A Latent Class Analysis using the Integrated Motivational-Volitional model of Suicidal Behaviour: Understanding Suicide Risk over 36 months

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Abstract

Background: The use of latent class analysis (LCA) to understand suicide risk is often not guided by theoretical frameworks. This study used the Integrated Motivational-Volitional (IMV) Model of Suicidal Behaviour to inform the classification of subtypes of young adults with a suicidal history.

Methods: Data from young adults in Scotland (n = 3508) were used in this study including a subgroup of participants (n = 845) with a history of suicidality. LCA using risk factors from the IMV model was conducted on this subgroup, and the subgroups and non-suicidal control group were compared. Trajectories of suicidal behaviour over 36 months was compared between the classes.

Results: Three classes were identified. Class 1 (62 %) had low scores on all risk factors, Class 2 (23 %) had moderate scores, and Class 3 (14 %) had high scores on all risk factors. Those in Class 1 had a stable low risk of suicidal behaviour, while those in Class 2 and 3 showed marked variation over time, although Class 3 had the highest risk across all timepoints.

Limitations: The rate of suicidal behaviour in the sample was low, and differential dropout may have impacted the findings.

Conclusions: These findings suggest that young adults can be classified into different profiles based on suicide risk variables derived from the IMV model, which still distinguishes them 36 months later. Such profiling may help determining who is most at risk for suicidal behaviour over time.

Keywords: Integrated motivational-volitional (IMV) model; Latent class analysis; Suicide; Theory

Suicide is a complex phenomenon, accounting for 703,000 deaths each year, including among young people (World Health Organization (WHO), 2021). Studies trying to predict suicide attempts have failed to do so accurately (Franklin et al., 2017). As many of the risk factors that are associated with suicide are highly correlated, and there may be complex interactions between the variables that determine suicide risk, traditional statistical approaches may not be suitable for accurately predicting suicides. Some alternatives have been proposed, such as Latent Class Analysis (LCA). LCA models use a person-centred method to divide a large group of individuals into smaller homogenous subgroups. Because of the complex interplay of factors that contribute to suicide risk, identifying classes of individuals with certain shared characteristics could lead to a way of classifying risk and improving detection and prevention. Several studies have sought to examine suicide using LCA models and examining a variety of risk and protective factors (Au et al., 2021; Bernanke et al., 2017; Hoogstoel et al., 2021; Logan et al., 2011; Love & Durtschi, 2021; Selby & Gardner, 2015; Thullen et al., 2016; Xiao et al., 2019). These studies have often taken different approaches. Some studies utilise representative population samples, which tend to identify one large control group of healthy individuals, and two or more groups at varying risk of suicidal ideation or attempts (Jiang et al., 2010; Jung et al., 2019; O'Neill et al., 2018; Rice et al., 2018; Zhu et al., 2019). Whereas other studies have focused specifically on those who have made a suicide attempt (Ginley & Bagge, 2017), or on specific risk groups, such as military veterans (Allan et al., 2020) or those in sexual minority groups (Giano et al., 2020).

A limitation of most of the previous LCA and suicide risk studies is that the choice in the risk factors used to identify the classes have often not been explicitly substantiated. Although some studies highlight theoretical frameworks of suicide risk, such as the Interpersonal Psychological Theory of Suicide (IPTS; Joiner, 2005) or the Integrated Motivational-Volitional model of suicidal behaviour (IMV; O'Connor & Kirtley, 2018), only one study has thus far explicitly used the variables of a model, the IPTS, to identify latent classes in a sample of individuals who had made a suicide attempt (Wong et al., 2020). Wong and colleagues (2020), using data from a relatively small sample (N=227), found three latent classes that differed from each other on some of the key factors in the IPTS, mainly thwarted belongingness and perceived burdensomeness.

Additionally, most previous studies have employed cross-sectional designs when investigating the relationship between latent classes and past or current suicidal thoughts and feelings. Although, some studies have used a longitudinal design, the follow-up time periods were short (Allan et al., 2020) or the outcome was limited to suicidal thoughts rather than suicide attempts (Wong et al., 2020; Zhu et al., 2019). To date, no studies have investigated the stability of the class assignments over time, which is crucial for the clinical utility of categorising people into different subgroups.

