide may lead to improved strategies for preventing suicide and reducing risk among those who misuse alcohol.

Aims: Drawing on recent theoretical models we investigated whether three alcohol-related psychological factors can help us understand the relationship between alcohol misuse and reporting having thought about suicide and having made a suicide attempt. These factors included a tendency to engage in impulsive or rash actions after drinking alcohol, believing that alcohol will lead to certain outcomes (alcohol expectancies) and experiencing problems due to alcohol.

Methods: This project used data from a 2015 study of 1546 adults aged 17 to 69 years from across Scotland who took part in the Health Lifestyle and Wellbeing study. Participants completed a 15–20-minute questionnaire which included measures of the three alcohol-related psychological factors and questions to assess if they had ever thought about suicide (lifetime suicide ideation) or ever attempted suicide (lifetime suicide attempt). Statistical tests were then used to investigate the studies aims and questions. Ethical approval for the 2015 study was provided by the College of Medical, Veterinary and Life Sciences Ethics Committee at the University of Glasgow (project no: 200140114).

Results: Findings from the study indicate that reporting a higher score on the measures of impulsivity after drinking alcohol, expecting that drinking alcohol will lead to suicide and reporting alcohol-related problems were all associated with a greater likelihood of reporting a history of suicide ideation and attempt. While alcohol-related problems may help us explain why alcohol misuse leads to suicide ideation and suicide attempts, a tendency to act impulsively after drinking may be more helpful in explaining how alcohol use leads to suicide attempts.

Practical Applications: These findings suggest that some alcohol-related psychological factors are associated with a higher risk of suicide outcomes and should be researched more in future. They are consistent with theoretical models that suggest certain factors may be better at explaining why some people think about suicide while others go on to attempt suicide. With continued research in this area we may be able to help clinicians better support individuals who misuse alcohol to prevent

suicide ideation. We may also be able to improve our ability to identify and support people who are at risk of attempting suicide.

Abstract

Background: Suicide is a major public health concern. People who misuse alcohol experience elevated risk of suicide ideation and suicide attempt. However, the role of specific alcohol-related psychological factors in suicide ideation and suicide attempt has received limited attention. The present study investigated the relationship of negative urgency whilst drinking, alcohol expectancies and alcohol-related problems with lifetime suicide ideation and attempt in the context of ideation to action frameworks.

Methods: Cross-sectional analysis using data from an existing study of 1546 adults aged 17 to 69 years from across Scotland. Participants completed a 20-minute questionnaire that included measures of key alcohol-related psychological factors and lifetime suicide ideation and attempt.

Results: Multivariable analysis indicated that negative urgency whilst drinking, suicide-specific alcohol expectancies, and alcohol-related problems were all significantly associated with lifetime suicide ideation and attempt when controlling for age, gender, and depression. As expected, negative urgency whilst drinking was a stronger mediator of hazardous alcohol use to suicide attempt than suicidal ideation. Alcohol expectancies did not mediate the relationships of hazardous drinking to suicide outcomes and alcohol-related problems mediated the relationship of hazardous use to suicide ideation and attempt to a similar degree.

Limitations: Causality cannot be inferred from the cross-sectional design.

Conclusion: Alcohol-related psychological factors should be considered when evaluating the risk of suicide ideation and attempts in individuals who misuse alcohol. Ideation to action frameworks may help to understand whether certain alcohol-related psychological factors are more strongly associated with the transition from suicide ideation to attempt.

Key words: alcohol misuse, suicide ideation, suicide attempt, negative urgency, alcohol expectancies

Introduction

Suicide refers to 'an act with fatal outcomes which the deceased, knowing or expecting potentially fatal outcomes, had initiated and carried out with the purpose of bringing about wanted changes' (de Leo, 2004, p12). Approximately 703, 000 individuals died by suicide in 2019, which is more than 1 in every 100 deaths worldwide (World Health Organization, 2021). In Scotland, 805 probable suicides were reported in 2020 which was a 3% annual decline (National Records of Scotland, 2020) however in recent times, rates of suicide have been disproportionately higher in Scotland compared to England and Wales (Dougall et al., 2017; Parkinson et al., 2017). High social and economic costs are associated with suicide, suicide attempts, and suicide ideation (Kerkhof, 2012; Shepard et al., 2016) which justify continued research and investment in suicide prevention. Suicide is the end point of a process involving suicide ideation and a suicide attempt with a fatal outcome. A suicide attempt is a non-fatal suicide behaviour, defined as a 'non-habitual act with nonfatal outcome that the individual, expecting to, or taking the risk to die or to inflict bodily harm, initiated and carried out with the purpose of bringing about wanted changes' (de Leo, et al 2006, p.14). Suicide ideation refers to contemplations, wishes, and preoccupations with suicide (Harmer et al., 2021) and can be described as casual, transient, passive, active, and persistent (de Leo, 2006).

The aetiology of suicide is complex and multifactorial (O'Connor & Nock, 2014). Contemporary models of suicide utilise ideation-to-action frameworks which distinguish between factors which are thought to contribute to the emergence of suicide ideation and those which are thought to play a role in the transition from ideation to suicide behaviour (e.g., O'Connor & Kirtley, 2018). Depressive and alcohol use disorders are common in individuals who die by suicide (Milner et al., 2013; Arsenault-Lapierre et al., 2004). Depression has been found to be a predictor of suicide ideation whilst disorders characterised by poor impulse control, such as alcohol use disorders, may better predict individuals who go on to plan and attempt suicide (Nock et al., 2010). Various psychological factors have been suggested which go beyond diagnostic categorisation and seek to explain the transition from suicide ideation to suicide attempt. Hopelessness, anhedonia, impulsivity, and high emotional reactivity have all been suggested to increase distress to intolerable levels in some individuals which increases the risk of suicide behaviour (Nock et al., 2008). Consistent with the stress-diathesis framework, negative life events have also been suggested to elevate the risk of suicide attempts (Pompili et al., 2010). In individuals with alcohol problems for example, interpersonal negative events significantly elevate the risk of suicide over the following 24 hours (Conner et al., 2012) and are a strong risk factor for suicide death (Kõlves et al., 2017).

Despite these advancements in identifying correlates and risk factors for suicide outcomes, our ability to longitudinally predict future suicide ideation or behaviour better than chance has not been demonstrated (Franklin et al., 2017). Until a clearer understanding develops on how risk factors coalesce into suicide in at-risk groups, it has been argued that individual-level suicide prevention strategies may be limited to detecting and treating mental disorders (Cavanagh et al., 2003). This is an unsatisfactory solution as most individuals with mental disorders do not attempt suicide, which implies that factors other than psychiatric symptoms are important in effective assessment and suicide prevention strategies. Empirical testing of suicide models developed for at-risk populations is an appropriate direction for future suicide research (Franklin et al, 2017). Increasingly, ideation-to-action frameworks are proposed for suicide research (Nock, et al., 2008) as many traditionally cited risk factors do not consistently distinguish individuals who think about suicide from individuals who attempt suicide (Klonsky et al., 2017). Taken together, these findings suggest that there is a need to empirically study factors which are differentially associated with suicide ideation and suicide behaviour in known at-risk populations.

Individuals who misuse alcohol are at elevated suicide risk (Amiri & Behnezhad, 2020; Ferrari et al., 2014; Norström & Rossow, 2016). The term alcohol misuse is a broad term which comprises diagnostic categories such as alcohol abuse and alcohol dependence (American Psychiatric Association, 2000) and alcohol use disorder (AUD; American Psychiatric Association, 2013), as well as drinking behaviours and patterns which are thought to be maladaptive but do not meet diagnostic criteria, such as hazardous alcohol use and harmful alcohol use (see Appendix 1.2 for full definitions). Individuals diagnosed with AUD are at increased risk of suicide ideation, suicide attempt and suicide death (Darvishi et al., 2015; Preuss et al., 2003). Prevalence estimates suggest that alcohol is also frequently consumed before suicide attempts (10–73%) and suicide death (10–69%; Cherpitel et al 2004). Alcohol consumption and suicide behaviour risk appear to follow a dose-response relationship (Borges et al., 2017). These findings suggest that both chronic and acute types of alcohol misuse confer elevated risk of suicide ideation and suicide behaviour. Psychosocial models of alcohol-related suicide aim to provide a theoretical account of how and why different types of alcohol misuse lead to suicide in adult (Conner et al., 2008; Hufford, 2001; Lamis & Malone, 2012) and adolescent populations (Bagge & Sher, 2008). These models include factors which are specific to alcohol misuse (hereafter referred to as alcohol-related factors) alongside nonalcohol-specific risk factors for suicide and present testable pathways via which alcohol misuse leads to suicide ideation and behaviours. However, there is less consensus about which factors and mechanisms best explain these relationships as they likely include cognitive, interpersonal and biological factors. It has been acknowledged that to date limited empirical research has been carried out into the role of several

alcohol-related factors (Bagge and Sher, 2008; Norström & Rossow, 2016). Further research could improve the accuracy of psychological models and holds potential to improve clinical practice by refining screening, assessment, and intervention to prevent suicide in this at-risk population.

Alcohol-expectancies

Influenced by Social Learning Theory (Bandura, 1977), alcohol-expectancies (AEs) encapsulate an individual's beliefs and ideas about the consequences of drinking alcohol. They have been conceptualised as being part of long-term memory that influence current and future alcohol consumption (Jones et al., 2001). Empirical research indicates that AEs may be able to predict congruent behaviour when drinking. For example, individuals who expect to become aggressive when they drink alcohol are more likely to attend to vexing stimuli and act in impulsive, aggressive, and disinhibited ways (Lac & Brack, 2018). Researchers such as Hufford (2001) have also proposed there may be suicide-specific AEs which increase the likelihood of suicide. These are that alcohol will: i) provide courage for suicidal acts, ii) numb the pain of suicidal acts, and iii) act as mood enhancer, which leads to a painful contrast if alcohol in fact exacerbates negative affect. However, research investigating the role of non-suicide specific and suicide-specific AEs in suicide risk has been limited to date. Wolford-Clevenger et al., (2020) tested if non-suicide specific AEs mediate the association between alcohol misuse and suicide ideation and reported non-significant findings. Self-harm specific AEs have however been found to be associated with alcohol misuse and a history of self-harm (Jarvi & Swenson, 2017) and research by Melson & O'Connor (2019) found that individuals who engaged in self-harm were significantly more likely to endorse self-harm AEs than individuals who thought about self-harm only. Non-self-harm specific AEs were not independently associated with self-harm behaviour (Melson & O'Connor, 2019). These findings suggest that suicide-specific AEs may be particularly important in understanding self-harm behaviour. However, more research is needed on the role of non-suicide specific and suicide-specific AEs and suicide outcomes, particularly suicide behaviour, to refine our theoretical understanding of AEs in individuals who misuse alcohol.

Alcohol-related Negative Urgency

Impulsivity has been conceptualised as a personality trait associated with a broad range of behaviours that reflect impaired self-regulation, poor planning, responding before consequential thinking, sensation-seeking, risk taking, and inability to inhibit responding (Gvion & Apte, 2011). Various dimensions of trait impulsivity may act as pathways towards impulsive actions (Whiteside et al., 2005) including suicidal behaviour. However, questions remain over how impulsivity may interact with other factors to lead to suicidal behaviour (see Gvion & Apte, 2011). Negative Urgency, defined

as a tendency to engage in rash, potentially dangerous actions when experiencing negative affect, may be particularly relevant to understanding the relationship between alcohol misuse and suicide. For example, empirically, Negative Urgency has been found to be associated with more negative consequences when drinking, including frequent black outs, risky behaviours, and interpersonal conflict (McCarty et al., 2017). More recent research has specifically focused on Negative Urgency contingent upon alcohol use (hereafter referred to as Negative Urgency-A: e.g., when I am upset and I drink alcohol, I often act without thinking). Using a modified version of the Negative Urgency subscale from the UPPS impulsivity behaviour scale (Whiteside et al., 2005), Melson and O'Connor recently reported that Negative Urgency-A differentiated adults who reported a history of self-harm acts from adults who had only thought about self-harm (Melson & O'Connor, 2019). These findings suggest that Negative-Urgency-A may be an important path by which alcohol misuse may lead to an increase in suicidal behaviour.

Alcohol-related problems

Models of alcohol-related suicide propose that negative life events are a distal risk factor for suicide, with effects that accumulate over time and contribute towards the emergence of suicide ideation through increases in social isolation and strain and to suicidal behaviour through depression symptoms (Conner & Duberstein, 2004). However, negative life events often occur in the months or days prior to suicide in adults (Foster, 2011) and evidence suggests that they can influence the transition from suicide ideation to first suicide attempt (Paul et al 2018). In populations with an AUD, a "last straw" effect has also been proposed whereby negative life events can result in a short, 24-hour window of elevated suicide behaviour risk (Conner et al., 2012). The literature therefore suggest that negative life events may increase risk of both suicide ideation and suicide attempt. What is less known however is the impact of life problems due to alcohol misuse on risk of suicide ideation and attempts. Research in adolescent samples highlights that alcohol-related problems, when defined as negative social and educational consequences due to drinking, are associated with broad measures of suicide proneness and suicidality (Lamis & Malone, 2011; Sunami et al, 2019). However, DeCou & Skewes, (2016) found that alcohol-dependence symptoms, not negative social and educational consequences due to drinking, predicted suicide ideation when controlling for depression in undergraduates. It seems plausible that problems due to the alcohol dependence syndrome as well as the negative social and other consequences that arise from alcohol misuse both contribute to the emergence of suicide ideation and the transition to suicide attempt. However, further empirical research investigating the role of alcohol-related problems in suicide ideation and suicide attempt is needed.

