



The association of family, social and romantic loneliness in relation to suicidal ideation and self-injurious behaviours

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ABSTRACT

Over 703,000 people die by suicide every year. The association between loneliness and self-injurious thoughts and behaviours has received increasing amounts of attention, with a significant link consistently being identified. However the impact that different types of loneliness have on physical and mental health remains under-researched. The current study aimed to explore how different forms of loneliness might be associated with self-injury, based on findings from existing theory-driven research. This cross-sectional online study investigated three types of loneliness (family, romantic, social) as well as loneliness as a unidimensional construct (global loneliness) in relation to suicidal ideation and several established variables associated with suicidal ideation (defeat, entrapment and depression). 582 participants (age 18–70 years) completed the survey between May and October 2021. Results showed that all forms of loneliness were associated with suicidal ideation, and all loneliness measures significantly, independently, moderated the association between entrapment and suicidal ideation. Furthermore, depression significantly mediated between family, romantic and global loneliness and suicidal ideation, but not social loneliness. The findings suggest that the quality and/or quantity of family, romantic and global relationships, should be explored when considering loneliness as a possible risk factor for suicidal ideation and may have a significant impact on mental and physical health. In particular, romantic loneliness may have a particularly adverse association with negative affect and suicidal ideation. Future work would benefit from replicating these findings longitudinally.

1. Introduction

Suicide is a major public health concern with over 703,000 suicide deaths occurring globally every year (World Health Organization, 2021). Despite the utility of theory-driven approaches to guide suicidal behaviour research in recent years, many suicide deaths occur with little or no warning (Klonsky and May 2010). Leading factors associated with suicide death include exposure to suicidal behaviour, namely having a close friend or relative die by suicide or attempt suicide (Wetherall et al., 2018). However, the pathways to suicide are complex, involving many risk factors, with recent calls to focus on extant psychological factors to better understand the emergence of suicidal ideation and behaviour (O'Connor and Nock, 2014). One risk factor which has gained increasing attention in public health, including in understanding suicide risk, is loneliness. Although there is evidence to suggest that there is an independent prospective association between loneliness and self-injurious

thoughts, and loneliness and self-injurious behaviours (McClelland et al., 2020), which dimensions of loneliness (e.g., family, friend or romantic loneliness) are most associated with these outcomes remains under-researched.

1.1. Loneliness in theories of suicide

To explore the association between loneliness and suicide, two leading models of suicidal behaviour need to be considered. Both the Interpersonal Theory of Suicide (IPT; Joiner, 2005; van Orden et al., 2010) and Integrated Motivational Volitional Model of Suicidal Behaviour (IMV; O'Connor and Kirtley, 2018; O'Connor, 2011) suggest that loneliness is an antecedent of suicidal ideation, working in a similar way to social support. Although this is only expressly stated in the IPT, the IMV model not only incorporates key drivers of the IPT in predicting suicidal behaviour (i.e., thwarted belongingness, perceived

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burdensomeness, desire for death), but it also considers predispositional factors (e.g., personality traits, genetics, family history of suicide) associated with suicide risk. Due to the broader, biopsychosocial approach of the IMV model, this model shall be used to guide the current study.

1.2. Summary of the IMV model

Within the IMV model, risk and protective factors of suicide are grouped into three overarching phases; i) the Pre-Motivational Phase comprising of factors which span from pre-birth through to adulthood, ii) the Motivational Phase which focuses on contextual factors in the present, including key drivers of suicide (i.e., defeat, entrapment, suicidal ideation; Williams, 2001) and contextual factors, and, iii) the Volitional Phase which determines the transition from self-injurious thoughts to self-injurious behaviour. Although loneliness is not explicitly mentioned within the IMV model, a recent study found that loneliness significantly moderated between defeat and entrapment, and between entrapment and suicidal ideation. Based on effect size, the authors concluded that loneliness was most likely to operate similarly to social support and thwarted belongingness; moderating the relationship between entrapment and suicidal ideation (McClelland et al., 2021). This is also consistent with the IPT, which argues that thwarted belongingness (which encapsulates loneliness), in combination with burdensomeness, can give rise to self-injurious thoughts. Due to the significant association between both moderation models however, further investigation is required.

1.3. Loneliness in association with wellbeing

Loneliness is a mismatch between the quantity or quality of relationships one has compared to those that they desire (Perlman and Peplau, 1982). As such, it is possible to feel lonely without being physically alone. Some argue that loneliness is a unidimensional construct, with many assessing loneliness using the University of California Loneliness Scale (UCLA; Russell, Peplau and Ferguson, 1980) to assess overall, or ‘global’ loneliness (Mund et al., 2022). Alternatively, Weiss (1973) argues that loneliness is multifaceted, comprising of social and emotional loneliness. Emotional loneliness pertains to deficiencies in family or romantic bonds, while social loneliness relates to friends. Research has found that different forms of loneliness can have different implications for physical and mental wellbeing. For example, in a nationally representative study of US high-school students, Lasgaard et al. (2011) found social and family loneliness were significantly associated with poorer mental wellbeing (i.e., depression and suicidal ideation), while social and romantic loneliness were more strongly associated with eating disorders and self-harm. These findings were further supported by a recent qualitative study exploring interpersonal factors prior to a suicide attempt where both romantic and family loneliness were common themes (McClelland et al. unpublished). There is also evidence that loneliness predicts suicidal thoughts and behaviour over time, with the relationship being mediated by depression (McClelland et al., 2020). However, very little research has focused on which types of loneliness may be most influential.

1.4. Current study aims

The key aim of this study was to investigate the associations between different forms of loneliness (family, romantic, social and global) in relation to self-injurious thoughts and behaviours. The findings of this research could inform the development of more nuanced suicide prevention strategies to support the mental wellbeing of those at risk of self-injury.

To address the current aim, four research questions were addressed.

1. To what extent are loneliness, depression, defeat and entrapment associated with suicidal ideation?
2. Which psychological factors distinguish between those with no history of self-injurious thoughts or behaviours, history of self-injurious thoughts only, and those with a history of self-injurious behaviour?
3. Which, if any, forms of loneliness moderate the relationship between defeat and entrapment and entrapment and suicidal ideation?
4. Does depression mediate the relationship between any form of loneliness and suicidal ideation, and if so, does the level of mediation vary.

