



Research report

Longitudinal risk profiling for suicidal thoughts and behaviours in a community cohort using decision trees

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ABSTRACT

Background: While associations between specific risk factors and subsequent suicidal thoughts or behaviours have been widely examined, there is limited understanding of the interplay between risk factors in the development of suicide risk. This study used a decision tree approach to develop individual models of suicide risk and identify the risk factors for suicidality that are important for different subpopulations.

Methods: In a population cohort of 6656 Australian adults, the study examined whether measures of mental health, physical health, personality, substance use, social support, social stressors and background characteristics were associated with suicidal ideation and suicidal behaviours after four-year follow-up.

Results: Previous suicidality, anxiety symptoms, depression symptoms, neuroticism and rumination were the strongest predictors of suicidal ideation and behaviour after four years. However, divergent factors were predictive of suicidal thoughts and behaviours across the spectrum of mental health. In particular, substance use was only associated with suicidal thoughts and behaviours in those with moderate levels of anxiety or depression.

Limitations: Most of the measurements were based on self-report. Further research is required to assess whether changes in risk factors lead to changes in suicidality.

Conclusions: Examining suicide risk factors using decision trees is a promising approach for developing individualised assessments of suicide risk and tailored intervention programs.

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1. Introduction

Suicide risk has been widely researched by examining the association of specific risk factors with subsequent outcomes of ideation, plans, attempts and completed suicide. For example, extensive research has examined the value of major depression as a predictor of suicidality, which encompasses both suicidal thoughts and suicidal behaviours (e.g., Moller, 2006; Oquendo et al., 2006; Rihmer, 2001). Although depression is strongly predictive of suicidality, the positive predictive value of depression as a risk factor for suicide is low, as only a small proportion people with depression develop suicidal behaviours. The same is true of anxiety, rumination, hopelessness and even suicidal ideation—each of these factors is strongly associated yet not sufficient for the development of suicidal behaviours. Rather than investigate the roles of individual factors, an alternative approach involves examining the interplay between risk factors in the

development of suicide risk. Such an approach may lead to the development of individualized models to predict suicide risk and provide clearer definition of the types of risk factors for suicidality that might be important for different groups of people. However, it may be necessary to apply new methodologies to this field of research in order to create such models.

In the domain of cardiovascular disease, there has been considerable research aimed at predicting cardiovascular disease based on a constellation of risk factors. To establish individual risk profiles for cardiovascular disease, epidemiological research has been coupled with evidence from intervention studies which demonstrate that reducing factors such as smoking, blood pressure and lipids will reduce the risk of disease and stroke. Using a decision tree approach, risk assessment charts have been developed, together with guidelines to enable clinicians to predict risk for their patients (Jackson, 2000). Suicide risk may not be as readily identifiable as cardiovascular risk, and there has been limited research on whether interventions that address modifiable risk factors for suicide reduce its incidence. Nevertheless, the use of novel approaches such as decision trees may inform clinical decision making in the area of suicide prevention and identify at-risk groups that have previously been overlooked.

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Decision trees are a family of analytic techniques, which include CHAID (Chi-square Automatic Interaction Detector) and CART (Classification and Regression Trees). They provide estimates of risk by partitioning the sample on the basis of the best predictors of the outcome. This partitioning allows examination of how risk factors interact, to create customized risk profiles that may be used to assess individual risk. The methodology may also be used to identify whether there is a broad range of risk factors that are implicated in suicide risk, or whether the same types of risk factors are important at all levels of risk. For example, do people with high levels of depression have the same additional risk factors for suicidality as people with low levels of depression? Traditional analyses, such as logistic regression models, do not readily address such issues. If variability in risk factors is explored using logistic regression, the tendency is to focus on a single interaction variable, as the inclusion of large numbers of interaction terms becomes problematic.

While the decision tree methodology has been widely applied to identifying risk factors for cardiovascular disease, the approach has been rarely used in the mental health domain. There have, however, been attempts to use decision tree methods to predict suicide attempts (Mann et al., 2008), depression (Batterham et al., 2009; Schoevers et al., 2006; Smits et al., 2008), neuroticism (Schmitz et al., 2003) and quality of life (D'Alisa et al., 2006). Previous decision tree modelling on suicide attempts has investigated a small number of psychiatric risk factors in a clinical sample (Mann et al., 2008). The Mann et al. (2008) study used a range of clinical severity measures, clinical diagnosis, aggression, hostility, impulsiveness and reasons for living to retrospectively distinguish patients who had recently or remotely attempted suicide from non-attempters. The study was developed from a stress–diathesis perspective of suicide, while noting that a range of related explanatory variables may further contribute to suicide risk (Mann et al., 2008). Although few factors were found to distinguish attempters from non-attempters, ideation severity was the primary predictor of both recent and remote attempts, with borderline personality disorder, depression and aggression further distinguishing non-attempters from recent or remote attempters.