Study aims

This study aims to enhance understanding of the role of alcohol-related factors in suicide, specifically the role of alcohol expectancies (AEs), alcohol-related negative urgency, and alcohol-related problems. Given research which suggests that alcohol-related factors can contribute to distinct parts of the suicide pathway (Conner et al., 2007) and that ideation to action frameworks should be incorporated into future suicide research (Nock et al., 2008), the current study will explore if these factors are more strongly associated with suicide ideation or suicide attempt.

Consistent with Melson & O'Connor (2019), which drew upon the ideation-to-action framework of the integrated motivational-volitional model of suicidal behaviour (IMV; O'Connor & Kirtley, 2018) the present research will conceptualise alcohol-related factors as either pre-motivational or volitional factors. Pre-motivational factors are related to the emergence of suicide ideation whereas volitional factors govern the transition from thinking about suicide to acting on those thoughts (O'Connor & Kirtley, 2018). Barzilay & Apter (2014) have suggested that to improve the generalisability of ideation-to-action suicide frameworks, they should be applied to more diverse, at-risk samples. This study aims to make a novel contribution by testing hypothesis based upon ideation-to-action frameworks to explain suicide ideation and suicide attempt risk in a community sample of adults where a measure of alcohol use was included.

Research questions and study hypotheses

The present research addresses two research questions and three hypotheses. The first research question is: to what extent are alcohol expectancies, alcohol-related negative urgency, and alcohol-related problems associated with lifetime suicide ideation and lifetime suicide attempt? Based on Lac & Brack, (2018), Melson & O'Connor, (2019), Sunami et al, (2019) and DeCou & Skewes, (2016) it is hypothesised that each of these alcohol-related factors will be significantly associated with both suicide-related outcomes.

The second research question is: do alcohol-related factors differentially contribute to distinct parts of the suicide process? Consistent with ideation-to-action approaches such as the IMV model (O'Connor & Kirtley, 2018), it is hypothesised that alcohol-related negative urgency and alcohol expectancies (considered volitional phase factors for the purpose of this study) will be stronger mediators of the relationship between hazardous alcohol use and lifetime suicide attempt than the hazardous alcohol use and lifetime suicide ideation relationship. In contrast, it is hypothesised that alcohol-related problems (considered a pre-motivational factor for the purpose of this study) will be

a stronger mediator of the relationship between hazardous alcohol use and lifetime suicide ideation than the alcohol use and lifetime suicide attempt relationship.

Methods

This project is a cross-sectional data analysis of a secondary dataset (Melson & O'Connor, 2019). Access to the dataset was provided through the author's affiliate status with the Suicidal Behaviour Research Laboratory (holders of the data). The College of Medical, Veterinary and Life Sciences Ethics Committee was contacted and confirmed the research remained within scope of the original study for which data were collected. In light of this, full ethics committee review was not required (see Appendix 2.2 and 2.3). The trainee was responsible for preparation of the dataset, including checking data accuracy, coding variables and handling missing data. The procedures for the original study and the measures and statistical analysis used in this project are presented below.

Participants and procedures

In 2015, adults aged 18 and over residing in Scotland were recruited to the baseline phase of the Health Lifestyle and Wellbeing (HLW) study, a study investigating lifestyle factors and their relationships with health and wellbeing among adults in Scotland. Recruitment involved convenience sampling, with employers, education institutions, and online community networks advertising the study and hosting or distributing a URL to complete an online survey. Contact details for the research team were provided and the independence of the research team from employers or education institutions was outlined. Written informed consent was gained and local ethical approval was provided by the College of Medical, Veterinary and Life Sciences Ethics Committee at the University of Glasgow (project no: 200140114). The questionnaire required 15-20 minutes to complete and included questions on a range of demographic, lifestyle, mental and physical health status, and other psychological measures. Participation was incentivised with entry into a prize draw. The vast majority of participants opted to complete the online version of the survey over a paper-based alternative. Only measures relevant to the current study are presented below.

Measures

Demographics and covariates

Depressive symptoms are strongly associated with increased suicide mortality and the strength of this association can vary according to age and sex (Ösby et al., 2001). Therefore, measures of age, gender, and depressive symptoms were included and controlled for during all multivariable analyses. Depressive symptoms were measured with the Centre for Epidemiologic Studies Depression Scale-

Revised (CESD-R; Eaton et al, 2004). According to Loo (2001), an acceptable internal consistency score for general research purposes is 0.80. In the current study, the Cronbach alpha coefficient for the CESD-R was 0.93.

Alcohol-related factors

Hazardous alcohol use and Alcohol-related Problems

Items from the Alcohol Use Disorders Identification Test (AUDIT) were used to measure hazardous alcohol us and alcohol-related Problems. The AUDIT is a psychometrically robust 10-item self-report questionnaire widely used in research and clinical settings to screen for alcohol misuse (Reinert & Allen, 2007; de Meneses-Gaya et al., 2009). AUDIT items can be scored and interpreted across 3 separate domains of alcohol misuse: items 1-3 measure hazardous alcohol use (i.e., consuming alcohol in quantities that increase the risk of harm to physical and mental health), items 4-7 measure symptoms of dependent alcohol use, and items 8-10 measure harmful alcohol use (i.e., physical, mental, and/or social problems due of alcohol use). This study uses items 1-3 (known as the AUDIT-C) to provide a measure of hazardous alcohol use. The AUDIT-C is a valid screening tool for levels of alcohol use that expose individuals to elevated risks of Alcohol Use Disorders (AUD) (Higgins-Biddle & Babor, 2018) and contains items such as, how often do you have a drink containing alcohol and how many units of alcohol do you drink on a typical day when you are drinking? All items are scored on a 4-point Likert scale. For scales with fewer than 10 items, a reliability estimate of 0.60 is considered acceptable (Loewenthal, 1996). In this study, the Cronbach alpha coefficient for Hazardous alcohol use was 0.71.

Research suggests that the problems typically associated with hazardous alcohol use (e.g., alcohol dependence and negative social/interpersonal, employment, financial consequences due to drinking) are better predictors of suicide outcomes than levels of consumption alone (DeCou & Skewes, 2016). Items 4-10 of the AUDIT were therefore combined to form a novel, composite measure of alcohol-related problems. Example items are, how often during the last year have you failed to do what was normally expected from you because of your drinking and have you or somebody else been injured as a result of your drinking? All items are scored on a 4-point Likert scale. The Cronbach alpha coefficient in this study was 0.76.

Negative Urgency-A

Negative Urgency-A was measured using a modified version of the 12-item Negative Urgency subscale of the UPPS Impulsive Behaviour Scale (Whiteside et al., 2005). The UPPS subscales include sensation seeking, lack of perseverance, lack of planning, negative urgency, and positive urgency and

have demonstrated utility in discerning between traits of impulsivity that account for different real-world risky behaviour (Smith et al., 2007) including self-harm (Glenn & Klonsky, 2010). Compared with other UPPS subscales, Negative Urgency has emerged as the strongest predictor of alcohol problems and alcohol dependence (Coskunpinar et al., 2013) and is also associated with risk taking and interpersonal difficulties when intoxicated (McCarty et al., 2017). To provide a more nuanced account of the potential role of Negative Urgency for suicidal risk the HLW study used a modified version to assess Negative Urgency contingent upon alcohol use. For example, original Negative Urgency items such as 'when I am upset, I often make matters worse because I act without thinking' was modified to 'when I am upset and I drink, I often make matters worse because I act without thinking'. Items are scored on a 4-point Likert scale: 1 (agree strongly) to 4 (disagree strongly). The Cronbach alpha coefficient in this study was 0.94.

Alcohol expectancies

Alcohol expectancies were measured using the Comprehensive Effects of Alcohol Questionnaire (CEOA; Fromme et al., 1993), a 38-item measure that loads onto seven alcohol-expectancies: sociability, tension reduction, liquid courage, sexuality, cognitive and behavioural impairment, risk and aggression, and self-perception. Research supports the criterion validity of CEOA expectancy scales as direct and indirect relationships to excess alcohol use have been demonstrated both cross-sectionally and longitudinally (Anthenien et al., 2017) and internal consistency of the CEOA scales range from adequate to good (Ham et al., 2005). In the present study only expectancy subscales anticipated to have a specific path to suicide were included, with three subscales (sociability, sexuality, and cognitive and behavioural impairment) omitted. In addition to the remaining CEOA subscales, an additional novel alcohol expectancy (suicide) was also measured with the addition of 7 suicide expectancy items. These novel expectancy items were informed by two prominent psychological models of suicide, the interpersonal theory of suicide (van Orden et al., 2010) and the IMV (O'Connor & Kirtley, 2018). Following the standard alcohol expectancy item format they were: 'when I drink, I expect to…' ['think about suicide'], ['attempt suicide'], ['feel disconnected'[, ['feel alone'], ['feel defeated'[, ['feel hopeless'], and ['feel trapped']. All items are scored on a 4-point Likert scale from 1 (disagree) to 4 (agree). All AE scales used in this study contained fewer than 10 items. Cronbach alpha coefficients ranged between 0.73-0.87 for the original scales from the CEOA. For the novel AE suicide scale, the Cronbach alpha coefficient was 0.82.

Lifetime suicide ideation and suicide attempt

Two items from the 2000 and 2007 British National Psychiatric Morbidity surveys (Meltzer 2002; Nicholson et al., 2009) were used to assess lifetime history of suicide ideation and suicide attempt. Participants were asked to answer the following: 'Have you ever seriously thought of taking your life, but not actually attempted to do so?' and 'Have you ever made an attempt to take your life, by taking an overdose of tables or in some other way? Both items were coded as 0 ('no') and 1 ('yes').' See Appendix 2.4 for the full HLW questionnaire.

Statistical analysis

All analyses were cross-sectional and used the statistical package SPSS version 26 (IBM Corp, 2019). In order to answer the first research question, initially a series of univariable logistic regression models were used to investigate the association between each study variable and lifetime suicide ideation and lifetime suicide attempt. Following this, multivariable logistic regression models that included covariates were carried out to investigate the association between Hazardous alcohol use and alcohol-related problems with lifetime suicide ideation and attempt (Models 1 and 2), alcohol-expectancies and lifetime suicide ideation and attempt (Models 3 and 4), and negative urgency and lifetime suicide ideation and attempt (Models 5 and 6). In Models 3-6, Hazardous alcohol use was also included as a covariate. Only alcohol-related factors which demonstrated significant univariable relationships were included in multivariable analysis.

In Models 1 and 2, age, gender, and depression were entered at step 1 and hazardous alcohol use and alcohol-related problems were entered at step 2. In Models 3 and 4, age, gender, depression, and hazardous alcohol use were entered at step 1 and selected (based on significant univariable associations) alcohol-expectancies were added at step 2. In Models 5 and 6, age, gender, depression, and hazardous alcohol use were entered at step 1 and negative urgency was added at step 2.

To investigate the second research question, whether alcohol-related factors would contribute to distinct parts of the suicide process, Hayes' (2013) PROCESS macro for SPSS was used to test logistic regression-based mediation effects (including estimates of indirect effects and direct effects). The PROCESS macro uses a bootstrap resampling technique (10,000 bootstrap samples) to estimate confidence intervals as this better reflects irregularities in sample distributions and increases power. The main outcome of interest are the indirect effects within these models, which will be considered even if a direct effect between the X (predictor) variable and Y (outcome) variable are non-significant. Hayes (2013) provides a comprehensive overview of recent methodological research

which supports this position which is a departure from the causal steps approach popularised by Baron & Kenny, (1986). A key criticism of the causal steps approach is the requirement to reject three null hypotheses prior to considering an indirect effect: i) that the total effect of X on Y is zero, ii) that the effect of X on M is zero, and iii) that M does not effect Y when controlling for X. It is argued that with each additional test being conducted, the chances of error increase. Hayes (2013) provides a summary of simulation studies which demonstrate that the causal steps approach therefore lacks statistical power and should not be the default approach used.

The statistical significance of model effects was demonstrated if the 95% unstandardised bootstrap confidence interval did not contain zero. A total of 6 simple mediation models were used to test the extent to which: alcohol expectancies mediated associations between hazardous alcohol use and lifetime suicide ideation and attempt (Figure 1); negative urgency mediated associations between hazardous alcohol use and lifetime suicide ideation and attempt (Figure 2); and if alcohol-related problems mediated associations between hazardous alcohol use and lifetime suicide ideation and attempt (Figure 3).

There is considerable complexity associated with logistic regression-based mediation analysis as conventional methods of calculating indirect (i.e., mediated) effect coefficients are not applicable (MacKinnon et al., 2007). Different methods of calculating indirect effects in logistic regression-based mediation exist however no consensus has emerged (Iacobucci, 2012). The default coefficient for continuous X (predictor) and M (mediator) variables and dichotomous Y (outcome) variables provided in the PROCESS macro is an unstandardised log-odds metric. However, to provide a more intuitive estimative of the indirect effect the log-odds metric was converted to an odds ratio (OR) which has been described as an acceptable analogue of Cohen's d (Feingold et al., 2019). Furthermore, given the lack of consensus in the literature around the most robust measure of indirect effect size, a partially standardised effect (Y-standardisation) was calculated based on the formula provided by Hayes (Hayes, 2013). This partially standardised effect is expressed relative to the standard deviation of the Y variable (i.e., a 1-unit change in X leads to a 0.5 SD change in Y through M). This provides a measure of the magnitude of change accounted for by each mediator in the same Y (outcome variable).