Based on the extant research, our hypotheses were the following.

1. Suicidal ideation would distinguish between those with no history of self-injurious thoughts or behaviours, a history of self-injurious thoughts only and with a history of self-injurious behaviours. All other factors would distinguish between those with a history of self-injurious thoughts only, and those with no history of self-injurious thoughts or behaviours.
2. Social and family loneliness would distinguish between those with a history of suicidal ideation and those without a history of self-injurious thoughts or behaviours.
3. Romantic loneliness would distinguish between those with and without a history of self-injurious behaviour.
4. Loneliness would be a stronger moderator of the relationship between entrapment and suicidal ideation than between defeat and entrapment.
5. Of all forms of loneliness investigated, social and family loneliness would be the strongest moderators of entrapment and suicidal ideation
6. Depression would mediate between social loneliness and suicidal ideation.

2. Methods

2.1. Procedure

Data were collected via Online Survey Systems from the July 1st to November 24, 2021. Anyone aged ≥ 18 years was eligible to participate in the study. The study advert was placed on the University of Glasgow research webpages and personal and professional social media profiles of the study authors (e.g., Twitter, Facebook). The advert summarised the study aims, eligibility and a link to the survey website which included study documents (e.g., participant information sheet, privacy notice) and the consent form before directing participants to the study measures. Upon completion of the study, participants were presented with a second weblink which provided the opportunity to enter a prize draw to win high street vouchers to the value of £200 as compensation for their participation. The link between the survey webpage and prize draw was broken so that contact details entered in the prize draw could not be associated with survey responses. Raw study data were downloaded from the survey platform via Excel files, which were then encrypted and stored on the University of Glasgow computing domain. Ethical approval was granted by the University of Glasgow Medical, Veterinary and Life Sciences Ethics committee (ref. No.: 200200138).

2.2. Measures

All study measures are listed briefly below. For more detailed descriptions, including example items, cronbach alphas, response scales, maximum score ranges and measure validity, see appendix 1. Study measures included: *Participant demographics* (e.g., participant's age, gender). *Self-injury history*: Adapted from the Adult Psychiatric Morbidity Survey (McManus et al., 2007) to identify experiences of self-injurious thoughts or behaviours (see appendix 2). *Suicidal ideation*: The Suicide Probability Scale (Cull and Gill, 1989) was used to explore

experiences of thoughts and behaviours relating to suicidal ideation. *Global loneliness*: The UCLA version 3 (Russell et al., 1980) assessed the frequency and intensity of loneliness and social isolation and a unidimensional construct. *Family, romantic and social loneliness*: The three subscales of the Social and Emotional Loneliness Scale (abbreviated version) for Adults (SELSA; DiTommaso and Spinner, 1993) assessed differing forms of loneliness (SELSA-Family, SELSA-Romantic, SELSA-Social). *Depression*: Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) measured depressive symptoms within the last two weeks. *Defeat*: The Defeat Scale (Gilbert and Allan, 1998) measured feelings of defeat within the last seven days. *Entrapment*: The Entrapment Scale (Gilbert and Allan, 1998) evaluated feelings of being trapped by either internal or external factors.

2.3. Statistical analysis

A priori g-power power analysis of sample size based on seven predictors and an alpha of 0.01 indicated that at least 121 participants would be required for the data analysis of this study. Statistical analyses were conducted using SPSS (version 27). Based on self-injury history, participants were allocated to one of three possible participant groups: i) no history of self-injurious thoughts or behaviour group (NH group); ii) a history of self-injurious thoughts but no history of self-injurious behaviour (SI group); and iii) a history of self-injurious behaviour (including suicide attempt), regardless of any history of self-injurious thoughts (SB group). Demographics were reported by group totals and percentages, except for age which was reported using means and standard deviation. Between-group age differences were tested using a one-way ANOVA.

Given the clinical history of the participant sample, normality was inferred based on visual inspection of the data rather than statistical evaluation (Mishra et al., 2019). Visual inspection showed that total scores on each study measure were normally distributed. Bivariate correlation analyses were conducted to initially assess the association between all study variables. Similarities between all loneliness variables were explored using collinearity assessments. a Variance Inflation Factor (VIF) of <2.5 was defined as meeting acceptable criteria for dissimilarity (Johnston et al., 2018). Total variable scores between self-injury history participant groups were compared using univariate and multiple variable multinomial logistic regressions (reported using chi-square; χ^2), followed by pairwise analyses reported using group means and standard deviation (\pm) followed by odds ratios (OR) and 95% confidence intervals (95% CI). Hayes (2013) PROCESS macro for SPSS was used to compare UCLA and SELSA subscales within the following moderation models between i) defeat and entrapment, and ii) entrapment and suicidal ideation. These were conducted using adjusted models controlling for demographics (age, gender) and depression then repeated controlling for all other loneliness scales to identify which was most influential. For mediation analysis, all loneliness scales were individually entered as independent variables to investigate the mediating effect of depression between loneliness and suicidal ideation controlling for age, gender and all remaining forms of loneliness. For a summary of the missing data analysis, see appendix 3.

3. Results

3.1. Participant summary

582 participants took part in the study. Participant demographics, including age, gender and sexuality are summarised below (see Table 1). To summarise, females represented 73.39% of the total participant sample though the gender ratio varied between participant groups. Participant ages ranged from 18 to 70 years (mean: 26.96 \pm 9.79), with 80.1% (n = 466) of participants being aged 18–30 years, 17.5% (n = 102) aged 31–59 years and 2.4% (n = 14) aged 60 years or over. 60.16% were heterosexual/straight and were most commonly British (49.8%),

Table 1
Participant demographic characteristics (n = 582).