The present study investigated a much wider range of risk factors that were prospectively assessed in a large community-based sample, the PATH through Life cohort (Anstey et al., 2011). As in the Mann et al. (2008) study, many of the factors in the current study were drawn from a stress–diathesis perspective. However, a much broader approach to measuring stressors and vulnerabilities was taken, incorporating measures of stressful life events and problems with finances, employment or relationships with a range of vulnerabilities including personality, physical and mental health status, and substance use. Furthermore, a number of interpersonal factors were also investigated, including social support and engagement in a range of activities. Another departure from the Mann et al. (2008) approach was in the design of the present study. While community samples have considerably lower prevalence of suicidality, such cohorts may better reflect the risk factors that are important for the development of suicidality, as many people experiencing suicidal behaviours are not seen in a clinical setting (De Leo et al., 2005). Consequently, community cohorts may provide a more representative picture of the factors that are important for the prevention of suicide. Furthermore, in contrast to the one-year retrospective reporting used in the Mann et al. (2008) study, the PATH through Life study provides long-term prospective follow-up data, such that the development of suicidality may be assessed over a four year period. While such a long period may dilute the observed effects, it also provides an opportunity for assessing ways in which early intervention and prevention efforts may best be targeted. It is also

informative to examine whether long-term risk factors are different to short-term risk factors, as the time course of suicidality has not been well established.

The specific factors assessed in the present study included background characteristics, along with measures of mental health, physical health, personality, substance use, social indicators and engagement in activities. There is evidence that each of these domains may play a role in suicidality. While poor mental health is unambiguously associated with suicide ideation and behaviours (Harris and Barraclough, 1997), poor physical health has also been shown to be predictive of suicidality, particularly in older cohorts (e.g., Fairweather et al., 2006; Preville et al., 2005). Risk factors for depression and anxiety, such as low mastery and high rumination, may also play important roles in the development of suicidality (Fairweather et al., 2006; Morrison and O'Connor, 2008). In addition, there is evidence that personality traits are important determinants of suicidality, particularly hopelessness, neuroticism and extroversion (Brezo et al., 2006). Similarly, engagement in particular types of activities, such as artistic activities or social activities may be associated with changes in suicide risk (Duberstein et al., 2004b; Preti et al., 2001). Indeed, a range of social factors have been implicated in suicide, including lack of social support (Conwell, 2001; Heikkinen et al., 1993; King and Merchant, 2008), financial or job pressure (Duberstein et al., 2004a; Woo and Postolache, 2008), relationship breakdown (Roskar et al., 2011) and stressful life events (Foster, 2011; Heikkinen et al., 1994).

There has been previous investigation of the predictors of suicidality in the present cohort (Fairweather-Schmidt et al., 2010; Fairweather et al., 2006, 2007). These studies have identified a number of predictors of suicidal ideation in the cohort, including demographic, mental health, life stress and personality measures (Fairweather et al., 2007) and that mental health, unemployment and negative social interactions are important for the development of suicidal behaviours in participants with ideation (Fairweather et al., 2006). The previous studies have also found age and gender differences in the predictors of suicidality (Fairweather-Schmidt et al., 2010; Fairweather et al., 2007). However, previous research on this cohort has not directly identified the risk factors most critical in predicting suicidal thoughts and behaviours, or examined whether factors other than age and gender interact to amplify the risk of suicidality. There are also some factors that warrant additional investigation, such as the roles of depression and anxiety symptoms, rumination and neuroticism on suicidal thoughts and behaviours. In particular, Nock et al. (2009) reported that depression was a strong predictor of ideation but anxiety and substance abuse were better predictors of suicide attempts. Consequently, the present study used the decision tree methodology to investigate which of the identified risk factors were most important in predicting suicidal ideation and suicide plans or attempts after four year follow-up, and whether different risk factors are important for different subgroups. It was hypothesized that initial suicidality would be the primary predictor of subsequent suicidality, followed by mental health problems. Beyond these risk factors, it was hypothesized that a range of factors would be differentially associated with suicidality across the spectrum of mental health. Although the lack of prior research on the strength of predictors and time course of risk factors precluded hypotheses about specific relationships, immediate triggers such as financial problems and life stressors were predicted to be less important over the long follow-up period than more enduring states. Furthermore, the risk factors associated with suicidal ideation were hypothesized to be different from those associated with suicidal behaviours, based on the recent findings of Nock et al. (2009).

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