For the current study, we used LCA models derived from a theoretical framework, the IMV model, to identify classes of individuals with a history of suicidal ideation and behaviour and used these classes to predict suicidal behaviour over 36 months. The IMV model builds upon several theories of suicide, such as the IPTS, and provides a framework for understanding how suicide risk develops from the pre-motivational phase (i.e., factors that create vulnerability to suicide), to the motivational phase (i.e., factors that lead to the emergence of suicidal thinking), to the volitional phase (i.e., factors that increase the likelihood of acting upon suicidal thoughts). Evidence has been found for the different phases of the IMV model (Branley-Bell et al., 2019; Lucht et al., 2020; O'Connor et al., 2021; Ordóñez-Carrasco et al., 2020; for an overview see Wetherall et al., 2020), and it has successfully distinguished between those who think about suicide and those who attempt suicide (Dhingra et al., 2015; Wetherall et al., 2018). However, we think that within those groups of people with suicidality, more fine-grained differences exist that we would not be able to find by only categorising them into those who think about suicide and those who attempt suicide. Therefore, using the IMV variables to identify latent subgroups or patterns within the data using LCA could increase our understanding of the characteristics of suicidal people. This method allows us to explore which combinations of risk factors co-occur and how these factors relate to the risk of future suicide attempts.

In this study, we identified latent classes using key variables derived from the IMV model among individuals who have had a history of suicidal thoughts or behaviour. These classes were compared with each other, as well as with a comparison group of individuals with no history of suicidal thoughts or behaviour. Specifically, this study had three aims. The first aim was to identify the best fitting number of latent classes and to identify how they differed on key suicide risk variables. The second aim was to use the latent classes to predict suicide attempts longitudinally. Lastly, the third aim was to identify whether the classes still differed at follow up and which of the IMV and suicide risk variables distinguished between the classes 36 months after baseline. If so, the latter would act as a validation of the predictive value of class structures over time as well as identifying key risk variables.

Methods

Participants and procedure

The data were from the Scottish Wellbeing Study (O'Connor et al., 2018), a nationally representative sample of young adults aged 18-34 years (n = 3508) in Scotland. Quota sampling was used based on age, sex and working status (for more details, see O'Connor et al., 2018). After providing written consent, participants completed an hour-long interview in their own homes. Participants completed a range of psychological and social measures that incorporated key aspects of the IMV model. Participants were compensated £25 for their time. Participants who agreed to be

contacted again were contacted after 12 months, 24 months, and 36 months, to complete a follow-up questionnaire, which was conducted by email, post, or phone. Participants were compensated with shopping vouchers and entered into a prize draw. Ethical approval was obtained from the Psychology Department's ethics committee at the University of Stirling as well as the US Department of Defense Human Research Protections Office.

Materials

Factors used in the LCA

A number of risk and protective factors for suicidal behaviour was assessed within the Scottish Wellbeing Study (O'Connor et al., 2018). For the creation of the latent classes, six indicator variables were used. These were depressive symptoms as measured by the Beck Depression Inventory (BDI; Beck et al., 1996), defeat and entrapment scales (Gilbert & Allan, 1998), and current suicidal ideation measured with the Scale for Suicide Ideation (SSI; Beck et al., 1988).

Factors used to test the classes

Other risk and protective factors from the Scottish Wellbeing Study were selected to test the classes. These factors were: social support (ENRICHD Social Support Instrument (ESSI)) (Mitchell et al., 2003), impulsivity (Barratt Impulsiveness Scale (BIS-11); Patton et al., 1995), thwarted belongingness and perceived burdensomeness (Interpersonal Needs Questionnaire, INQ; van Orden et al., 2012), acquired capability (Acquired Capability for Suicide Scale (ACSS); van Orden et al., 2008), social perfectionism (from the Multidimensional Perfectionism Scale) (Hewitt & Flett, 1991), problematic alcohol use (CAGE questionnaire, Ewing, 1984), and mental wellbeing (Warwick-Edinburgh Mental Well-being Scale (WEMWBS); Tennant et al., 2007). More details on the measures used can be found in (Wetherall et al., 2018), however, note that each of the measures demonstrated good internal reliability in the current study.