Variable	NH (n = 106)	SI (n = 74)	SB (n = 400)	Total sample ^a (n = 582)	ANOVA F (df)
Gender n (%)rowhead					
Male	33 (31.13)	22 (29.73)	76 (19.00)	131 (22.51)	
Female	69 (65.09)	49 (66.22)	304 (76.00)	422 (72.51)	
Other	3 (2.83)	3 (4.05)	16 (4.00)	22 (3.78)	
Unknown/prefer not to say	1 (0.94)	0 (0)	4 (1.00)	7 (1.20)	
Total	106	74	400	582	
Age rowhead					
Mean	27.50	27.72	26.63	26.93	F (2) =
Std. Deviation	10.68	9.98	9.52	9.79	0.60, p
Range	18–67	18–60	18–70	18–70	= NS
Unknown/prefer not to say	1 (0.94)	0 (0)	3 (0.75)	6 (1.03)	
Nationality n (%)rowhead					
British	54 (50.94)	32 (43.24)	204 (51.0)	290 (50.00)	
Mixed	2 (1.89)	0 (0)	9 (2.25)	11 (1.90)	
Other	48 (45.28)	42 (56.76)	180 (45.00)	270 (46.55)	
Unknown/prefer not to say	2 (1.89)	0 (0)	7 (1.75)	11 (1.90)	
N	106	74	400	582	
Sexuality n (%)rowhead					
Heterosexual	74 (69.81)	53 (71.62)	219 (54.75)	346 (59.45)	
Gay/Lesbian	4 (3.77)	3 (4.05)	17 (4.25)	24 (4.12)	
Bisexual	12 (11.32)	12 (16.22)	111 (27.75)	135 (23.20)	
Asexual	3 (2.83)	0 (0)	17 (4.25)	20 (3.44)	
Not sure	8 (7.55)	4 (5.41)	24 (6.00)	36 (6.19)	
Other	3 (2.83)	1 (1.35)	9 (2.25)	13 (2.23)	
Unknown/prefer not to say	2 (1.89)	1 (1.35)	3 (0.75)	8 (1.37)	
N	106	74	400	582	

Df = degrees of freedom; F = effect size; N = total number; NS = not significant; p = p-value sd. = standard deviation; % = percentage based on allocated self-injurious history group; NS = not significant; NH = no history of self-injurious thoughts or behaviour group; SI = history of self-injurious thoughts but no history of self-injurious behaviour; SB = history of self-injurious behaviour (including suicide attempt), regardless of any history of self-injurious thoughts. 582 participants were included in the total sample, however as two participants did not sufficiently answer the self-injury history questions the total number of participants allocated a self-injury history group is 580.

followed by Indian (4.30%) or American/USA (3.9%). An ANOVA revealed no significant difference in age between groups and no significant between-group variations were observed based on the remaining demographic characteristics.

3.2. Correlations between variables

The correlations between all study variables are summarised in appendix 4. Suicidal ideation was significantly associated with all study variables. UCLA Loneliness, SELSA-family and SELSA-Social were

significantly positively associated with all study variables. SELSA-Romantic was also positively associated with all study variables except defeat where no significant association was observed.

3.3. Collinearity tests

VIF scores for each loneliness scale in the current study were: SELSA-Family = 1.40, SELSA-Romantic = 1.121, SELSA-Social = 2.31, and UCLA = 2.89.

3.4. Distinguishing between those with different self-injury histories

Table 2 summarises univariate and multiple variable multinomial logistic regressions based on participants' history of self-harm behaviour, history of suicidal ideation only or no history of self-harm behaviour or ideation participant groups.

3.4.1. Logistic regression

Univariate multinomial logistic regression and multivariate multinomial logistic regression data summaries are located in Table 2. Detailed descriptions of the univariate multinomial logistic regression results and post-hoc pairwise analyses are provided in appendix 5.

Multiple variable multi-nomial logistic regression revealed that SELSA-Romantic ($\chi^2 = 6.945, p < 0.05$), and suicidal ideation ($\chi^2 = 42.225, p < 0.001$) independently distinguished between participants based on self-injury history when controlling for all other study variables. Multiple variable post-hoc pairwise comparisons indicated that this significant result was likely to be due to an anomalous suppressor effect, with the only statistically difference being observed between SI and SB groups only. Multiple variable multi-nomial logistic regression did not identify any significant difference in depression between the three participant groups.

Post-hoc pairwise analysis showed significant differences in SELSA-Romantic scores between SI and SB groups (25.92 ± 13.04 and 24.39 ± 13.61 respectively; OR: 0.95 95% CI: 0.92–0.99) and differences in depression scores between NH and SB groups (16.22 ± 5.82 and 20.38 ± 6.84 respectively; OR: 1.19, 95% CI: 1.02–1.38). Suicidal ideation significantly distinguished between NH and SB groups (11.42 ± 3.94 and 14.57 ± 4.83 respectively; OR: 1.99, 95% CI: 1.51–2.62) and SI and SB groups (12.99 ± 4.73 and 14.57 ± 4.83 respectively; OR: 1.52, 95% CI: 1.20–1.99) but not between NH and SI groups (11.42 ± 3.94 and 12.99 ± 4.73 respectively; OR: 1.312 95% CI: 0.968–1.777). Further pairwise

Table 2
Multi-variable and univariate multinomial logistic regression on group allocation to NH, SI, and SB participant group (n = 586).

	Univariate			Multivariate		
	Chi-square	df	p	Chi-Square	df	p
SELSA						
Family	7.66	2	p < 0.05	0.74	2	ns
Romantic	4.86	2	ns	6.95	2	p < 0.05
Social	2.43	2	ns	2.51	2	ns
UCLA	7.15	2	p < 0.05	4.70	2	ns
Depression	35.93	2	p < 0.001	5.70	2	ns
Defeat	55.55	2	p < 0.001	0.10	2	ns
Entrapment	27.14	2	p < 0.001	0.22	2	ns
Suicidal Ideation	45.32	2	p < 0.001	42.23	2	p < 0.001

df = degrees of freedom; p = p-value; ns = not significant. NH = no history of self-injurious thoughts or behaviour group; SI = history of self-injurious thoughts but no history of self-injurious behaviour; SB = history of self-injurious behaviour (including suicide attempt), regardless of any history of self-injurious thoughts.

comparisons are summarised in appendix 6.

3.5. Moderation analyses

All forms of loneliness (UCLA and SELSA) were investigated to explore their moderation effect between defeat and entrapment.

3.5.1. Moderation between defeat and entrapment

No forms of loneliness significantly moderated between defeat and entrapment (see appendix 7 for results).