Missing data

After excluding those who did not complete the minimum dataset n = 1,546 were included in main analyses. The overall level of missingness was small, with higher levels of missingness found for items 1-3 of the AUDIT. For all key variables, total item-level missingness was 0.26% and the scale-level

missingness ranged from 0-64 (0-4.1%). Scale-level missingness <5% is considered small (Graham, 2009). Analyses of patterns of missingness indicated that missing values on key variables were associated with observed responses on other items and there was no systematic missingness when checked against sample characteristics. Consistent with missing at random (MAR) assumptions the Expectation Maximization (EM) method was chosen as an appropriate missing data procedure (Newman, 2014). Additional variables contained within the dataset, but which are not part of the study analyses, were correlated with study variables and were included as auxiliary variables to strengthen the EM estimation model: depression, negative mood regulation expectancies, perceived stress, wellbeing, and a rating of mental health. This is advised as best practice to reduce missing data bias and error (Newman, 2014). In the final step EM was used to replace missing values for the key variables: AUDIT, alcohol expectancies, and negative urgency.

Results

Descriptive information

There were a total of 1546 participants in the sample (Table 1). Participants were predominately female (70.2%) and white (91.8%). The average age was 34.4 (SD = 12.9; range 17-69) years. The majority had never married (54.7%), held degree or post-graduate degree qualifications (58.6%), were employed (65.3%) and identified as heterosexual (88.5%).

Table 1: Demographic Characteristics

Characteristic			
Continuous variables		**M**	**SD**
Age		34.4	12.9
Categorical variables		**N**	**%**
Gender	Male	430	29.8
	Female	1086	70.2
Ethnicity	White	1418	91.7
	Other	127	8.2
Marital/relationship status	Married	486	31.4
	Common-law marriage	52	3.4
	Divorced	78	5
	Never married	845	54.7
	Separated	43	2.8
Education level	School/HNC/NHC/NQ/SVQ	636	41.1
	Degree or PG degree	906	58.6
Employment status	Employed	1010	65.3
	Student	465	30.1
	Unemployed and seeking work	47	3

Of the sample 27.9% of participants scored ≥ 17 on the measure of depression, the threshold for clinically meaningful depressive symptoms (Radloff, 2016). A minority of participants reported suicide ideation (32.4%) or suicide attempt (7.6%). See appendix 2.5 or descriptive information for key study variables as well as the total AUDIT score for reference.

Univariable associations of alcohol factors with suicide ideation and suicide attempt

Tables 2 and 3 display univariable logistic regression results for each alcohol-related factor for the lifetime suicide ideation and lifetime suicide attempt outcomes respectively. The majority of the alcohol factors were significantly associated with an increased odds of suicide ideation and attempt. However, hazardous alcohol was not significantly associated with an increase in the odds of suicide ideation or suicide attempt and AE Tension Reduction was not significantly associated with an increase in the odds of suicide attempt. Relatively greater odds of suicide ideation with AE suicide and AE Self-Perception were observed, along with relatively greater odds of suicide attempt with AE suicide, AE Self-Perception, AE Risk and Aggression, and Negative Urgency-A.

Table 2 Univariate Logistics Regression outcomes for Presence of Lifetime Suicide Ideation

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Hazardous alcohol use	0.018	0.02	0.803	1	0.37	1.09	0.98	1.06
Alcohol-related problems	0.12	0.018	46.12	1	**<.001**	**1.13**	**1.09**	**1.17**
AE Suicide	1.295	0.123	110.931	1	**<.001**	**3.65**	**2.87**	**4.65**
AE Tension reduction	0.179	0.079	5.173	1	**0.02**	**1.20**	**1.03**	**1.40**
AE Liquid courage	0.396	0.074	28.552	1	**<.001**	**1.49**	**1.29**	**1.72**
AE Risk and aggression	0.527	0.083	40.484	1	**<.001**	**1.69**	**1.44**	**1.99**
AE Self-perception	0.772	0.091	72.188	1	**<.001**	**2.16**	**1.81**	**2.59**
Negative Urgency-A	0.555	0.073	58.258	1	**<.001**	**1.74**	**1.51**	**2.01**

Note: AE = Alcohol Expectancy, 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Table 3 Univariate Logistic Regression outcomes for Presence of Lifetime Suicide Attempt

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Hazardous alcohol use	0.053	0.035	2.277	1	0.131	1.05	0.98	1.13
Alcohol-related problems	0.138	0.023	36.934	1	**<.001**	**1.15**	**1.10**	**1.20**
AE Suicide	1.251	0.171	53.396	1	**<.001**	**3.49**	**2.50**	**4.89**
AE Tension reduction	0.018	0.137	0.018	1	0.894	1.018	0.78	1.33
AE Liquid courage	0.57	0.134	18.144	1	**<.001**	**1.77**	**1.36**	**2.30**
AE Risk and aggression	0.809	0.14	33.541	1	**<.001**	**2.25**	**1.71**	**2.95**
AE Self-perception	0.845	0.145	33.806	1	**<.001**	**2.33**	**1.75**	**3.09**
Negative Urgency-A	0.919	0.119	59.718	1	**<.001**	**2.51**	**1.99**	**3.17**

Note: AE = Alcohol Expectancy, 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at $p < .05$.

Model 1: Hierarchical logistic regression of alcohol-related problems and lifetime suicide ideation

Table 4.1 displays the hierarchical logistic regression results for hazardous alcohol use and alcohol-related problems and lifetime suicide ideation. Age, gender, and depression were included in step 1 as covariates. The model overall was significant, x^2 (5, N=1546) = 219.11, p= 0.001 and correctly classified 70.8% of cases. Hazardous alcohol use had a significant and negative association with suicide ideation, suggesting that as hazardous alcohol use increases, suicide ideation decreases. This was an unexpected finding, given the non-significant univariable regression outcome for hazardous alcohol use and lifetime suicide ideation. Further investigation revealed that hazardous alcohol use was strongly positively correlated with alcohol-related problems (r= 0.45, p<0.001) and weakly positively correlated with suicide ideation (r= 0.01, p=0.37). This suggest that in the multivariable regression analysis, a suppression effect may account for the unexpected coefficient sign reversal and significant result. Alcohol-related problems were significantly positively associated with suicide ideation.

Table 4.1 Multivariable Logistic Regression model including covariates and hazardous alcohol use and alcohol-related problems on Lifetime Suicide Ideation

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Covariates								
Age	0.000	0.005	0.001	1	0.979	1.00	0.99	1.01
Gender	0.091	0.133	0.467	1	0.494	1.10	0.84	1.42
Depression	0.068	0.006	136.385	1	**<.001**	**1.07**	**1.06**	**1.08**
Alcohol-related factors								
Hazardous alcohol use	-0.051	0.026	3.854	1	**0.05**	**0.95**	**0.90**	**1.00**
Alcohol-related problems	0.085	0.024	12.644	1	**<.001**	**1.09**	**1.04**	**1.14**

Note: 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Model 2: Hierarchical Logistic regression of Alcohol-related Problems and lifetime suicide attempt

Table 4.2 displays the hierarchical logistic regression results for suicide attempt. Again, the model overall was significant. x^2 (5, N=1546) = 103.882, p= 0.001, correctly classifying 92.3% of cases. Only alcohol-related problems were significantly associated with the odds of lifetime suicide attempt over covariates.

Table 4.2 Multivariable Logistic Regression model including covariates and hazardous alcohol use and alcohol-related problems on Lifetime Suicide Attempt

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Covariates								
Age	0.017	0.008	3.852	1	**0.05**	**1.02**	**1.00**	**1.03**
Gender	-0.726	0.260	7.801	1	**0.01**	**0.48**	**0.29**	**0.81**
Depression	0.062	0.008	59.374	1	**<.001**	**1.06**	**1.05**	**1.08**
Alcohol-related factors								
Hazardous alcohol use	-0.019	0.044	0.180	1	0.672	0.98	0.90	1.07
Alcohol-related problems	0.101	0.032	9.914	1	**0.002**	**1.10**	**1.03**	**1.17**

Note: 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Model 3: Hierarchical Logistic regression of AEs and lifetime suicide ideation

In univariable analysis AE tension reduction was not significantly associated with lifetime suicide attempt and was relatively more weakly associated with lifetime suicide ideation. As outlined in the statistical analysis plan, this meant AE tension reduction was not included within multivariable models.

Table 5.1 displays the hierarchical logistic regression results for AEs and lifetime suicide ideation. Age, gender, depression, and hazardous alcohol use were included as covariates. The four AEs included were AE suicide, AE self-perception, AE risk and aggression, and AE liquid courage. The model overall was significant, x^2 (7, N=1546) = 247.81, p= 0.001, and correctly classified 72.3% of cases. The only AE which was independently associated with the odds of suicide ideation was AE suicide, suggesting that as endorsement in this expectancy increased, so too do the odds of lifetime suicide ideation.

Table 5.1 Multivariable Logistic Regression model including covariates and Alcohol Expectancies on Lifetime Suicide Ideation

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Upper	Lower
Covariates								
Age	-0.001	0.01	0.08	1	0.77	1	0.99	1.01
Gender	-0.13	0.14	0.95	1	0.33	0.88	0.67	1.14
Depression	0.06	0.01	102.78	1	**<.001**	**1.06**	**1.05**	**1.08**
Hazardous alcohol use	-0.01	0.02	0.004	1	0.95	1	0.96	1.04
Alcohol-related factors								
AE Suicide	0.74	0.19	14.98	1	**<.001**	**2.09**	**1.44**	**3.04**
AE Self perception	0.05	0.14	0.16	1	0.69	1.06	0.80	1.40
AE Risk and Aggression	-0.02	0.14	0.02	1	0.90	0.98	0.74	1.30
AE Liquid Courage	0.14	0.12	1.22	1	0.27	1.14	0.90	1.45

Note: AE = Alcohol Expectancy, 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Model 4: Hierarchical Logistic regression of AEs and lifetime suicide attempt

Table 5.2 displays the hierarchical logistic regression results for AEs and lifetime suicide attempt. The overall model was also significant, x^2 (7, N=1546) = 115.59, p= 0.001), correctly classifying 92.2% of cases. The only AE which was independently associated with the odds of suicide ideation was AE suicide, suggesting that as endorsement in this expectancy increased, so too do the odds of lifetime suicidal attempt.

Table 5.2 Multivariable Logistic Regression model including covariates and Alcohol Expectancies on Lifetime Suicide Attempt

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Covariates								
Age	0.016	0.01	3.42	1	0.06	1.02	1	1.03
Gender	-0.75	0.26	8.14	1	**0.004**	**0.48**	**0.29**	**0.79**
Depression	0.06	0.01	47	1	**<.001**	**1.06**	**1.04**	**1.08**
Hazardous alcohol use	0.04	0.04	1.18	1	0.28	1.04	0.97	1.12
Alcohol-related factors								
AE Suicide	0.58	0.28	4.43	1	**0.04**	**1.79**	**1.04**	**3.07**
AE Self perception	0.02	0.23	0.01	1	0.93	1.02	0.66	1.58
AE Risk and Aggression	0.39	0.23	2.93	1	0.09	1.48	0.94	2.32
AE Liquid Courage	0.06	0.21	0.08	1	0.78	1.06	0.71	1.58

Note: AE = Alcohol Expectancy, 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Model 5: Hierarchical Logistic regression of Negative Urgency-A and lifetime suicide ideation

Table 6.1 displays the hierarchical logistic regression results in which age, gender, depression, and hazardous alcohol use were included as covariates. The final model was significant, x^2 (4, N=1546) = 220.058, p= 0.001, and correctly classified 70.5% of cases. Negative urgency was significantly independently associated with an increase in the odds of lifetime suicide ideation.

Table 6.1 Multivariable Logistic Regression model including covariates and Negative Urgency-A on Lifetime Suicide Ideation

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Co-variates								
Age	-0.00	0.01	0.09	1	0.76	1	0.99	1.01
Gender	-0.02	0.13	0.03	1	0.87	0.98	0.75	1.27
Depression	0.07	0.01	135.93	1	**<.001**	**1.07**	**1.06**	**1.08**
Hazardous alcohol use	-0.04	0.02	2.26	1	0.13	0.97	0.92	1.01
Alcohol-related factor								
Negative Urgency-A	0.29	0.01	16.12	1	**<.001**	**1.03**	**1.02**	**1.04**

Note: 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Model 6: Hierarchical Logistic regression of Negative Urgency-A and lifetime suicide attempt

Table 6.2 displays the hierarchical logistic regression results for suicide attempt. The model was also significant x^2 (4, N=1546) = 117.482, p= 0.001 and correctly classified 92.3% of cases. Again, negative urgency was significantly independently associated with an increase in the odds of suicide attempt.

Table 6.2 Multivariable Logistic Regression model including covariates and Negative Urgency-A on Lifetime Suicide attempt

	B	S.E.	Wald	df	Sig.	OR	95% C.I. for OR	
							Lower	Upper
Co-variates								
Age	0.01	0.01	2.39	1	0.12	1.01	1	1.03
Gender	-0.57	0.26	4.86	1	**0.03**	**0.57**	**0.34**	**0.94**
Depression	0.06	0.01	54.91	1	**<.001**	**1.06**	**1.04**	**1.078**
Hazardous alcohol use	-0.01	0.04	0.1	1	0.76	0.99	0.92	1.07
Alcohol-related factor								
Negative Urgency-A	0.06	0.11	24.11	1	**<.001**	**1.06**	**1.04**	**1.08**

Note: 95% CI =Confidence interval, OR = Odds ratio. **Bold** =significant at p < .05.