Suicidal ideation and suicide attempts

People's history of suicidal thoughts, attempts and self-harm was assessed with three questions drawn from the Adult Psychiatric Morbidity Survey (McManus et al., 2009): "Have you ever seriously thought of taking your life, but not actually attempted to do so?", "Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way?", and "Have you ever deliberately harmed yourself in any way but not with the intention of killing yourself?". Responses to these items were "no", "yes" or "would rather not say". Suicidal ideation and suicide attempts were assessed at each follow-up (12, 24 and 36 months), with the first two items used to assess the history of suicidal ideation and suicide attempts, but they were adapted to reflect the last 12 months.

Data analysis

Preliminary analyses were conducted in SPSS 23 (IBM Corp, 2015) to select only those participants who reported lifetime suicidal ideation and/or a lifetime suicide attempt at baseline for inclusion in the latent class analysis, with a sample of *n* = 867 participants. Participants with missing values on any of the indicator variables used to create the profiles were also excluded, and the final sample size for the LCA was *n* = 845. A Latent Class Analysis was carried out in R, using the tidyLPA package (Rosenberg et al., 2018). The subgroups for this study were defined by six indicator variables: depressive symptoms, current suicidal ideation, defeat, internal entrapment and external entrapment, as well as impulsivity. Solutions were fit for one to six classes. The best-fitting class solution was decided based on the Akaike's Information Criteria (AIC), Bayesian Information Criteria (BIC), the Bootstrapped Likelihood Ratio test (BLRT) and entropy.

The full sample (n=3508) was used for follow-up analyses, where those who were excluded from the LCA (n=2663) are hereafter labelled the Comparison Group. This was the group that did not report a history of suicidal ideation or attempts. Follow-up analyses were conducted in Jamovi (The jamovi project, 2022). Classes were compared at baseline using ANOVAs. Mixed effects logistic regression analysis was used to predict suicide attempts longitudinally. Multinomial regression analyses were used to study class differences at follow-up. More information on each test is available in the supplementary materials.

Results

Description of the latent classes

An overview of the different LCA solutions is reported in Table 1. In the LCA, a three-class solution was selected for the best fit for the current sample (n=845). While the six-class solution had the lowest AIC and BIC values, it had low entropy and various classes smaller than 5% of the sample. A scree plot which helped to identify which solution to select can be found in Appendix A.

[Insert Table 1 here]

Descriptive statistics by class membership are shown in Table 2. The three classes reflected a group of people with relatively low symptoms (Class 1; n = 529, 62% of the sample), a group of people with moderate symptoms (Class 2; n = 195, 23% of the sample), and a group with high levels of symptoms (Class 3; n = 119, 14% of the sample). These groups were compared against each other, and with the comparison group (n=2663). The groups differed on all variables of interest except age, sex and ethnicity. Full details on the differences between the classes at baseline are in the supplementary materials.

[Insert Table 2 here]

Predicting suicide attempts at follow up

Out of the 3508 participants, 2418 (68.9%) completed the 12 months follow up, 2236 (63.7%) completed the 24 months follow up, and 2226 (63.5%) completed the third follow-up at 36 months. At 36 months, an ordinal logistic regression revealed significant differences in attrition between the classes. Using the comparison group as a reference group, those in Class 1 were more likely to have missed one or more follow-up, $Wald\ z = 2.42, p = .015, OR = 1.24$, as well as those in Class 3, $Wald\ z = 3.42, p < .001, OR = 1.79$. Looking at the demographics, those who remained in the study were slightly older (M=25.7, SD=4.75) than those who didn't (M=25.1, SD=4.91), $t(3450) = 3.61, p < .001$, and those who remained were more likely to be female, $\chi^2(1) = 84.5, p < .001$.