3.5.2. Loneliness as a moderator between entrapment and suicidal ideation

Within the unadjusted models only SELSA-Family, SELSA-Romantic and UCLA were significant (see appendix 8 for model data). Of the significant unadjusted moderation models, gender and age were found to have no significant interactive effect whereas depression was significantly correlated with each loneliness scale (SELSA-Family: $\beta = 0.003, se = 0.001, t = 2.893, p < 0.01, 95\% CI: 0.001–0.004$; SELSA-Romantic: $\beta = 0.001, se = 0.001, t = 2.318, p < 0.05, 95\% CI: 0.0002–0.0023$; UCLA: $\beta = 0.002, se = 0.001, t = -2.852, p < 0.01, 95\% CI: 0.001–0.003$). These models also remained significant when controlling for all other forms of loneliness (SELSA-Family: $\beta = 0.002, se = 0.001, t = 2.765, p < 0.01, 95\% CI: 0.001–0.004$; SELSA-Romantic: $\beta = 0.001, se = 0.001, t = 2.162, p < 0.05, 95\% CI: 0.000–0.002$; UCLA: $\beta = 0.001, se = 0.001, t = 2.508, p < 0.05, 95\% CI: 0.000–0.003$).

3.6. Depression as a mediator between loneliness and suicidal ideation

Full mediation analysis summaries are in appendix 9. In brief, after controlling for age, gender and all remaining forms of loneliness, depression was observed to partially mediate between SELSA-Family and suicidal ideation ($\beta = 0.044, se = 0.015, 95\% CI: 0.014–0.074$; Fig. 1A) and between UCLA and suicidal ideation ($\beta = 0.114, se = 0.016, 95\% CI: 0.084–0.146$; Fig. 1B). Based on confidence intervals, these models did not significantly differ from one another. Depression was observed to fully mediate between SELSA-Romantic and suicidal ideation ($\beta = 0.011, se = 0.010, t = 1.118, p = 0.246, 95\% CI: 0.008–0.030$; Fig. 1C). In contrast, depression was not observed to be a mediator between SELSA-Social and suicidal ideation ($\beta = -0.024, se = 0.025, 95\% CI: 0.076–0.226$; Fig. 1D).

4. Discussion

The aim of this study was to investigate the associations between different forms of loneliness in relation to self-injurious thoughts and behaviours. To this end four, research questions were addressed.

The first question aimed to identify the extent to which all study variables were associated with suicidal ideation. Correlation analysis revealed that suicidal ideation was significantly associated with all variables included in this study.

The second research question aimed to explore which psychological factors distinguished between participant groups based on their history of self-injurious thoughts and behaviours (if any). Suicidal ideation significantly differentiated between participant groups when all other study variables were controlled for, thereby supporting our first hypothesis. SELSA-Family, SELSA-Social and SELSA-Romantic distinguished between participant groups, but this was only observed when other study variables were not controlled for, thereby partially supporting our second and this hypothesis.

These findings contradict previous research by, for example, Lasgaard et al. (2011) where social and family loneliness, but not romantic loneliness, were found to be significantly more likely to be associated with suicidal ideation than self-harm. An explanation for this may be that although both Lasgaard et al. (2011) and the current study used a 15-item abbreviation of the SELSA questionnaire, there were some differences in the phrasing of some questions. The version of the SELSA

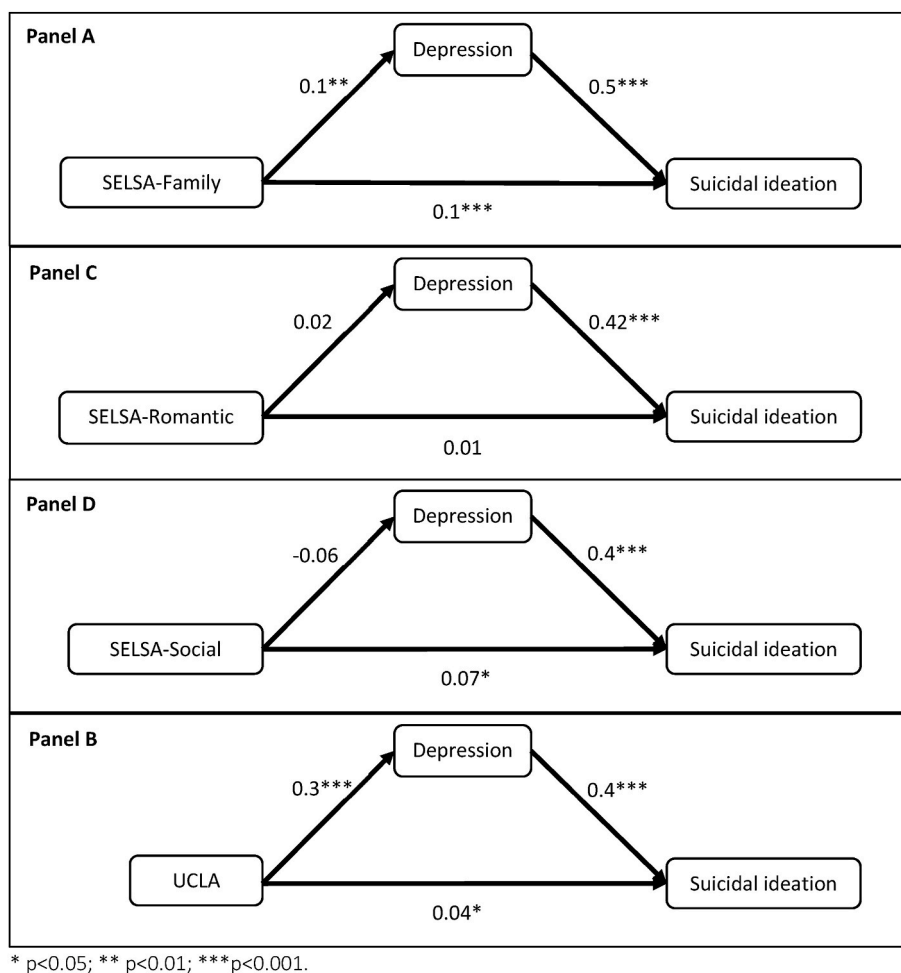


Fig. 1. Mediating effect of depression between loneliness and suicidal ideation. *p < 0.05; **p < 0.01; ***p < 0.001.

adopted in the current study was based on the measure developed by diTommaso and Spinner (1993) and the factor model proposed by Cramer et al. (2000), whereas the version adopted by Laskaard et al. (2011) was based on a revised SELSA measure (di Tommaso, Brannen and Best, 2004). Differences between measure item phrasing may have therefore lead to differences in question interpretation by the participant.