Mediation analysis using Hayes' (2013) PROCESS

In this section simple mediation models are used to test hypotheses that the proposed volitional phase alcohol factors (Negative Urgency-A and AEs) will more strongly mediate hazardous alcohol use and lifetime suicide attempt than hazardous alcohol use and lifetime suicide ideation. Mediation models are also used to test the hypothesis that the proposed motivational phase factor (Alcohol related Problems) will more strongly mediate the hazardous alcohol use and lifetime suicide ideation relationship than hazardous alcohol use and lifetime suicide attempt. In each model, the indirect effect between hazardous alcohol use and each suicide outcome through each potential mediator is the path of interest.

Simple mediation models of hazardous alcohol use on lifetime suicide ideation and attempt mediated by Negative Urgency-A

Figure 1 Panel A shows that there was a significant positive association between hazardous alcohol use and negative urgency (β=0.10, SE= 0.01, CI= 0.08, 0.11, $p<0.001$) and a significant positive association between negative urgency and suicide ideation (β=0.61, SE= 0.08, CI= 0.45, 0.76, $p<0.001$). The direct effect of hazardous alcohol use on suicide ideation was negative and non-significant (β=-0.04, SE= 0.02, CI= -0.08, 0.001, $p=0.06$). The indirect effect of hazardous alcohol use on lifetime suicide ideation due to Negative Urgency was positive and significant (β=0.06. SE=0.01, CI= 0.04, $p=0.08$). This indicates that an increase in hazardous alcohol use was associated with increased likelihood of suicide ideation due to the effect of hazardous alcohol on negative urgency.

Panel B shows that there was also a significant positive association between negative urgency and suicide attempt (β=0.95, SE= 0.12 CI= 0.71, 1.2, $p<0.001$). The direct effect between hazardous alcohol use and suicide attempt was non-significant (β=-0.04, SE= 0.04, CI= -0.11, 0.04, $p=0.32$). The indirect effect was positive and significant (β=0.09, SE=0.01, CI= 0.06, 0.12), indicating that an increase in hazardous alcohol use was associated with increased likelihood of suicide attempt due to the effect of hazardous alcohol use on negative urgency.

Figure 1: Mediation analysis of Negative Urgency-A on the relationship between hazardous alcohol use and lifetime suicide ideation (panel A) and lifetime suicide attempt (panel B)
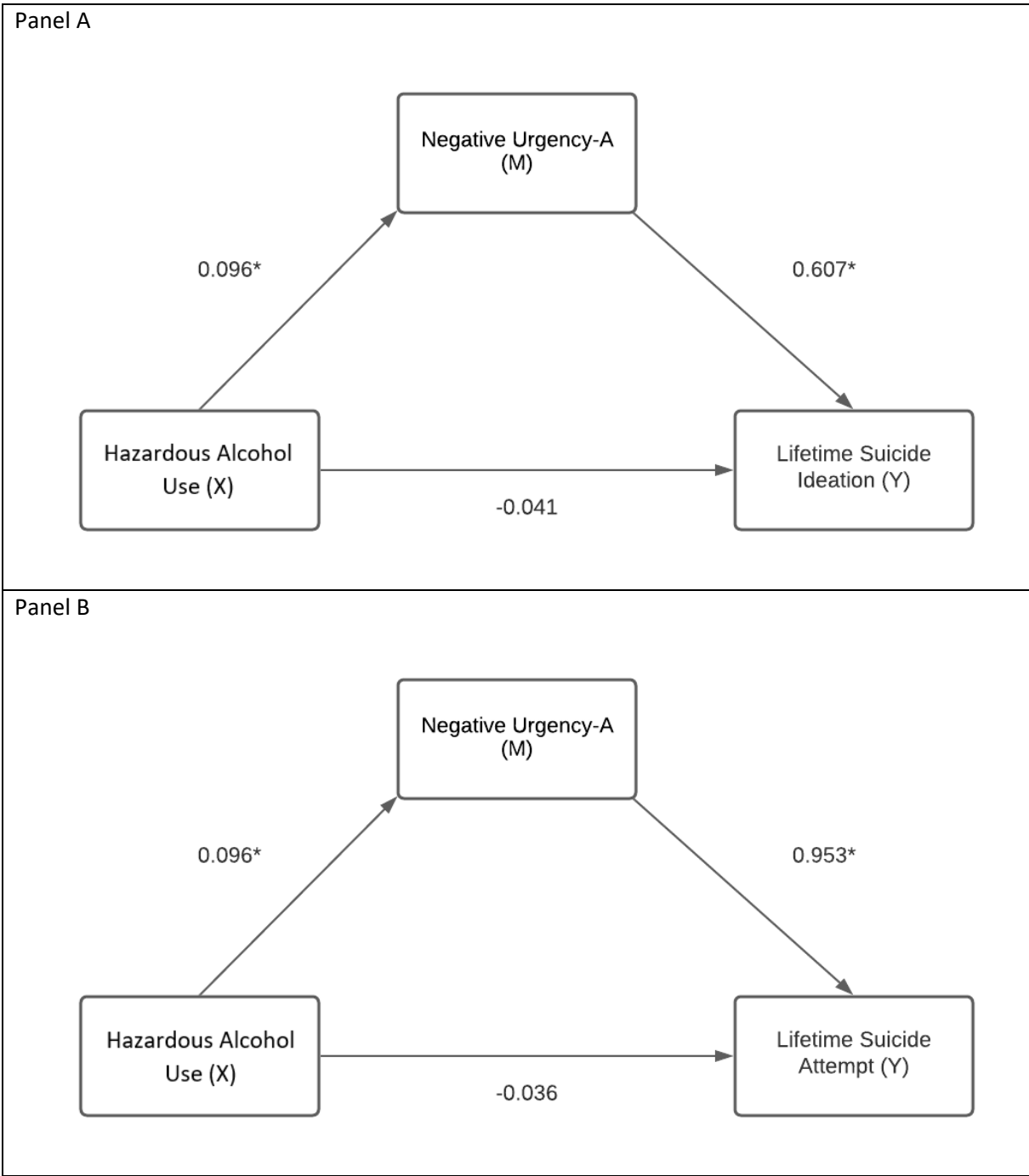
Note: All coefficients are unstandardised *p<0.001

Figure 2: Mediation analysis of AE Suicide on the relationship between hazardous alcohol use and lifetime suicide ideation (panel A) and lifetime suicide attempt (panel B)

Note: All coefficients are unstandardised *p<0.001

Figure 3 Mediation analysis of Alcohol-related problems on the relationship between hazardous alcohol use and lifetime suicide ideation (panel A) and lifetime suicide attempt (panel B)
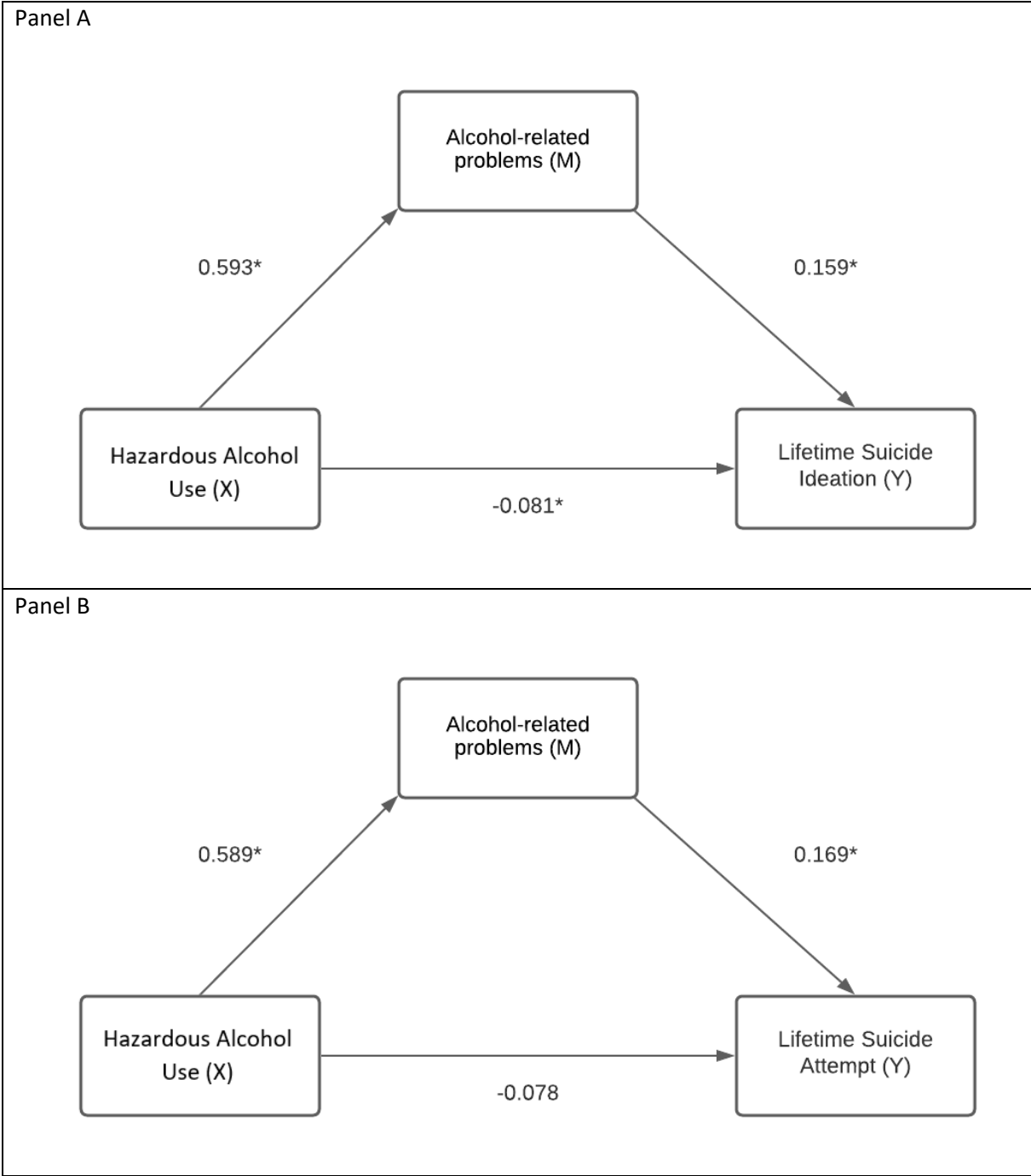
Note: All coefficients are unstandardised *p<0.05

<u>Simple mediation models of hazardous alcohol use on lifetime suicide ideation and attempt</u>
<u>mediated by AE Suicide</u>

Figure 2 Panel A shows that hazardous alcohol use was not significantly associated with AE suicide
(β=-0.002, SE= 0.004, CI= -0.01, 0.01, p=0.59), but AE suicide was significantly associated with lifetime
suicide ideation (β=1.30, SE= 0.13, CI= 1.10, 1.56, p<0.0001). The indirect effect of hazardous alcohol
use on lifetime suicide ideation due to AE suicide was non-significant (β=-0.00, SE= 0.01, CI= -0.02,
0.01).

Panel B shows that AE suicide was also significantly associated with lifetime suicide attempt (β=1.26,
SE= 0.18, CI= 0.91, 1.62, p<0.0001). The indirect effect of hazardous alcohol use on lifetime suicide
attempt due to the effect of hazardous alcohol use on AE suicide was also non-significant (β=-0.00,
SE= 0.01, CI= -0.02, 0.01).

<u>Simple mediation models of hazardous alcohol use on lifetime suicide ideation and attempt</u>
<u>mediated by Alcohol-related Problems</u>

Figure 3 Panel A shows that hazardous alcohol use was significantly associated with alcohol-related
problems (β=0.59, SE= 0.02, CI= 0.54, 0.64, p<0.001) and that alcohol-related problems were
significantly associated with lifetime suicide ideation (β=0.16, SE= 0.022, CI= 0.17, 0.202, p<0.0001).
In this model, hazardous alcohol use had a significant negative direct effect on lifetime suicide
ideation (β=-0.08, SE= 0.02, CI= -0.13, -0.03). The indirect effect of hazardous alcohol use on lifetime
suicide ideation due to alcohol-related problems was positive and significant (β=0.09, SE= 0.01, CI=
0.07, 0.12), indicating that an increase in hazardous alcohol use was associated with increased
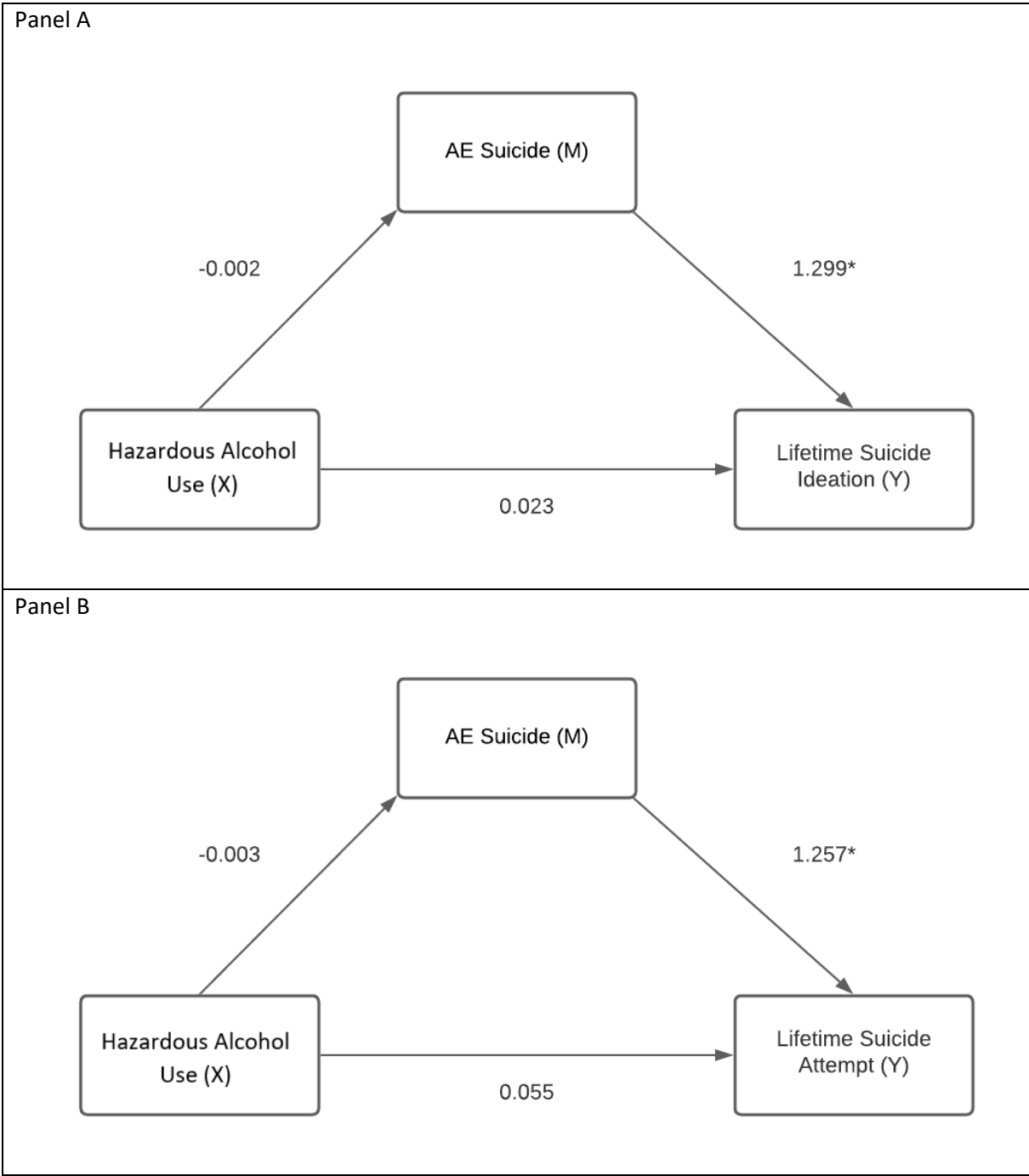likelihood of suicide ideation due to the effect of hazardous alcohol use on alcohol-related problems.