Because of this differential dropout, our original analysis plan changed, and the multinomial regression to distinguish between class differences at 36 months is not reported in this paper. However, for transparency, it is reported in the supplementary materials, as we think the results show interesting findings despite the fact that the remaining sample is not representative. Moreover, because of this attrition, a mixed effects logistic regression was used to predict suicide attempts at the three follow-ups. Class assignment was added as a factor, together with Follow-up. This Follow-up variable compared the three different time points at 12-, 24- and 36-months post-baseline. There was a significant effect of Class on the likelihood of a suicide attempt, $F(2,2451) = 56.27, p < .001$. Post-hoc comparisons showed that there were significant differences between all groups, with the comparison group being the least likely to have a suicide attempt at any of the follow-ups, followed by Class 1, then Class 2, and finally Class 3. We also found a significant effect of Follow-up, $F(2,4433) = 10.86, p < .001$. There was no significant difference in the likelihood of a suicide attempts across all classes between the 12-month and the 24-month follow-up. There were however significant differences between the 12-month and the 36-month follow-up, $t(4552) = 4.04, p < .001$, indicating that people were more likely to have attempted suicide at 12 months than at 36 months. We found a similar effect for the comparison between 24 months and 36 months, $t(4330) = 4.10, p < .001$. We also found a significant interaction between Follow-up and Class, $F(6,4390) = 6.65, p < .001$, which we have plotted for ease of interpretation in Figure 1. We found that the comparison group and Class 1 stayed relatively stable over time, with Class 1 showing a slight decrease by 36 months post-baseline, whereas Class 2 showed a slight increase in the likelihood of a suicide attempt at 24 months compared to 12 months. Class 3 showed the most notable difference, with a much higher likelihood of a suicide attempt at the 12-month follow-up, after which the likelihood decreases with time, albeit still being higher than the other groups.

[Insert Figure 1 here]

Discussion

The aim of this study was to use Latent Class Analysis (LCA) to identify subgroups within a nationally representative dataset based on established suicide risk factors from the IMV model (O'Connor & Kirtley, 2018). Additionally, we examined how these groups differed at baseline and longitudinally, as well as predicting who was most at risk for future suicidal behaviour. Within a subsample of individuals with a history of suicidal thoughts and/or attempts, we identified three subgroups (based on levels of depression, defeat, internal and external entrapment, suicidal ideation and impulsivity); a low symptom group (Class 1 = 62%), a moderate symptom group (Class 2 = 23%), and a high symptom group (Class 3 = 14%).

Findings suggested that higher levels of symptoms were also associated with higher levels on associated risk variables such as impulsivity and perfectionism, and lower levels of protective variables such as social support. At 36 months follow-up, those in the high symptom class were most likely to have made a suicide attempt in the last 36 months, and the control group having the lowest risk. Comparing the different follow-ups, it seems that the risk of a suicide attempt was highest within 12 months after baseline in the high risk group. However, the moderate risk group showed an increase in suicide attempt rates at the 24-month follow-up, which was retained at 36 months. The low risk group showed a relatively stable risk over time. While a history of suicidal behaviour has been highlighted in many previous studies, both for suicide deaths (Bostwick et al., 2016) and future suicide attempts (O'Connor et al., 2013), entrapment has not had as much attention. Our findings suggest that within a subsample of people with a suicidal history, entrapment may be especially important in distinguishing between those at lower and higher risk for future suicidal behaviour. This finding fits with a clinical prospective study which identified entrapment as a key variable in predicting future suicidal behaviour (O'Connor et al., 2013), as well as Branley-Bell et al. (2019) who called for entrapment to receive closer attention in suicide risk assessments. The current findings are also consistent with the central tenet of the motivational phase of the IMV model, which suggests that entrapment is part of the final common pathway to suicidal thinking and behaviour (O'Connor & Kirtley, 2018). Future research and clinical practice should aim to embed the assessment of entrapment within clinical formulation protocols. As the risk of a suicide attempt was most pronounced in the high risk group at 12 months, and decreased after that, it highlights that long-term prediction may be less viable when assessing suicide risk.