Furthermore, the multivariate pairwise comparison revealed no significant difference in suicidal ideation scores between participant groups with no history of self-injurious thoughts or behaviour, and those with a history of self-injurious thoughts only. This may be because the Suicide Probability Scale is designed to assess current suicidal ideation, whereas most participants in the self-injurious thoughts only group may only have had experience of historic self-injurious thoughts which were not on-going at the time of the study. Consequently, it may be the suicidal ideation measure is not sensitive enough to detect differences between these participants and those with no history of self-injurious thoughts or behaviours.

The third research question of this study was to explore which forms of loneliness moderated between defeat and entrapment and entrapment and suicidal ideation. As predicted by our fourth hypothesis, and consistent with existing literature (McClelland et al., 2021), loneliness was a stronger moderator between entrapment and suicidal ideation than between defeat and entrapment. However, due to the overlapping confidence intervals, no significant difference between the moderating effects of each loneliness measure was identified between defeat and entrapment, or between entrapment and suicidal ideation. Therefore, our fifth hypothesis was not supported.

The final research question aimed to identify whether depression mediated the relationship between loneliness and suicidal ideation, and whether the level of any mediation varied between different forms of loneliness. It was expected that depression would mediate between social loneliness and suicidal ideation; this hypothesis was not confirmed. The results showed that after controlling for demographics and other forms of loneliness, depression did not significantly mediate between social loneliness and suicidal ideation. Instead, depression partially mediated between family loneliness and global loneliness in relation to suicidal ideation which, based on confidence intervals, did not differ in effect size compared to one another. Furthermore, depression was observed to fully mediate between romantic loneliness and suicidal ideation. Although Weiss (1973) argues that social and emotional loneliness cannot compensate for one-another, it is widely understood that romantic and familial loneliness are both associated with emotional loneliness (Peplau, 2022). However, based on the findings of this study, we posit that with regard to self-harm, emotional loneliness, particularly romantic loneliness, may be more detrimental to one’s physical and mental wellbeing than social loneliness.

4.1. Implications of findings

The evidence here suggests that global, romantic and family loneliness (but not social loneliness) operate as motivational moderators within the context of the IMV model; moderating the association between entrapment and suicidal ideation. As each form of loneliness was found to independently moderate between entrapment and suicidal

ideation, this supports arguments by Weiss (1973) that social and emotional loneliness, operate separately of each another. Therefore, suicide prevention interventions which focus on loneliness strategies may benefit from considering the multifaceted nature of loneliness. Indeed, academic research commonly operationalises loneliness as a singular construct, for example, as marital status or presence of close friends (Shaw et al., 2021).

Depression was observed to significantly mediate between all forms of loneliness in relation to suicidal ideation. Therefore, those who present with suicidal ideation and loneliness, may benefit from focusing on depressive symptoms to help alleviate suicidal ideation in lonely individuals. However, identification of which form of loneliness the individual is experiencing would also be advantageous. The results of this study suggest that the association between depression in relation to romantic loneliness and suicidal ideation, though significant, was smaller than that of depression in relation to other forms of loneliness and suicidal ideation. Therefore, when considering focusing on depression to alleviate suicidal ideation adults who are lonely, clinicians should be mindful that any reduction in suicidal ideation may be lesser in those who are romantically lonely, than those who are reporting family, friend or global loneliness.

4.2. Limitations

The findings of this study must be considered within the context of their limitations. This includes the cross-sectional design preventing inferences being made about cause and effect. Equally, mediation analysis is more commonly used in longitudinal designs where the temporal order of variables can be more reliably established. The study sample was overrepresented by females, and, despite the wide age range, the vast majority of participants were less than 30 years of age. Therefore the findings may not be applicable to other populations and comparisons between age groups could not be made. Additionally, the participant sample did not reflect the prevalence of suicidal ideation and self-harm within the general population, with people who self-harm being over-represented in this study. This ‘over-sampling’ may have led to an over-estimation in effect sizes. However, the sample composition is not unexpected as low mood was mentioned in the advertisement for the study. At the start of data collection the final COVID-9 social restrictions were being eased (e.g., opening of nightclubs) in the UK but by the end of recruitment, subsequent variants of the coronavirus were being identified and the use of facemasks was being encouraged again. This time of flux may have led to elevated feelings of strain,

Appendix 1. Study measures

Study measures are listed briefly below. Internal consistency was assessed using Cronbach’s alpha (α) and is provided for each measure based on the current study sample.

Demographics. This included participant’s age, gender, nationality, living arrangements (e.g., cohabitation), relationship status and sexual orientation.

Self-injury history: Consistent with National Institute for Health and Care Excellence (2013) guidelines, self-harm was defined as ‘any act of self-poisoning or self-injury carried out by an individual irrespective of motivation’ including suicide, suicide attempt and non-suicidal self-injury. Self-reported histories of self-harm thoughts, behaviours, non-suicidal self-injury and suicide attempt were replicated from self-injury history measures used by McClelland et al. (2021; see appendix 2 for measure items). These items were developed based on those used in the Adult Psychiatric Morbidity Survey (McManus et al., 2007).

Suicidal ideation. The Suicide Probability Scale (Cull and Gill, 1989) comprises of eight statements assessing thoughts and behaviours to measure participants’ suicidal ideation (e.g., I think of things too bad to share with others) and has been shown to be a reliable and valid measure (Atli et al., 2009) Responses were recorded using a four-item Likert type scale from ‘none or little of the time’ (1) to ‘most or all of the time’ (4) with subscale scores ranging from 8 to 24 ($\alpha = 0.90$).

Global loneliness. The UCLA version 3 (Russell et al., 1980) is the most commonly used measure of self-reported loneliness. The scale assesses the frequency and intensity of loneliness and social isolation as a univariate construct (eg., I feel isolated from others). Responses to this 20 – item measure were answered using a four-point Likert-type scale ranging from ‘never’ (1) to ‘often’ (4). This measure is valid and reliable across a range of populations (Durak and Senol-Durak, 2010). Total measure scores range from 20 to 80 ($\alpha = 0.93$).