Panel B shows that alcohol-related problems was also associated with lifetime suicide attempt
(β=0.17, SE= 0.03, CI= 0.11, 0.22, p<0.0001). The direct effect of hazardous alcohol use on lifetime
suicide attempt was not significant (β=-0.08, SE= 0.04, CI= -0.16, 0.00, p=0.06). The indirect effect of
hazardous alcohol use on lifetime suicidal attempt due to alcohol-related problems was positive and
significant (β=0.10, SE= 0.02, CI= 0.06, 0.14).

Table 7 presents each indirect effect from mediation models 1-3 expressed in alternative forms as an
Odds Ratio (ORs) and partially standardised effects. The OR expresses the increased odds of lifetime
suicide ideation and lifetime suicide attempt group membership, given a 1-unit change in hazardous
alcohol use, due to the specified alcohol-related psychological factor. For example, the indirect effect
OR for Negative Urgency-A on lifetime suicide ideation indicates that for a one-unit increase in
hazardous alcohol use, the odds of lifetime suicide ideation group membership increase by 6%. The

corresponding odds increase of lifetime suicide attempt membership is 10%. The partially standardised effect expresses the indirect effect relative to the standard deviation increase of the suicide outcome variable for a one-unit change in hazardous alcohol use. Taking Negative Urgency-A as an example, a one-unit change in hazardous alcohol use corresponds to an increase of 0.13 standard deviations in lifetime suicide ideation. The corresponding increase in lifetime suicide attempt is 0.36 standard deviations.

From Table 7, consistent with the hypothesis, Negative Urgency-A was a stronger mediator of hazardous alcohol use and lifetime suicide attempt than hazardous alcohol use and suicide ideation. However, counter-to hypotheses it can also be seen that there was no evidence that AE Suicide mediated suicide ideation or attempt and that alcohol-related problems mediated the association between hazardous alcohol use and suicide outcomes to a similar degree.

Table 7: Indirect effects from simple mediation models 1-3 expressed as ORs and partially standardised effects

Alcohol factor	OR	95% CI		Partially standardised effects
Negative urgency-A				
Suicide Ideation	1.06	1.04	2.16	0.13
Suicide Attempt	1.10	1.07	1.12	0.36
AE suicide				
Suicide Ideation	1	1	1	0
Suicide Attempt	1	1	1	0.01
Alcohol-related problems				
Suicide Ideation	1.10	1.07	1.13	0.20
Suicide Attempt	1.10	1.07	1.15	0.36

Note: 95% CI =Confidence interval, OR = Odds ratio.

Discussion

This study investigated three alcohol-related factors that feature prominently in theoretical models of alcohol-related suicide. Consistent with the ideation to action framework presented in the integrated motivational volitional model (O'Connor & Kirtley, 2018), Negative Urgency-A and Alcohol Expectancies (AEs) were conceptualised as volitional phase alcohol factors that would more strongly mediate the relationship between hazardous alcohol use and lifetime suicide attempt than the relationship between hazardous alcohol use and lifetime suicide ideation. In contrast alcohol-related problems were conceptualised as a pre-motivational phase factor which was expected to more strongly mediate the relationship between alcohol use and suicide ideation versus alcohol use and suicide attempt.

In this study Negative Urgency-A was significantly associated with lifetime suicide ideation and attempt. Furthermore, Negative Urgency-A more strongly mediated the relationship between alcohol use and lifetime suicide attempt than lifetime suicide ideation. These findings extend existing research that individuals who endorse Negative Urgency may be prone to risk-taking behaviours when intoxicated (McCarty et al., 2017), and are more likely to engage in self-harm (Melson & O'Connor, 2019) to suicide-specific outcomes.

Of several AE types, only AE Suicide was independently associated with lifetime suicide ideation or attempt when controlling for depression, age, gender, and hazardous alcohol use. One potential reason for this finding is that the AEs were all significantly correlated with each other. This suggests the possibility that there may be conceptual overlap between them and there may be an underlying factor shared by all. Notwithstanding, these findings suggest that non-suicide-specific AEs may not predict suicide behaviours as well as non-suicidal behaviours (Lac & Brack, 2018). However, AE Suicide was associated with lifetime suicide ideation and suicide attempt, suggesting that individuals endorsing this expectancy may be at elevated suicide risk. This supports further study of suicide-specific AEs and suicide outcomes. This study did not find evidence that AE Suicide mediates the relationship between alcohol use and suicide ideation or suicide attempt. This was a somewhat unexpected finding given that Melson & O'Connor (2019) demonstrated self-harm specific AEs were significantly more common in individuals who engaged in self-harm compared with individuals who thought about self-harm only. As this study is cross-sectional, these findings do not rule out the possibility that AEs Suicide are involved in the transition to suicide attempt whilst drinking, i.e., they may trigger congruent suicide behaviours when intoxicated.

Alcohol-related problems were significantly associated with lifetime suicide ideation and lifetime suicide attempt. Perhaps surprisingly, hazardous alcohol use was not significantly associated with

suicide ideation or attempt in univariable analysis which is inconsistent with previous findings (Lehfeld et al., 2010). These findings do however align with prior research which suggests that factors other than alcohol consumption levels are needed for a nuanced explanation of the well-established relationship between alcohol and suicide outcomes (DeCou & Skewers, 2016). Contrary to our hypothesis, alcohol-related problems mediated the relationship between hazardous alcohol use and suicide ideation and attempt to a similar degree. One interpretation of this finding is that alcohol-related problems may play a role in the emergence of suicide ideation and suicide attempt for individuals who report hazardous alcohol use. For example, alcohol-problems may develop cumulatively over time due to repeated alcohol misuse and lead to the emergence of suicide ideation. Alcohol-related problems may also elevate risk of transitions from ideation to suicide attempt (i.e., the "last straw" effect).

Research and clinical implications

Support for the study hypotheses that alcohol-factors would differentially mediate suicide outcomes was mixed although findings lend support to the interpretation that Negative Urgency-A and alcohol-related problems may partially explain the transition from suicide ideation to suicide attempt, as well as the emergence of suicide ideation because of alcohol use. However, the cross-sectional design used in this study does not directly test or support this interpretation. Future research that utilises case-crossover designs may be better suited to establishing, for example, that increases in hazardous alcohol use precede and cause negative life events which are shortly followed by suicide behaviours, or that increases in hazardous alcohol use precede suicide attempts in individuals who endorse Negative Urgency-A. Furthermore, the use of smartphone technology and applications have been argued to have utility in measuring factors that may proximally influence suicide behaviour (Franklin, 2017). Further research may benefit from incorporating smartphone apps to monitor the impact alcohol dependence symptoms have on the emergence of suicide behaviour or the interaction between alcohol consumption and Negative Urgency-A.

Future prospective research studies would be advised to enhance our understanding of when and how alcohol-related factors are involved in the emergence of suicide ideation. It has been noted for instance that AUD and depression are highly comorbid and that there are plausible causal pathways from each disorder to the other (Rehm et al., 2017). Prospective research that measures alcohol-related factors such as alcohol-dependence symptoms or negative consequences due to drinking over time would help refine ideation to action models of alcohol-related suicide as they could establish a temporal order to alcohol use and the emergence of suicide ideation. Due to the low

base-rate of suicide attempt and suicide death however, large sample sizes would be required (Conner et al, 2007).

The potential clinical implications of further study in this area relate to early intervention in those at risk of developing suicide ideation and effective screening and suicide prevention efforts in suicidal individuals who drink alcohol. For example, furthering our understanding of which drinking patterns and which alcohol-related factors predict suicide ideation could inform clinical service provision to help identify and support these at-risk individuals. Brief alcohol-interventions could also be modified to incorporate empirically supported alcohol-factors as treatment targets. An example here might be interventions aiming to ameliorate the negative social consequences of drinking if evidence accumulates that over time this alcohol-related factor predicts the emergence of suicide ideation in drinkers without a history of suicide risk. Similarly, if evidence points to specific alcohol-related factors that predict the transition from ideation to suicide behaviour, clinicians could be better supported to screen and support these individuals.

Limitations

As mentioned above a key limitation of the current study is its cross-sectional design combined with the use of mediation analysis, which means that casual inferences about the roles of Negative Urgency-A and Alcohol-related Problems in suicide outcomes are putative. As mediational analysis assumes a temporal ordering of predictor, mediator, and outcome variables, it should be noted that the measurement periods used in this study do not necessarily conform to this, e.g., alcohol use was measured over the previous year, mediator variables were measured as stable phenomena without a specified time period, and the suicide outcomes were measured over the lifetime. This means that findings from the mediation analyses should be interpreted with caution and more robust conclusions may be provided through prospective mediation analyses. However, a theoretical justification for the temporal ordering of alcohol use preceding suicide outcomes was provided in this paper which strengthens the case for using mediation analysis in cross-sectional designs to explore potential causal pathways (Shrout, 2011).

Several novel measures of alcohol-related factors were introduced, and which have not been subjected to psychometric development. For example, alcohol-related problems was a composite of AUDIT alcohol dependence and alcohol-related negative consequences items. However, previous research which has made a distinction between problems and dependence found that symptoms of dependence, not alcohol-related problems, are associated with suicide ideation (DeCou & Skewers, 2016). Further research to parse these alcohol-related factors and their impact on suicide outcomes

would be helpful. The AE Suicide measure is also novel, and although it is informed by contemporary theories of suicide (O'Connor & Kirtley, 2018; van Orden et al., 2010) psychometric testing of validity and reliability should be considered in the future.

It should also be noted that in testing the study hypothesis, no formal tests were used to compare the magnitude of the indirect mediating pathways due to the complexity associated with mediation analysis using logistic regression. Although odds ratios and partially standardised effects were presented, future research would benefit from implementing a more robust method of testing whether specific alcohol-related psychological factors are more strongly associated with suicide ideation or suicide attempt.

Finally, it has been argued that the accurate prediction of suicide outcomes will require a multitude of factors to be studies simultaneously (Franklin, 2017). This study sought to better understand the role of just three alcohol-related factors and a broader perspective combining alcohol-related factors with other promising factors such as alcohol-induced negative mood and disinterest (Ehlers et al, 2018) may be needed.

Conclusion

Despite several limitations, the current study makes novel contributions to the literature by demonstrating that Negative Urgency-A is associated with suicide outcomes and may be implicated in the transition to suicide attempt in individuals who report hazardous alcohol use in a community sample. This study is also one of the first to investigate and report an association of suicide-specific alcohol expectancies with suicide ideation and attempt. Further investigation of the role of these and other alcohol-related factors is warranted and should be undertaken in the context of ideation to action frameworks. This will help to establish whether alcohol-related factors such as Negative Urgency-A may be used to identify those at increased risk of suicide and develop suitable strategies to manage this risk.