We were surprised that the classes did not differ from each other on acquired capability as the IPTS suggests that those at higher risk of attempting suicide have a higher capability for suicide (Joiner, 2005). However, our findings are more consistent with Ma et al. (2019) who did not find differences in capability for suicide in their group analysis (Ma et al., 2019). One possible explanation for our null finding is that all of the groups contained some individuals with a previous suicide attempt, thereby rendering it difficult to detect differences in capability between the classes. While this

study grouped together those who simply think about suicide and those who attempt suicide, which some argue are two categorically distinct groups (Witte et al., 2017), it does show that high-risk individuals are more likely to attempt suicide at a later point and that these individuals differ on some key components of the ideation-to-action framework (Klonsky et al., 2017) from those who are at a lower risk, both at baseline and longitudinally.

Limitations

It is important to acknowledge our study limitations. First, in the prospective analyses, it is likely that our findings have been affected by differential drop-out as those in the high symptom class were most likely to have dropped out of the study, leading to this group being underrepresented in the follow-up analysis. This dropout prevented us from drawing many meaningful conclusions about the stability of class membership over time, which was one of our original aims. However, we do believe that the remaining results are still important additions to the suicide literature. Second, like many similar studies, as all measures were self-report, the findings may be affected by demand characteristics and the under-reporting of sensitive issues such as suicidal thoughts and behaviours. Lastly, despite being a nationally representative sample, the total number of suicide attempts reported by participants was low, which may limit the statistical power. In future research, larger or more high-risk samples should be considered. It is also unclear the extent to which these findings generalise to other countries, in particular those from other cultures. Lastly, we were unable to use longitudinal models such as Latent Class Growth Modelling (LCGM) to investigate changes in symptoms over time. Future research should aim to collect the same variables at baseline and follow-up in order to allow for these more sophisticated methods of predicting suicide-related outcomes. This would allow for studying trajectories of symptom severity related to suicide risk over time and identifying key constructs that affect these trajectories.

Conclusions

Overall, our findings emphasise the importance of previous suicidal behaviour and entrapment when investigating suicide risk. To our knowledge, this is the first study using constructs from the IMV model to create latent classes to predict future suicidal behaviour. It provides a solid basis for future research in this area. These findings highlight the potential utility of latent classes in the understanding and prediction of suicide risk.

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Table 1

Overview of the solutions from the Latent Class Analysis

Model	AIC	BIC	Entropy	Bootstrapped Likelihood Ratio test p-value
One class	34287	34415	1.000	-
Two classes	34273	34434	0.538	**.010**
Three classes	33577	33771	**0.888**	**.010**
Four classes	33587	33814	0.655	.356
Five classes	33599	33859	0.590	.475
Six classes	**33290**	**33584**	0.640	**.010**

Note. values in bold indicate the best solution according to that criterion.

Table 2

Baseline demographic, IMV, and other risk and protective variables amongst the three latent classes and the control group