Family, romantic and social loneliness. The Social and Emotional Loneliness Scale (abbreviated version) for Adults (SELSA; DiTommaso and Spinner,

particularly on relationships, as well as feelings of entrapment and depressive symptoms, which may have exacerbated the participant responses on some of the study variables. Finally, due to the common co-occurrence of loneliness and social isolation, it may have been advantageous for social isolation to be included as a covariate in the analyses conducted here.

5. Conclusions

Family, romantic and global loneliness scores each uniquely differentiated between participant groups based on their history of self-injurious thoughts and/or behaviours. These forms of loneliness also moderated the association between entrapment and suicidal ideation. When other forms of loneliness were controlled for, depression fully mediated between romantic loneliness and suicidal ideation, and partially mediated between family and global loneliness in relation to suicidal ideation. Therefore, family, global, and particularly romantic loneliness, may each have an adverse impact on mental wellbeing independently of other forms of loneliness. Consideration of these specific forms of loneliness must be considered in research and clinical contexts exploring self-harm behaviour. Future work would benefit from further replications of this study using a prospective approach, as well as controlling for social isolation and ensuring that all age groups are sufficiently represented for between-group analyses.

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Author contributions

All authors have participated in conception and design, of the study article, revising drafts of the manuscript critically for important intellectual content and all authors approve of the final version.

Declaration of competing interest

This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.

1993), includes subscales which assess three loneliness domains; family (SELSA-Family; five-items, e.g., ‘I really belong in my family’; scale range: 5–35; $\alpha = 0.94$), romantic (SELSA-Romantic; six-item e.g., ‘I have an unmet need for a close romantic relationship’; scale range: 6–42; $\alpha = 0.95$) and social (SELSA-Social; four-items e.g., ‘I can depend upon my friends for help’; scale range: 4–28, $\alpha = 0.95$). All items were assessed using a 7-item Likert type scale from ‘strongly disagree’ (1) to ‘strongly agree’ (7) and the measure is a valid and reliable index of loneliness in adult populations (Jowkar, 2012).

Depression. The Patient Health Questionnaire-9 (PHQ-9; Klonsky and May, 2010) is a nine-item self-report measure of depressive symptoms within the last two weeks (e.g., ‘little interest or pleasure in doing things’). Wang et al. (2014) demonstrated that the PHQ-9 was a reliable and valid measure of depression in the general population. Questions are based on experiences of depression within the last two weeks and are measured using a four-item Likert scale from ‘not at all’ (1) to ‘nearly every day’ (4). Total measure scores ranged from 9 to 36 ($\alpha = 0.90$).

Defeat. The Defeat Scale (Gilbert and Allan, 1998) is a 16-item measure which assesses feelings of defeat within the last seven days (e.g., ‘I feel powerless’) with responses recorded using a five-item Likert type scale ranging from ‘never’ (0) to ‘always’ (4). The measure has been shown to be a reliable and valid instrument (Akin et al., 2013) with scores ranging between 0 and 64 ($\alpha = 0.96$).

Entrapment. The Entrapment Scale by Gilbert and Allan (1998) is a 16-item measure which evaluates participants’ feelings of being trapped by either internal or external factors (e.g., ‘I feel powerless to change myself’ versus ‘I am in a relationship I can’t get out of’). Answers are recorded using a five-item Likert type scale from ‘not at all like me’ (1) to ‘extremely like me’ (5). The measure has established reliability and validity (Panagioti et al., 2015) and total scores ranged from 16 to 80 ($\alpha = 0.96$).

Appendix 2. Self-injurious history questions

- 1) Have you ever seriously thought of taking your life, but not actually attempted to do so?
 - a) Yes
 - b) No
- 2) Have you ever made an attempt to take your life?
 - a) Yes
 - b) No
- 3) Have you ever seriously thought about trying to deliberately harm yourself but not with the intention of killing yourself but not actually done so?
 - a) Yes
 - b) No
- 4) Have you ever deliberately harmed yourself in any way but not with the intention of killing yourself?
 - a) Yes
 - b) No
- 5) Have you ever had thoughts of suicide?
 - a) Yes
 - b) No

Appendix 3. Missing data analysis

Consistent with similar studies (McClelland et al., 2021; Wetherall et al., 2018), any participant who completed less than 75% of the survey overall was removed from the study, which resulted in four participants being excluded from the survey overall (n = 582). Equally, participants’ data were removed from an individual scale if less than 75% of the measure items were completed. Applying this rule resulted in 4–11 participants (0.6–1.9%) being excluded for each measure which is reflected in the different participant totals (n) summarised in appendix 3. Remaining missing data of individual items ranged from 0 to 4.2% per variable. Little’s Missing Completely at Random (MCAR) test was non-significant for most variables, indicating that these values were missing completely at random and no further adjustments to data were required. Depression data were missing not completely at random, however as less than 1% of data were missing per item this result was likely due to the high correlation between items 1 and 2 of the measure and therefore Little’s output was dismissed.

To create complete datasets for further analysis, estimation-maximisation imputation techniques were applied to generate statistically likely data to fill the missing data responses of the study measures. However, participants who did not answer all self-injury history questions could not be allocated to a self-injury history group and were not included in the logistic regression analyses. All participants were included in all correlation and moderation analyses as self-injury history data was not a pre-requisite.

Appendix 4. Variable correlations

		SELSA			UCLA	Depression	Defeat	Entrapment	Suicidal Ideation
		Family	Romantic	Social					
SELSA Family	r		0.112**	0.406***	0.530***	0.376***	0.413***	0.422***	0.452***
Romantic	n	581		579	581	582	576	582	582
	r			0.135**	0.293***	0.216***	0.089	0.220***	0.223***
Social	n		578		580	581	576	581	581
	r				0.746***	0.365***	0.438***	0.438***	0.449***
UCLA	n				578	579	576	579	579
	r					0.538***	0.607***	0.637***	0.575***
	n					581	576	581	581

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		SELSA			UCLA	Depression	Defeat	Entrapment	Suicidal Ideation
		Family	Romantic	Social					
Depression	r					0.732***	0.767***	0.749***	
	n					576	582	582	
Defeat	r						0.820***	0.709***	
	n						576	576	
Entrapment	r							0.732***	
	n							582	
Mean		13.82	24.15	10.9741	45.71	19.43	27.33	41.62	13.82
sd.		24.15	13.478	6.639	12.218	6.737	15.637	17.719	4.837
n		582	581	579	581	582	576	582	582

*** = p < 0.001; ** = p < 0.01; * = p < 0.05; r = regression coefficient; n = total number; sd. = standard deviation α = cronbachs alpha; SPP = socially prescribed perfectionism.