References

Amiri, S., & Behnezhad, S. (2020). Alcohol use and risk of suicide: a systematic review and Meta-analysis. *Journal of Addictive Diseases*, *38*(2), 200–213. https://doi.org/10.1080/10550887.2020.1736757

Anthenien, A. M., Lembo, J., & Neighbors, C. (2017). Drinking motives and alcohol outcome expectancies as mediators of the association between negative urgency and alcohol consumption. *Addictive Behaviors*, *66*, 101–107. https://doi.org/10.1016/j.addbeh.2016.11.009

Arsenault-Lapierre, G., Kim, C., & Turecki, G. (2004). Psychiatric diagnoses in 3275 suicides: a meta-analysis. *BMC Psychiatry*, *4*, 37. https://doi.org/10.1186/1471-244X-4-37

Bagge, C. L., & Sher, K. J. (2008). Adolescent alcohol involvement and suicide attempts: Toward the development of a conceptual framework. *Clinical Psychology Review*, *28*(8), 1283–1296. https://doi.org/10.1016/j.cpr.2008.06.002

Bandura, A., & Walters, R. (1977). *Social learning theory*. Englewood Cliffs, N.J.: Prentice Hall

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173–1182. https://doi.org/10.1037//0022-3514.51.6.1173

Borges, G., Bagge, C. L., Cherpitel, C. J., Conner, K. R., Orozco, R., & Rossow, I. (2017). A meta-analysis of acute use of alcohol and the risk of suicide attempt. *Psychological Medicine*, *47*(5), 949–957. https://doi.org/10.1017/S0033291716002841

Cavanagh, J. T. O., Carson, A. J., Sharpe, M., & Lawrie, S. M. (2003). Psychological autopsy studies of suicide: A systematic review. In *Psychological Medicine* (Vol. 33, Issue 3, pp. 395–405). Psychol Med. https://doi.org/10.1017/S0033291702006943

Center for Epidemiologic Studies Depression Scale: Review and Revision (CESD and CESD-R). - PsycNET. (n.d.). Retrieved January 29, 2022, from https://psycnet.apa.org/record/2004-14941-011

Conner, K. R., & Duberstein, P. R. (2004). Predisposing and Precipitating Factors for Suicide Among Alcoholics: Empirical Review and Conceptual Integration. *Alcoholism: Clinical and Experimental Research*, *28*(5 SUPPL.), 6S-17S. https://doi.org/10.1097/01.ALC.0000127410.84505.2A

Conner, K. R., Hesselbrock, V. M., Meldrum, S. C., Schuckit, M. A., Bucholz, K. K., Gamble, S. A., Wines, J. D., & Kramer, J. (2007). Transitions to, and correlates of, suicidal ideation, plans, and unplanned and planned suicide attempts among 3,729 men and women with alcohol dependence. *Journal of Studies on Alcohol and Drugs*, *68*(5), 654–662. https://doi.org/10.15288/jsad.2007.68.654

Conner, K. R., Houston, R. J., Swogger, M. T., Conwell, Y., You, S., He, H., Gamble, S. A., Watts, A., & Duberstein, P. R. (2012). Stressful life events and suicidal behavior in adults with alcohol use disorders: Role of event severity, timing, and type. *Drug and Alcohol Dependence*, *120*(1–3), 155–161. https://doi.org/10.1016/j.drugalcdep.2011.07.013

Conner, K. R., McCloskey, M. S., & Duberastein, P. R. (2008). Psychiatric risk factors for suicide in the alcohol-dependent patient. *Psychiatric Annals*, *38*(11), 742–748. https://doi.org/10.3928/00485713-20081101-04

Coskunpinar, A., Dir, A. L., & Cyders, M. A. (2013). Multidimensionality in impulsivity and alcohol use: a meta-analysis using the UPPS model of impulsivity. *Alcoholism, Clinical and Experimental Research*, *37*(9), 1441–1450. https://doi.org/10.1111/ACER.12131

Darvishi, N., Farhadi, M., Haghtalab, T., & Poorolajal, J. (2015). Alcohol-Related Risk of Suicidal Ideation, Suicide Attempt, and Completed Suicide: A Meta-Analysis. *PLOS ONE*, *10*(5), e0126870. https://doi.org/10.1371/JOURNAL.PONE.0126870

David Klonsky, E., Qiu, T., & Saffer, B. Y. (2017). Recent advances in differentiating suicide attempters from suicide ideators. *Current Opinion in Psychiatry*, *30*(1), 15–20. https://doi.org/10.1097/YCO.0000000000000294

de Leo, D. (2004). *Suicidal behaviour : theories and research findings*. Hogrefe & Huber.

de Meneses-Gaya, C., Zuardi, A. W., Loureiro, S. R., Alexandre, J., & Crippa, S. (2009). PSYCHOLOGY NEUROSCIENCE Alcohol Use Disorders Identification Test (AUDIT): An updated systematic review of psychometric properties. *Psychology & Neuroscience*, *2*(1), 83–97. https://doi.org/10.3922/j.psns.2009.1.12

DeCou, C. R., & Skewes, M. C. (2016). Symptoms of Alcohol Dependence Predict Suicide Ideation Among Alaskan Undergraduates. *Crisis*, *37*(3), 232–235. https://doi.org/10.1027/0227-5910/a000373

Dougall, N., Stark, C., Agnew, T., Henderson, R., Maxwell, M., & Lambert, P. (2017). An analysis of suicide trends in Scotland 1950–2014: comparison with England & Wales. *BMC Public Health 2017 17:1*, *17*(1), 1–11. https://doi.org/10.1186/S12889-017-4956-6

Feingold, A., MacKinnon, D. P., & Capaldi, D. M. (2019). Mediation analysis with binary outcomes: Direct and indirect effects of pro-alcohol influences on alcohol use disorders. *Addictive Behaviors*, *94*, 26–35. https://doi.org/10.1016/J.ADDBEH.2018.12.018

Ferrari, A. J., Norman, R. E., Freedman, G., Baxter, A. J., Pirkis, J. E., Harris, M. G., Page, A., Carnahan, E., Degenhardt, L., Vos, T., & Whiteford, H. A. (2014). The burden attributable to mental and substance use disorders as risk factors for suicide: Findings from the Global Burden of Disease Study 2010. *PLoS ONE*, *9*(4). https://doi.org/10.1371/journal.pone.0091936

Foster, T. (2011). Adverse Life Events Proximal to Adult Suicide: A Synthesis of Findings from Psychological Autopsy Studies. *Achieves of Suicide Research, 15(1), 1–15.* https://doi.org/10.1080/13811118.2011.540213

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., Musacchio, K. M., Jaroszewski, A. C., Chang, B. P., & Nock, M. K. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychological Bulletin*, *143*(2), 187–232. https://doi.org/10.1037/BUL0000084

Fromme, K., Stroot, E., & Kaplan, D. (1993). Comprehensive Effects of Alcohol: Development and Psychometric Assessment of a New Expectancy Questionnaire. *Psychological Assessment*, *5*(1), 19–26. https://doi.org/10.1037/1040-3590.5.1.19

Glenn, C. R., & Klonsky, E. D. (2010). A multimethod analysis of impulsivity in nonsuicidal self-injury. *Personality Disorders: Theory, Research, and Treatment*, *1*(1), 67–75. https://doi.org/10.1037/a0017427

Graham, J. W. (2009). Missing data analysis: making it work in the real world. *Annual Review of Psychology*, *60*, 549–576. https://doi.org/10.1146/ANNUREV.PSYCH.58.110405.085530

Gvion, Y., & Apte, A. (2011). Aggression, Impulsivity, and Suicide behavior: A review of the literature. In *Archives of Suicide Research* (Vol. 15, Issue 2, pp. 93–112). https://doi.org/10.1080/13811118.2011.565265

Ham, L. S., Stewart, S. H., Norton, P. J., & Hope, D. A. (2005). Psychometric assessment of the comprehensive effects of alcohol questionnaire: Comparing a brief version to the original full scale. In *Journal of Psychopathology and Behavioral Assessment* (Vol. 27, Issue 3, pp. 141–158). https://doi.org/10.1007/s10862-005-0631-9

Harmer, B., Lee, S., Duong, T. vi H., & Saadabadi, A. (2021). Suicidal Ideation. *Acute Medicine: A Symptom-Based Approach*, 415–420. https://doi.org/10.1007/9781139600354.061

Hayes, A. F. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-based Approach* . 507.

Higgins-Biddle, J. C., & Babor, T. F. (2018). A review of the Alcohol Use Disorders Identification Test (AUDIT), AUDIT-C, and USAUDIT for screening in the United States: Past issues and future directions. *Am J Drug Alcohol Abuse 44*(6), 578–586. https://doi.org/10.1080/00952990.2018.1456545

Hufford, M. R. (2001). Alcohol and suicidal behavior. *Clinical Psychology Review*, *21*(5), 797–811. https://doi.org/10.1016/S0272-7358(00)00070-2

Iacobucci, D. (2012). Mediation analysis and categorical variables: The final frontier. *Journal of Consumer Psychology*, *22*(4), 582–594. https://doi.org/10.1016/J.JCPS.2012.03.006

Jarvi, S. M., & Swenson, L. P. (2017). The role of positive expectancies in risk behavior: An exploration of alcohol use and nonsuicidal self-injury. *Crisis: The Journal of Crisis Intervention and Suicide Prevention*, *38*(2), 115–122. https://doi.org/10.1027/0227-5910/a000417

Jones, B. T., Corbin, W., & Fromme, K. (2001). A review of expectancy theory and alcohol consumption. *Addiction*, *96*(1), 57–72. https://doi.org/10.1046/J.1360-0443.2001.961575.X

Kerkhof, A. (2012). Calculating the Burden of Disease of Suicide, Attempted Suicide, and Suicide Ideation by Estimating Disability Weights., *Crisis*, *33*(2), 63–65. https://doi.org/10.1027/0227-5910/A000161

Kõlves, K., Draper, B. M., Snowdon, J., & de Leo, D. (2017). Alcohol-use disorders and suicide: Results from a psychological autopsy study in Australia. *Alcohol*, *64*, 29–35. https://doi.org/10.1016/j.alcohol.2017.05.005

Lac, A., & Brack, N. (2018). Alcohol expectancies longitudinally predict drinking and the alcohol myopia effects of relief, self-inflation, and excess. *Addictive Behaviors*, *77*, 172–179. https://doi.org/10.1016/j.addbeh.2017.10.006

Lamis, D. A., & Malone, P. S. (2012). Alcohol Use and Suicidal Behaviors among Adults: A Synthesis and Theoretical Model. *Suicidology Online*, *3*, 4–23.

Lehfeld, H., Boenisch, S., Bramesfeld, A., Mergl, R., Havers, I., Althaus, D., Lehfeld, H., Niklewski, G., & Hegerl, U. (2010). The role of alcohol use disorder and alcohol consumption in suicide attempts-a secondary analysis of 1921 suicide attempts. *Cambridge.Org*. https://doi.org/10.1016/j.eurpsy.2009.11.007

Loo, R. (2001). Motivational orientations toward work: An evaluation of the work preference inventory (student form). *Measurement and Evaluation in Counseling and Development*, 33(4), 222-233.

Loewenthal, K. M. (1996). The final scale and its validation. Autor. An introduction to psychological tests and scales. London: UCL Press Limited, 55-60.

MacKinnon, D. P., Lockwood, C. M., Brown, C. H., Wang, W., & Hoffman, J. M. (2007). The intermediate endpoint effect in logistic and probit regression. *Clinical Trials*, *4*(5), 499–513. https://doi.org/10.1177/1740774507083434

McCarty, K. N., Morris, D. H., Hatz, L. E., & McCarthy, D. M. (2017). Differential associations of UPPS-P impulsivity traits with alcohol problems. *Journal of Studies on Alcohol and Drugs*, *78*(4), 617–622. https://doi.org/10.15288/jsad.2017.78.617

Melson, A. J., & O'Connor, R. C. (2019). Differentiating adults who think about self-harm from those who engage in self-harm: the role of volitional alcohol factors. *BMC Psychiatry*, *19*(1), 319. https://doi.org/10.1186/s12888-019-2292-3

Milner, A., Sveticic, J., & de Leo, D. (2013). Suicide in the absence of mental disorder? A review of psychological autopsy studies across countries. *The International Journal of Social Psychiatry*, *59*(6), 545–554. https://doi.org/10.1177/0020764012444259

National Records of Scotland. (2020). *Probable Suicides: Deaths which are the Result of Intentional Self-harm or Events of Undetermined Intent: Main Points Report*. https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/vital-events/deaths/suicides

Newman, D. A. (2014). Missing Data: Five Practical Guidelines. *Organizational Research Methods 17*(4), 372–411. https://doi.org/10.1177/1094428114548590

Nicholson, S., Jenkins, R., in, H. M.-A. psychiatric morbidity, & 2007, undefined. (2009). Suicidal thoughts, suicide attempts and self-harm. *Researchgate.Net*. https://doi.org/10.13140/2.1.1563.5205

Nock, M. K., Borges, G., Bromet, E. J., Cha, C. B., Kessler, R. C., & Lee, S. (2008). Suicide and Suicidal Behavior. *Epidemiologic Reviews*, *30*(1), 133–154. https://doi.org/10.1093/EPIREV/MXN002

Nock, M. K., Hwang, I., Sampson, N. A., & Kessler, R. C. (2010). Mental Disorders, Comorbidity and Suicidal Behavior: Results from the National Comorbidity Survey Replication. *Molecular Psychiatry*, *15*(8), 868. https://doi.org/10.1038/MP.2009.29

Norström, T., & Rossow, I. (2016). Alcohol Consumption as a Risk Factor for Suicidal Behavior: A Systematic Review of Associations at the Individual and at the Population Level. In *Archives of Suicide Research* (Vol. 20, Issue 4, pp. 489–506). Routledge. https://doi.org/10.1080/13811118.2016.1158678

O'Connor, R. C., & Kirtley, O. J. (2018). The integrated motivational-volitional model of suicidal behaviour. In *Philosophical Transactions of the Royal Society B: Biological Sciences* (Vol. 373, Issue 1754). Royal Society Publishing. https://doi.org/10.1098/rstb.2017.0268