Variable	Control group (n=2607)	Class 1 (n=529)	Class 2 (n=195)	Class 3 (n=119)	Omnibus *F* or χ^2	*p*
Demographics						
Age, *M (SD)*	25.41 (4.87)	25.62 (4.56)	25.43 (4.75)	25.63 (4.88)	0.35	.790
Sex (female), *n (%)*	1293 (49.6)	276 (52.2)	111 (56.9)	53 (44.5)	6.25	.100
Marital status (married/civil partnership), *n (%)*	461 (17.7)	79 (14.9)	18 (9.2)	7 (5.9)	20.9	**<.001**
Employment status (active) *n (%)*	2147 (82.8)	382 (72.3)	119 (61.7)	68 (57.6)	105	**<.001**
Ethnicity (white) *n (%)*	2442 93.7)	500 (94.5)	186 (95.4)	113 (95.0)	1.41	.703
Sexual orientation (heterosexual) *n (%)*	1713 (94.6)	319 (90.9)	121 (82.9)	54 (74.0)	69.8	**<.001**
Variables for the formation of the latent classes						
BDI, *M (SD)*	7.59 (7.94)	13.70 (9.46)	29.07 (11.04)	37.16 (11.11)	532.9	**<.001**
BSSI 19, *M (SD)*	0.18 (1.19)	0.67 (1.87)	2.95 (3.59)	16.87 (5.36)	427.6	**<.001**
Defeat, *M (SD)*	12.35 (9.96)	20.62 (11.24)	37.68 (10.87)	45.65 (10.48)	718.4	**<.001**
Internal Entrapment, *M (SD)*	2.16 (3.96)	4.03 (3.66)	17.18 (3.63)	18.93 (4.55)	1463.3	**<.001**
External Entrapment, *M (SD)*	4.08 (6.01)	7.50 (7.06)	20.22 (7.87)	25.82 (7.81)	556.1	**<.001**
Impulsivity, *M (SD)*	60.31 (10.20)	64.89 (10.67)	70.13 (11.33)	72.33 (11.77)	99.8	**<.001**
Mental health risk variables						
Social support, *M (SD)*	26.5 (3.99)	25.0 (4.89)	22.5 (5.06)	19.9 (6.38)	85.7	**<.001**
Perceived Burdensomeness, *M (SD)*	11.7 (5.21)	15.7 (7.08)	25.2 (8.30)	31.7 (8.61)	400.5	**<.001**
Thwarted Belongingness, *M (SD)*	10.2 (5.66)	12.9 (6.48)	18.0 (6.25)	22.6 (6.08)	254.9	**<.001**
Socially Prescribed Perfectionism, *M (SD)*	40.1 (12.49)	44.7 (13.31)	53.5 (12.82)	57.5 (14.20)	125.8	**<.001**
ACSS, *M (SD)*	13.6 (4.10)	14.8 (4.26)	15.1 (4.80)	16.4 (5.11)	25.4	**<.001**
Wellbeing, *M (SD)*	51.9 (7.51)	48.6 (7.35)	39.5 (7.92)	33.9 (7.31)	367.4	**<.001**
Problematic alcohol use (yes), *n (%)*	209 (8.0)	70 (13.2)	36 (18.5)	18 (15.1)	37.2	**<.001**
Suicide attempt in the last year (yes), n (%)	0 (0.0)	24 (4.6)	21 (10.8)	43 (36.4)	667	**<.001**
History of self-harm (yes), *n (%)*	165 (6.4)	215 (40.6)	94 (48.2)	76 (63.9)	767	**<.001**

Note. Pairwise deletion was used for all analyses, so different total N for each comparison. Full test details can be found in supplementary materials. Bold values indicate significant results. Abbreviations: BDI = Beck Depression Inventory, BSSI = Beck Scale for Suicidal Ideation, ACSS = Acquired Capability for Suicide Scale.

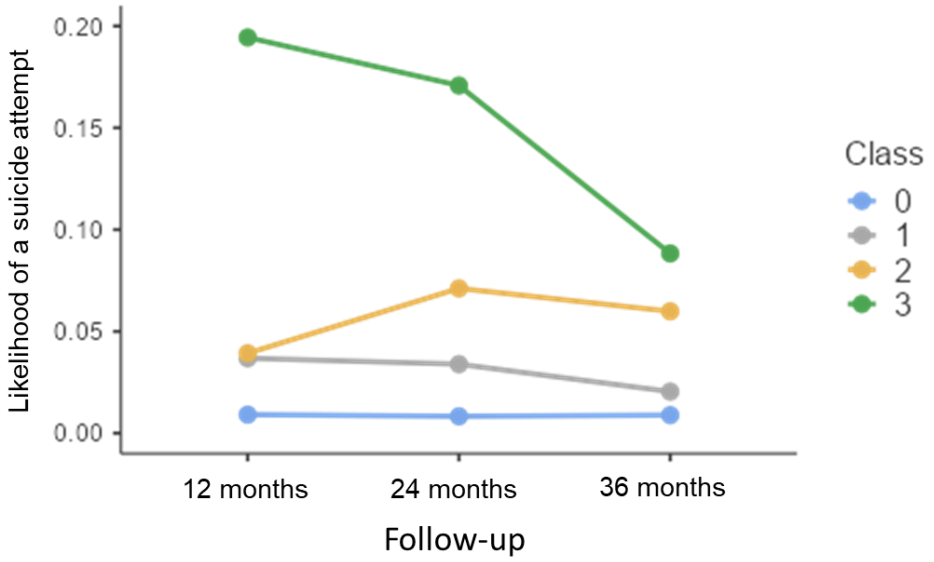

Figure 1: Plot showing the likelihood of a suicide attempt for each of the follow-ups, separated by Class.