Appendix 5. Univariate multinomial logistic regression and pairwise post-hoc analysis

Of the four loneliness measures, only UCLA ($\chi^2 = 7.15$, $df = 2$, $p < 0.05$) and SELSA-Family ($\chi^2 = 7.66$, $df = 2$, $p < 0.05$) distinguished between self-injury participant groups. Depression, defeat, entrapment, and suicidal ideation also significantly differentiated between groups (see Table 2).

Pairwise post-hoc analyses are presented in the table below revealed significant differences between NH and SI for SELSA-Romantic (25.92 ± 13.02 and 25.92 ± 13.04 respectively; OR = 1.02, 95% CI: 1.00–1.05) and between NH and SB for SELSA-Family (12.05 ± 7.49 and 14.40 ± 8.39 respectively; OR = 1.04, 95% CI: 1.01–1.07), SELSA-Romantic (25.92 ± 13.02 and 24.39 ± 13.61 respectively; OR = 1.02, 95% CI: 1.00–1.03) and UCLA (42.89 ± 12.35 and 46.43 ± 12.06 respectively; OR = 1.02, 95% CI: 1.01–1.04). Suicidal ideation was the only variable to significantly differentiate between all pairwise comparisons (NH vs SI: 11.42 ± 3.94 and 12.99 ± 4.73 respectively, OR = 1.12, 95% CI: 1.03–1.22; NH vs SB: 11.42 ± 3.94 and 14.57 ± 4.83 respectively, OR = 1.21, 95% CI: 1.13–1.29; SI vs SB: 12.99 ± 4.73 and 14.57 ± 4.83 respectively, OR = 1.08, 95% CI: 1.02–1.14). No significant differences were identified between SI and SB for any loneliness measures. Further pairwise differences were observed for depression, defeat, entrapment and suicidal ideation (see appendix 5).

Table displaying univariate pairwise analysis of variables based on participant self-reported lifetime history of self-harm.

	NH vs SI ^A		NH vs SB ^A		SI vs SB ^B	
	OR	95% CI	OR	95% CI	OR	95% CI
SELSA- Family	1.02	0.98–1.06	1.04	1.01–1.07	1.02	0.99–1.05
SELSA- Romantic	1.02	1.00–1.05	1.02	1.00–1.03	0.99	0.97–1.01
SELSA-Social	1.01	0.96–1.06	1.03	0.99–1.06	1.01	0.98–1.05
UCLA	1.02	0.99–1.04	1.02	1.01–1.04	1.01	0.99–1.03
Depression	1.07	1.02–1.12	1.11	1.07–1.16	1.04	1.00–1.08
Defeat	1.03	0.99–1.08	1.10	1.06–1.13	1.06	1.03–1.09
Entrapment	1.02	1.00–1.04	1.03	1.02–1.05	1.02	1.00–1.03
Suicidal ideation	1.12	1.03–1.22	1.21	1.13–1.29	1.08	1.02–1.14

CI = confidence interval; OR: Odds Ratio ^A Control is reference variable; ^B Ideation is reference variable NH = no history of self-injurious thoughts or behaviour group; SI = history of self-injurious thoughts but no history of self-injurious behaviour; SB = history of self-injurious behaviour (including suicide attempt), regardless of any history of self-injurious thoughts.

Appendix 6. Multiple-variable multinomial post-hoc pairwise analysis

	NH vs SI ^A		NH vs SB ^A		SI vs SB ^B	
	OR	95% CI	OR	95% CI	OR	95% CI
SELSA- Family	1.012	0.922–1.111	0.980	0.906–1.061	0.969	0.898–1.045
SELSA- Romantic	1.041	0.999–1.084	0.992	0.957–1.029	0.954	0.919–0.990

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	NH vs SI ^A		NH vs SB ^A		SI vs SB ^B	
	OR	95% CI	OR	95% CI	OR	95% CI
SELSA-Social	0.913	0.797–1.052	0.916	0.815–1.029	1.003	0.884–1.138
UCLA	0.992	0.913 0 1.078	1.067	0.987–1.153	1.075	0.998–1.159
Depression	1.155	0.983–1.359	1.187	1.023–1.376	1.027	0.906–1.164
Defeat	0.998	0.929–1.073	0.991	0.932–1.054	0.993	0.926–1.054
Entrapment	1.006	0.945–1.070	0.994	0.942–1.049	0.989	0.941–1.038
Suicidal ideation	1.312	0.968–1.777	1.988	1.511–2.615	1.516	1.202–1.911

CI = confidence interval OR: Odds Ratio.^A Control is reference variable; ^B Ideation is reference variable. NH = no history of self-injurious thoughts or behaviour group; SI = history of self-injurious thoughts but no history of self-injurious behaviour; SB = history of self-injurious behaviour (including suicide attempt), regardless of any history of self-injurious thoughts.

Appendix 7. Forms of loneliness as moderators of defeat and entrapment

SELSA-Family

A significant main effect was observed between defeat and entrapment ($b = 1.01, se = 0.086, t = 11.82, p < 0.001, 95\% CI: 0.846-1.184$) and between SELSA-Family and entrapment ($b = 0.35, se = 0.170, t = 2.046, p < 0.05, 95\% CI: 0.013-0.684$), however no significant interaction was observed between defeat and SELSA-Family in association with entrapment ($b = -0.01, se = 0.005, t = -1.729, p = 0.085, 95\% CI: 0.018 - 0.001$). Despite this, simple slopes analysis one standard deviation above and below the mean, show that low ($b = 0.964, se = 0.063, t = -15.357, p = <0.001, 95\% CI: 0.840-1.087$) and high ($b = 0.802, se = 0.068, t = 11.880, p = <0.001, 95\% CI: 0.669-0.935$) SELSA-Family was significantly different from zero (see Fig. 1).