O'Connor, R. C., & Nock, M. K. (2014). The psychology of suicidal behaviour. In *The Lancet Psychiatry* (Vol. 1, Issue 1, pp. 73–85). Elsevier Ltd. https://doi.org/10.1016/S2215-0366(14)70222-6

Ösby, U., Brandt, L., Correia, N., Ekbom, A., & Sparén, P. (2001). Excess mortality in bipolar and unipolar disorder in Sweden. *Archives of General Psychiatry*, *58*(9), 844–850. https://doi.org/10.1001/ARCHPSYC.58.9.844

Parkinson, J., Minton, J., Lewsey, J., Bouttell, J., & McCartney, G. (2017). Recent cohort effects in suicide in Scotland: A legacy of the 1980s? *Journal of Epidemiology and Community Health*, *71*(2), 194–200. https://doi.org/10.1136/jech-2016-207296

Pompili, M., Serafini, G., Innamorati, M., Dominici, G., Ferracuti, S., Kotzalidis, G. D., Serra, G., Girardi, P., Janiri, L., Tatarelli, R., Sher, L., & Lester, D. (2010). Suicidal Behavior and Alcohol Abuse. *International*

Journal of Environmental Research and Public Health, *7*(4), 1392. https://doi.org/10.3390/IJERPH7041392

Preuss, U. W., Schuckit, M. A., Smith, T. L., Danko, G. P., Bucholz, K. K., Hesselbrock, M. N., Hesselbrock, V., & Kramer, J. R. (2003). Predictors and correlates of suicide attempts over 5 years in 1,237 alcohol-dependent men and women. *American Journal of Psychiatry*, *160*(1), 56–63. https://doi.org/10.1176/APPI.AJP.160.1.56

Radloff, L. S. (2016). The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. *Applied Psychological Measurement. 1(3), 385–401.* https://doi.org/10.1177/014662167700100306

Rehm, J., Gmel, G. E., Gmel, G., Hasan, O. S. M., Imtiaz, S., Popova, S., Probst, C., Roerecke, M., Room, R., Samokhvalov, A. v., Shield, K. D., & Shuper, P. A. (2017). The relationship between different dimensions of alcohol use and the burden of disease—an update. In *Addiction* (Vol. 112, Issue 6, pp. 968–1001). Blackwell Publishing Ltd. https://doi.org/10.1111/add.13757

Reinert, D. F., & Allen, J. P. (2007). The alcohol use disorders identification test: An update of research findings. In *Alcoholism: Clinical and Experimental Research* (Vol. 31, Issue 2, pp. 185–199). https://doi.org/10.1111/j.1530-0277.2006.00295.x

Shepard, D. S., Gurewich, D., Lwin, A. K., Reed, G. A., & Silverman, M. M. (2016). Suicide and Suicidal Attempts in the United States: Costs and Policy Implications. *Suicide & Life-Threatening Behavior*, *46*(3), 352. https://doi.org/10.1111/SLTB.12225

Shrout, P. E. (2011). Commentary: Mediation analysis, causal process, and cross-sectional data. *Multivariate Behavioral Research*, 46(5), 852-860.

Smith, G. T., Fischer, S., Cyders, M. A., Annus, A. M., Spillane, N. S., & McCarthy, D. M. (2007). On the validity and utility of discriminating among impulsivity-like traits. *Assessment*, *14*(2), 155–170. https://doi.org/10.1177/1073191106295527

van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E. (2010). The Interpersonal Theory of Suicide. *Psychological Review*, *117*(2), 575–600. https://doi.org/10.1037/a0018697

Whiteside, S. P., Lynam, D. R., Miller, J. D., & Reynolds, S. K. (2005). Validation of the UPPS impulsive behaviour scale: A four-factor model of impulsivity. *European Journal of Personality*, *19*(7), 559–574. https://doi.org/10.1002/per.556

Wolford-Clevenger, C., Bradizza, C., Parrott, D., Cropsey, K. L., & Stuart, G. L. (2020). The conditional association of problematic drinking with suicidal ideation by alcohol expectancies. *Addictive Behaviors*, *108*. https://doi.org/10.1016/J.ADDBEH.2020.106436

World Health Organization (WHO). (2021). *Suicide worldwide in 2019: global health estimates*. Licence: CC BY-NC-SA 3.0 IGO.

Chapter 3: Appendices

Appendix 1.1 Aims and scope of BMC Psychiatry

<u>Aims and scope</u>

BMC Psychiatry is an open access, peer-reviewed journal that considers articles on all aspects of the prevention, diagnosis and management of psychiatric disorders, as well as related molecular genetics, pathophysiology, and epidemiology.

The journal welcomes manuscripts in the following broad areas of psychiatry research:

- Causes, treatment and prevention of suicide including assessment and risk-management approaches, ethical issues in intervention research, cross-cultural risk factors for suicide

For submission guidance, please visit: <u>https://bmcpsychiatry.biomedcentral.com/submission-guidelines/aims-and-scope</u>

Appendix 1.2 Definitions of types of alcohol misuse

Type of alcohol misuse	Definition
Hazardous alcohol consumption	A pattern of drinking that increases the risk of harmful consequences
Harmful alcohol use/alcohol abuse	A pattern of drinking that is causing damage to health, closely related to DSM-4-TR criteria for *alcohol abuse* (drinking which results in failure to fulfil work, school, or home obligations, places individuals in psychically hazardous situations, results in social or interpersonal problems etc)
Alcohol dependence	A pattern of drinking that is causing withdrawal symptoms, evidence of physical tolerance and increased amounts of alcohol being consumed over time etc as described in DSM-IV-TR.
Alcohol Use Disorder	A problematic pattern of alcohol use leading to clinically significant impairment or distress, manifested in at least 2 of following criteria* occurring within a 12-month period: 1. Alcohol is often taken in larger amounts or over a longer period than was intended. 2. There is a persistent desire or unsuccessful efforts to cut down or control alcohol use. 3. A great deal of time is spent in activities necessary to obtain alcohol, use alcohol, or recover from its effects. 4. Recurrent alcohol use resulting in a failure to fulfil major role obligations at work, school, or home. 5. Continued alcohol use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of alcohol.*

*only 5 of 11 criteria shown here.

Appendix 1.3 Appraisal of Cross-sectional Studies

Introduction

1. Were the aims/objectives of the study clear?

Methods

2. Was the study design appropriate for the stated aim(s)?
3. Was the sample size justified?
4. Was the target/reference population clearly defined? (Is it clear who the research was about?)
5. Was the sample frame taken from an appropriate population base so that it closely represented the target/reference population under investigation?
6. Was the selection process likely to select subjects/participants that were representative of the target/reference population under investigation?
7. Were measures undertaken to address and categorise non-responders?
8. Were the risk factor and outcome variables measured appropriate to the aims of the study?
9. Were the risk factor and outcome variables measured correctly using instruments/measurements that had been trialled, piloted or published previously?
10. Is it clear what was used to determined statistical significance and/or precision estimates? (e.g. p-values, confidence intervals)
11. Were the methods (including statistical methods) sufficiently described to enable them to be repeated?

Results

12. Were the basic data adequately described?
13. Does the response rate raise concerns about non-response bias?
14. If appropriate, was information about non-responders described?
15. Were the results internally consistent?
16. Were the results presented for all the analyses described in the methods?

Discussion

17. Were the authors' discussions and conclusions justified by the results?
18. Were the limitations of the study discussed?
19. Were there any funding sources or conflicts of interest that may affect the authors' interpretation of the results?
20. Was ethical approval or consent of participants attained?

For full AXIS including rating guidance for each item, visit https://osf.io/hrvsx

Appendix 1.4 Assessment of Quality for each systematic review study using the Appraisal tool for Cross-Sectional Studies (AXIS)

Quality rating for each question Criteria: Yes (Y), No (N), Don't Know																						
Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Rating
1 Gonzalez et al (2009)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	15/20	Fair
2 Kizza et al (2012)	Y	Y	N/A*	Y	Y	Y	N	Y	Y	N/A*	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/18	Fair
3 Mash et al (2016)	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair
4 Gauthier et al (2019)	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair
5 Gonzalez (2019)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	15/20	Fair
6 Lamis et al (2014)	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair
7 Bagge et al (2015)	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair
8 Marschall-Levesque et al (2016)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	16/20	Good
9 DeCou & Skewes (2016)	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	N	Y	N	Y	13/20	Fair
10 Bhattacharjee et al (2012)	N	Y	N	Y	Y	Y	N	Y	Y	N	N	Y	N	N	Y	N	Y	N	N	N	9/20	Poor
11 Choi et al (2018)	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair
12 Lamis & Malone (2011)	Y	Y	N	Y	N	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	13/20	Fair
13 Grazioli et al (2018)	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	17/20	Good
14 Lamis et al (2010)	Y	Y	N	Y	Y	N	N	Y	Y	N	N	Y	N	N	Y	N	Y	Y	N	Y	11/20	Fair
15 Gonzalez & Halvorsen (2021)	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
16 Kelly et al (2017)	Y	Y	N	Y	Y	Y	N	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	13/20	Fair
17 Gonzalez & Hewell (2012)	Y	Y	N	Y	Y	N	N	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	N	N	12/20	Fair
18 Sunami et al (2019)	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	15/20	Fair
19 Conner et al (2007)	Y	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	13/20	Fair
20 Conner et al (2006)	Y	Y	N	Y	Y	N	N	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	12/20	Fair
21 Ehlers et al (2018)	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	16/20	Good
22 Wolford-Clevenger et al (2020)	Y	Y	N	Y	N	N	Y	Y	N	N	N	Y	N	N	Y	N	N	Y	N	Y	9/10	Poor
23 Windle (2003)	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	N	N	N	11/20	Fair
24 Conner et al (2014)	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair
25 Preuss et al (2002)	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	14/20	Fair

NOTE: *N/A=not applicable as qualitative study. Scores between 0-9 = poor, 10-15 = fair, and 16-20 = good

Appendix 2.1 Original MRP Proposal

Name of Assessment: MRP proposal

Title of Project: Investigating the role of alcohol-related factors on self-harm and suicide.

Student: Daniel Jon Stopforth

Student ID:

Supervisor: Dr Ambrose Melson

Date of submission 14/12/20

Word Count 3849

Abstract

Background

Self-harm and suicide prevention are global health priorities. Individuals who misuse alcohol are at a considerably increased risk of dying by suicide. Although various models of alcohol-related suicide have been formulated, empirical investigation of the purported mechanisms by which alcohol increases risk of suicide, including alcohol expectancies and impulsivity, are more limited and focused research using high quality data is warranted.

Aims

Enhance understanding of the relationship between alcohol factors and increased risk of self-harm and suicide, including potential mechanisms such as the mediating and/or moderating effects of impulsivity and alcohol-related expectancies.

Methods

The proposed research is a secondary analysis of a recently collected non-clinical dataset comprising individuals aged 18 years and over residing in Scotland. Measures of demographics, depressive symptoms, alcohol use and problems, self-harm and suicidality were taken at baseline and at 2 further follow ups up to 18 months post-baseline. Alcohol-related psychological factors including alcohol-related impulsivity, and alcohol-expectancies were also measured. Planned analysis include univariate and multivariate analyses of cross-sectional data to investigate the relationship of alcohol use and alcohol-related factors with self-harm and suicide outcomes. Baseline and follow-up data will be linked as part of this project, enabling prospective investigation of these relationships between alcohol-related factors, self-harm, and suicide for the first time using the dataset.

Practical applications

Findings will help to elucidate relationships between self-harm and suicide risk and may lead to improved assessment and clinical management of patients at risk of self-harm and suicide.

Introduction

Definitions and epidemiology of suicide and self-harm

Suicide is a global phenomenon, defined by the World Health Organisation as 'an act with fatal outcomes which the deceased, knowing or expecting potentially fatal outcomes, had initiated and carried out with the purpose of bringing about wanted changes' (de Leo, 2004). Suicide consistently ranks among the top 10 contributors to disease burden across regions (Naghavi, 2019). Figures from 2018 estimate 784 suicides in Scotland, a 15.3% increase from the previous year (Public Health Scotland, 2019).

Self-harm is one of the strongest predictors of suicide. Approximately 1 in 25 individuals who present at hospital due to self-harm will kill themselves within 5 years (Carroll, Metcalfe and Gunnell, 2014). Clinical guidelines define self-harm as 'any act of self-poisoning or self-injury carried out by a person, irrespective of their motivation' (NICE, 2011). In UK samples, the relative risk of suicide within the first year of hospital-presenting self-harm is 49 times greater than the public (Hawton et al., 2015).

Risk factors for suicide

Suicide risk is multifactorial, emerging from a complex interplay of well-established personality factors, cognitive factors, social aspects, and negative life events (O'Connor and Nock, 2014). Most often, individuals who die by suicide have at least one psychiatric disorder (Cavanagh et al., 2003).

Despite progress in identifying risk factors for suicide, our ability to predict suicidal thoughts or suicidal behaviours significantly over chance has not been demonstrated (Franklin et al., 2017). More research on suicide that incorporates purported psychological factors has been called for to further enhance understanding and refine interventions (Conner and Ilgen, 2011; O'Connor and Nock, 2014). Furthermore, in line with global health initiatives which seek to better identify and support individuals from groups at high risk of suicide (World Health Organisation, 2020), refining psychological models of self-harm and suicide within these groups is needed (Franklin et al., 2017).

Alcohol-related factors and suicide

Individuals who meet the criteria for Alcohol Use Disorders (AUDs) are more likely to report suicide ideation, attempt suicide, and die by suicide (Darvishi et al., 2015). AUDs refer to categories of mental and behavioural disorders whereby the overuse of, or dependence on, alcohol leads to detrimental effects on an individual's physical and mental health, or the welfare of others (WHO, 2016).