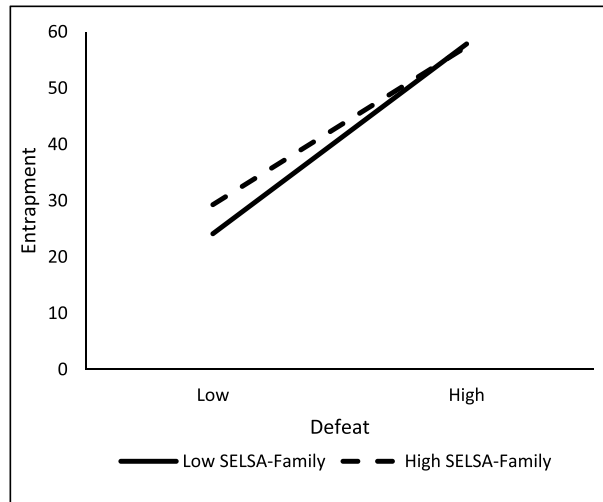


Fig. 2. Exploring SELSA-Family as a moderator between defeat and entrapment

SELSA-Romantic

A significant main effect was observed between defeat and entrapment ($b = 0.90, se = 0.087, t = 10.24, p < 0.001, 95\% CI: 0.723-1.068$) and but not between SELSA-Family and ntrapment ($b = 0.073, se = 0.98, t = 0.741, p = 0.459, 95\% CI: 0.120 - 0.265$). Furthermore, no significant interaction was observed between defeat and SELSA-Romantic in association with entrapment ($b = 0.003, se = 0.003, t = 0.098, p = 0.922, 95\% CI: 0.006 - 0.006$).

SELSA-Social

A significant main effect was observed between defeat and entrapment ($b = 0.991, se = 0.083, t = 11.932, p < 0.001, 95\% CI: 0.827-1.155$) and but not between SELSA-Family and entrapment ($b = 0.227, se = 0.224, t = 1.013, p = 0.312, 95\% CI: 0.215 - 0.669$). Furthermore, no significant

interaction was observed between defeat and SELSA-Romantic in association with entrapment ($b = -0.007$, $se = 0.006$, $t = -1.151$, $p = 0.251$, 95% CI: 0.019 – 0.005).

UCLA

A significant main effect was observed between defeat and entrapment ($b = 0.167$, $se = 0.015$, $t = 11.125$, $p < 0.001$, 95% CI: 0.137–0.196) and but not between SELSA-Family and entrapment ($b = 0.051$, $se = 0.060$, $t = 0.848$, $p = 0.397$, 95% CI: 0.070 – 0.163). Furthermore, no significant interaction was observed between defeat and SELSA-Romantic in association with entrapment ($b = -0.002$, $se = 0.001$, $t = 1.159$, $p = 0.247$, 95% CI: 0.001 – 0.004).

Appendix 8. Moderation of loneliness between entrapment and suicidal ideation

Unadjusted models

SELSA-Family: ($b = 0.002$, $se = 0.001$, $t = 2.364$, $p < 0.05$, 95% CI: 0.0004–0.0040).
 SELSA-Romantic: ($b = 0.001$, $se = 0.001$, $t = 2.148$, $p < 0.05$, 95% CI: 0.0001–0.0024).
 UCLA: ($b = 0.0002$, $se = 0.001$, $t = 2.953$, $p < 0.01$, 95% CI: 0.001–0.003).
 SELSA-Social: did not significantly moderate between entrapment and suicidal ideation.

Appendix 9. Depression as a mediator between loneliness and suicidal ideation

SELSA-Family

SELSA-Family was significantly associated with depression ($b = 0.103$, $se = 0.033$, $t = 3.135$, $p < 0.01$, 95% CI: 0.039, 0.168) and depression was significantly associated with suicidal ideation ($b = 0.427$, $se = 0.022$, $t = 18.940$, $p < 0.001$, 95% CI: 0.381, 0.469). The inclusion of SELSA-Family in the model did not reduce the direct effect to non-significance ($b = 0.77$, $se = 0.018$, $t = 4.317$, $p < 0.001$, 95% CI: 0.042, 0.112). As the indirect effect was significant ($b = 0.044$, $se = 0.015$, 95% CI: 0.014, 0.074), this suggests that depression partially mediated the association between SELSA-Family and suicidal ideation.

SELSA-Romantic

SELSA-Romantic was not significantly associated with depression ($b = 0.023$, $se = 0.018$, $t = 1.288$, $p = 0.198$, 95% CI: 0.012, 0.059) however depression was significantly associated with suicidal ideation ($b = 0.425$, $se = 0.022$, $t = 18.40$, $p < 0.001$, 95% CI: 0.381, 0.469). The inclusion of SELSA-Romantic in the model reduced the direct effect to non-significance ($b = 0.011$, $se = 0.010$, $t = 1.118$, $p = 0.264$, 95% CI: 0.008, 0.030) therefore indicating that depression fully mediated the association between SELSA-Romantic and suicidal ideation.

SELSA-Social

SELSA-Social was not significantly associated with depression ($b = -0.057$, $se = 0.053$, $t = -1.067$, $p = 0.287$, 95% CI: 0.302, 0.453) but depression was significantly associated with suicidal ideation ($b = 0.425$, $se = 0.022$, $t = 18.940$, $p < 0.001$, 95% CI: 0.381, 0.467). The inclusion of SELSA-Social in the model did not reduce the direct effect to non-significance ($b = 0.065$, $se = 0.029$, $t = 2.279$, $p < 0.05$, 95% CI: 0.009, 0.121). As the indirect effect was not significant ($b = -0.024$, $se = 0.025$, 95% CI: 0.076, 0.024), this suggests that depression did not mediate the association between SELSA-Social and suicidal ideation.

UCLA

UCLA-LS was significantly associated with depression ($b = 0.289$, $se = 0.019$, $t = 15.115$, $p < 0.001$, 95% CI: 0.252, 0.327) and depression was significantly associated with suicidal ideation ($b = 0.436$, $se = 0.023$, $t = 19.102$, $p < 0.001$, 95% CI: 0.392, 0.481). The inclusion of UCLA-LS in the model did not reduce the direct effect to non-significance ($b = 0.097$, $se = 0.012$, $t = 7.820$, $p < 0.001$, 95% CI: 0.073, 0.121). As the indirect effect was significant ($b = 0.126$, $se = 0.012$, 95% CI: 0.105, 0.150), this suggests that depression partially mediated the association between UCLA-LS and suicidal ideation.

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