A range of problems associated with AUDs are thought to play a role in the increased risk of self-harm and suicide. For instance, consistent associations and comorbidity of alcohol dependence and psychiatric disorders, particularly major depressive disorders, are suggested to increase risk of suicide (Sullivan, Fiellin and O'Connor, 2005). While causal pathways between alcohol dependence and depressive disorders have been suggested, research most strongly supports the notion that dependent alcohol use causes major depressive illnesses, thereby increasing suicide risk (Rehm et al., 2017). Furthermore, alcohol dependence is thought to increase the frequency of negative life events and interpersonal difficulties (Hufford, 2001) that can lead to significant distress, crisis and increase suicide risk. Findings from meta-analyses suggests that acute alcohol use also confers increased risk of suicide, which is consistent with a dose-response relationship, meaning that the relative risk of suicide increases as consumption in a drinking episode increases (Conner and Bagge, 2019).

A number of models have sought to explain the role of alcohol use factors (including those linked to dependent and acute use of alcohol) in suicide, and describe the interplay with other well established risk factors (Hufford, 2001; Bagge and Sher, 2008; Conner and Ilgen, 2011). These models propose various factors which may mediate or moderate the relationship between alcohol and suicide risk, including impulsivity and alcohol expectancies.

Impulsivity is a personality trait related to a broad range of behaviours that reflect impaired self-regulation, including poor planning, responding before consequential thinking, sensation-seeking, risk taking, and inability to inhibit responding (Gvion and Apte, 2011). Various dimensions of trait impulsivity may act as pathways towards impulsive actions (Whiteside et al., 2005). However Negative Urgency, defined as a tendency to engage in rash, potentially dangerous actions when experiencing negative affect, may be of relevance in understanding the relationship between alcohol factors and suicide. For example, Negative Urgency is associated with more negative consequences when drinking, including frequent black outs, risky behaviours, and interpersonal conflict (McCarty et al., 2017).

Alcohol-expectancies encapsulate motivations for drinking alcohol, i.e., what we expect will happen following drinking and which are thought to lead people to act in ways consistent with their expectancies. One model (Hufford, 2001) has proposed three alcohol-expectancies which could act as risk factors for suicide: alcohol will i) provide courage for suicidal acts , ii) numb the pain of suicidal acts, iii) act as mood enhancer, leading to high emotional contrast if alcohol unexpectedly exacerbates negative affect.

Importantly, while impulsivity and alcohol expectancies have been proposed as possible factors which may help to explain the relationships between alcohol misuse and suicide, there has been limited empirical research into their role.

Study rationale

Suicide risk is multifactorial, with a range of established risk factors; however, our ability to predict suicide remains inconsistent and there is a need to enhance understanding of self-harm and suicide risk. There may be a need to move away from '1 size fits all' models and empirically test psychosocial models tailored to vulnerable groups.

Individuals who misuse alcohol are known to be at increased risk of self-harm and suicide, but there has been limited empirical investigation of specific alcohol-related factors. A recent article (Melson and O'Connor, 2019) utilised the Health, Lifestyle and Wellbeing (HLW) dataset to identify that the alcohol-related factors negative urgency and alcohol expectancies can differentiate individuals who think about self-harm from individuals who engage in self-harm. However, several important questions remain unanswered and can be addressed in the proposed project. Firstly, the authors focused on self-harm as their outcome, but it is also important to understand the role of alcohol factors for other key suicidal outcomes, including suicidal ideation and, where possible, suicide attempts. The authors also focused on several alcohol factors and did not consider the possible role of a wider range of relevant alcohol factors, including harmful use or alcohol dependence. This is important as models of suicide propose distinct problems related to acute and dependent use which may increase risk of suicide through different pathways. Lastly, the authors investigated cross-sectional relationships and an important next step is to investigate alcohol factors and suicide outcomes prospectively.

Aims

The aim of the research is to enhance understanding of the relationship between alcohol misuse and increased risk of self-harm and suicide, including potential mechanisms such as the mediating and/or moderating effects of impulsivity and alcohol-related expectancies.

<u>Research questions</u>

1. What is the relationship between specific alcohol factors (e.g., different types of alcohol problems/AUDs, impulsivity, alcohol expectancies) to self-harm and suicidal outcomes (e.g., self-harm ideation and self-harm, suicidal ideation, and suicide attempt)?

2. What is the prospective relationship between alcohol factors and outcomes?

Plan of investigation

<u>Design</u>

Secondary analysis of the HLW study dataset, an observational study with three time points: baseline, time 1 (approximately 6 months post baseline) and time 2 (approximately 18 months post baseline). The project will utilise cross-sectional and prospective aspects of the design in analyses to investigate nuanced alcohol factors and their relationship with suicide outcomes.

<u>Participants and Procedures</u>

In 2015 adults residing in Scotland and aged 18 and over were recruited to the baseline phase of HLW, a study investigating lifestyle factors and their relationships with health and wellbeing among adults in Scotland. Recruitment involved convenience sampling, with employers, educational institutions, and online community networks advertising the study and hosting or distributing a URL to complete an online survey. Participation was incentivised with entry into a prize draw and almost all participants completed the online version of the survey.

Approximately 6 and 18 months after baseline participants were invited to complete two follow-up surveys. After excluding those ineligible and with substantial missing data, the baseline dataset includes responses of 1546 adults, who were predominantly female (n = 1079; 70%), identified as white (n = 1422; 94%) and were on average aged 34 years (range: 17-69 years). While data collection is complete for baseline and both follow-ups, the prospective dataset will be finalised as part of the current project.

<u>Inclusion and exclusion criteria</u>

All adults aged 18+ years were eligible to participate if they were resident in Scotland. Exclusion criteria included: not providing written informed consent, withdrawing from the study, and not providing the minimum dataset (i.e., >50% missing data across single items or >10% missing data from multi-item scales). Inclusion criteria for the prospective dataset will require completion of an agreed set of key study measures at baseline and minimum of one follow-up.

<u>Measures</u>

<u>Demographics and covariates</u>

Demographic factors were recorded as part of the HLW dataset including age, gender, ethnicity, employment status, marital status, education level, etc. Depressive symptoms were measured using the Centre for Epidemiologic Studies Depression Scale-Revised (CESD-R, a 20-item measure of experiencing symptoms of depression. These variables will be controlled for during analysis.

Alcohol factors

Alcohol use and problems were measured using the Alcohol Use Disorders Identification Test (AUDIT), a self-report questionnaire used to screen for alcohol consumption and related risks in clinical settings (Reinert and Allen, 2007). Each of 10 items is scored between 0-4, with total scores ≥8 indicating hazardous and harmful drinking. AUDIT items can also be scored and interpreted along three domains. The AUDIT has excellent test-retest reliability and internal consistency (de Meneses-Gaya et al., 2009) as well as good sensitivity and specificity in screening for recently diagnosed alcohol use disorders (Reinert and Allen, 2007).

Impulsivity: Negative Urgency is measured using the 12-item Negative Urgency subscale of the UPPS Impulsive Behaviour Scale (Whiteside et al., 2005) and is significantly associated with risk taking and interpersonal difficulties during acute alcohol use (McCarty et al., 2017). To provide a more nuanced account of the role of Negative Urgency the HLW study used a modified version to assess Negative Urgency contingent upon alcohol use. For example, original Negative Urgency items such as 'when I am upset, I often make matters worse because I act without thinking' was modified to 'when I am upset and I drink, I often make matters worse because I act without thinking'.

Alcohol expectancies: were measured at baseline using the Comprehensive Effects of Alcohol Questionnaire (Fromme, Stroot and Kaplan, 1993) plus seven novel suicide and self-harm expectancy items informed by two key psychological models of suicide (van Orden et al., 2010; O'Connor and Kirtley, 2018). Novel expectancy items were 'when I drink, I expect to…' 'think about suicide', 'attempt suicide', 'feel disconnected', 'alone', 'defeated', 'hopeless', and 'trapped'. Evidence supports the criterion validity of CEOA expectancy scales as direct and indirect links to excess alcohol use exist both cross-sectionally and longitudinally (Anthenien, Lembo and Neighbors, 2017), while internal consistency of the CEOA scales range from adequate to good (Ham et al., 2005).

Outcomes

Self-harm and suicide history: Four items from the UK Psychiatric Morbidity Survey (Nicholas, Jenkins and Meltzer, 2007) assess history of self-harm behaviour and ideation. Two items ask if respondents have thought about suicide versus attempted suicide. Two other items assess self-harm ideation and behaviour without suicidal intent.

Current suicidal ideation: was measured by the Suicide Ideation subscale of the Suicide Probability Scale (Cull and Gill, 1988), comprising eight items on feelings and behaviours related to current suicidality. Participants respond to items such as 'I feel people would be better off if I were dead' on a 4-point scale ranging from 'none or a little of the time' to 'most or all of the time'. The subscale has demonstrated good internal consistency, reliability, and validity (Valadez et al., 2009).

Data analysis

Justification of sample size: The baseline HLW dataset includes 1546 participants and was recently used to identify significant univariate and multivariate associations of alcohol factors in self-harm outcomes (Melson and O'Connor, 2019). It is likely therefore that the proposed analysis will have sufficient power to detect univariate and multivariate cross-sectional relationships for self-harm and suicide outcomes. The preparation of the prospective dataset is a key activity to be undertaken within this MRP; therefore, the prospective dataset sample size is currently unknown. Furthermore, the incidence of suicide attempts in the sample is unknown, although it is likely to be low. In a recent longitudinal analysis using a comparable, large Scottish sample (n= 3508), attrition after 1 year was 31% (n= 2420) and 2% (n= 50) reported a suicide attempt (O'Connor et al., 2018). As a guide, if the sample in this proposal had 31% attrition and 2% incidence of suicide attempt, that would result in prospective sample of 1067 individuals with 21 suicide attempts. Given the anticipated low incidence

of suicide attempts, prospective analyses will therefore focus on more incident outcomes, including suicidal ideation and self-harm.

Analysis plan

<u>Cross-sectional baseline analysis</u>

Univariate and multivariate analyses will examine associations between key variables (alcohol use problems/AUDs, negative urgency, and alcohol-expectancies) and self-harm and suicide outcomes. This will identify whether specific alcohol factors are associated with self-harm and suicide outcomes. Factors which alter the strength or direction (moderators) or explain the relationship (mediators) will also be examined.

<u>Prospective analysis</u>

The prospective dataset will be created prior to undertaking analyses, including linking datasets, screening, and checking participant data and coding variables. Alcohol factors significantly associated with suicide outcomes in analysis of baseline data will be included in prospective analyses, which for reasons noted earlier will focus on a more limited set of prevalent or incident suicide outcomes.

Analyses will control for confounding variables/co-variates, including demographics and depressive symptoms.

All analyses will be conducted in SPSS. Where relevant, moderation and mediation analysis will be undertaken using the Hayes (2018) PROCESS macro for SPSS.

<u>Setting and equipment</u>

Research equipment, consumables and expenses form completed. As secondary data analysis, this study will not incur cost not otherwise covered by the University of Glasgow (e.g., student access to SPSS).

<u>Health and safety issues</u>

Health and safety form completed. There are no substantive risks relating to participants, study procedure, and/or setting as study is secondary data analysis.

Ethics, governance, and data protection

Ethical approval for the primary study was granted by the College of Medical, Veterinary and Life Sciences Ethics Committee at the University of Glasgow (project no: 200140114). All participants provided written informed consent and the trainee has been approved to access, prepare, and analyse the data.

To prepare the prospective dataset for analyses the trainee will have access to raw electronic data containing potentially identifiable participant information. In accordance with guidance issued by the University of Glasgow on the management of research records, all electronic research data will be stored in a password-protected file on the researchers University-issued cloud storage system. Individual data files will also be password protected. Only the researcher will have access to the cloud-storage system and the individual, password-protected data files. This arrangement was confirmed as being "fit for purpose" as defined by the University's Data Protection & Freedom of Information Office in email correspondence dated 02/11/20. Finally, identifying information will be removed as soon as it is no longer necessary.

<u>Timeline</u>

Project will be completed over uninterrupted 30-month period as part of APL trainee pathway. Key MRP milestones hereafter MRP proposal for blind review include data management and preparation, development of analysis plan, beginning analysis (by February 2021), interpreting, and writing up findings, alongside systematic review project and completing final thesis write-up (by February 2022).

Practical applications and dissemination

The study seeks to enhance understanding of suicide risk for individuals who misuse alcohol and therefore could improve identification and assessment of suicide risk in these individuals. The findings will become part of a series of research studies using the HLW dataset and will be appropriate for dissemination in peer reviewed publications, at academic conferences and among clinical professions.

References available upon request.

Appendix 2.4 HLW Questionnaire

See questionnaire at https://osf.io/b4yrk

Appendix 2.5: Key Variable Descriptive Information

		Mean	Std. Deviation
Continuous Variables			
AUDIT total		7.29	5.12
AUDIT: Hazardous alcohol use		5.22	2.75
AUDIT: Alcohol-related problems		2.07	3.13
AE Tension Reduction		2.55	0.70
AE Liquid Courage		2.20	0.75
AE Risk and Aggression		1.92	0.67
AE Self Perception		1.76	0.62
AE Suicide		1.45	0.47
Negative Urgency-A		1.93	0.70
Depression		12.52	11.03
Categorical Variables		N	%
Lifetime suicide ideation	Yes	501	32.4
	No	1043	67.5
Lifetime suicide attempt	Yes	117	7
	No	1428	92

Note: AUDIT = Alcohol Use Disorders Identification Test, AE = Alcohol Expectancy