

Defeat and Entrapment Mediate the Relationship between Insomnia Symptoms and Suicidal
Ideation in Young Adults

Daniel Bradford, Stephany Biello, Kirsten Russell

School of Psychology, University of Glasgow

Author Note

All same institution affiliation at time of research being carried out.

Daniel Bradford MSc <https://orcid.org/0000-0002-7523-8764>

New affiliation: *MRC/CSO Social and Public Health Sciences Unit, University of Glasgow*

Prof. Stephany Biello <https://orcid.org/0000-0002-3497-5215>

Corresponding author: *School of Psychology, Hillhead Street, Glasgow, G12 8QB, UK.*

stephany.biello@glasgow.ac.uk

Kirsten Russell PhD <https://orcid.org/0000-0002-7034-2749>

Twitter: @Kirsten_Russell

New affiliation: *School of Psychological Sciences and Health, University of Strathclyde*

Other Notes

Funding - Work done as part of masters degree so no funding support.

Conflicts of interest - None to report.

Acknowledgement – The authors would like to thank the anonymous reviewers for their insightful and useful comments which significantly improved the content of this manuscript.

Author Biographies

Daniel Bradford - Daniel Bradford holds an MSc in Psychological Science from the University Glasgow and has a background in quantitative data analysis in engineering. His research interests include the relationship between sleep and health, and health in disadvantaged groups. He is currently a PhD student based in the Medical Research Council/Chief Scientist's Office Social and Public Health Sciences Unit at the University of Glasgow. His PhD work relates to the health of looked-after children.

Kirsten Russell - Kirsten Russell, PhD is an Analyst Researcher within the Violence Reduction Unit and a Visiting Researcher within the School of Psychological Sciences and Health, University of Strathclyde. She is an Editor for the International Network of Early Career Researchers in Suicide and Self-Harm blog. Kirsten's research interests center on applying theoretical frameworks to advance our understanding of the etiology of suicidal and self-harming behaviors.

Stephany Biello - Stephany has experience of over 27 years as a neurobiologist and psychologist. She completed her PhD at the University of Toronto in Canada, and has a particular interest in biological rhythms and sleep. Her current research program is aimed at understanding how the clock organizes the physiological and behavioral changes that occur on a daily basis, and the implications for health, well-being and social structures. She has published widely on the basic neurobiology of the suprachiasmatic nucleus and the pharmacological control of the circadian clock. Her work has also extended to human models where she has explored factors that maintain insomnia through to the association of disrupted circadian rhythmicity with mood disorders, subjective wellbeing, and cognitive function. Stephany has significant experience in Higher Education in the UK and developing strategy

in that context. She has acted as both Head and Deputy Head of the School of Psychology at the University of Glasgow, and is currently Dean for Learning in Science and Engineering.

Abstract

Objective - In recent years, there has been a growing interest in understanding the relationship between sleep disturbance and suicide. The current study aimed to advance understanding regarding the psychological processes driving these relationships, by examining if insomnia symptoms are related to suicidal ideation via perceptions of defeat and entrapment.

Method – Young adults (n = 259; 202 students [78.0%], 45 employed [17.4%], 12 unemployed [4.6%]) completed an anonymous self-report survey which was advertised via social media, university participant pools, and fliers. The survey was described as being related to sleep and mood/mental health. Validated measures were used to assess insomnia symptoms, chronotype, defeat, entrapment, suicidal ideation and behavior, and a range of covariates.

Results - Bivariate associations found insomnia severity to be related to poorer affective outcomes including severity of suicidal ideation. The relationship between insomnia and suicidal ideation was mediated by perceptions of defeat and entrapment.

Conclusions - Taken together, these findings shed light on the psychological mechanisms linking sleep disturbance and suicidal ideation by highlighting the role of defeat and entrapment. These findings have the potential to improve suicide risk assessment and prevention in young adults experiencing difficulties initiating or maintaining sleep.

Keywords: sleep disturbance, insomnia, suicide, young adults, Integrated Motivational–Volitional Model of Suicidal Behavior

Highlights

- Defeat and entrapment mediate relationship between insomnia and suicidal ideation
- Evidence for IMV model in community sample
- Uses validated multi-item suicide measure

Defeat and Entrapment Mediate the Relationship between Insomnia Symptoms and Suicidal Ideation in Young Adults

Suicide is a leading cause of death in people aged 15–29 globally (World Health Organisation, 2019) and suicidal ideation is a risk factor for death by suicide (Brown, Beck, Steer, & Grisham, 2000). Yet suicide prevention strategies aimed at young people remain ineffective (De Silva et al., 2013; Harrod, Goss, Stallones, & DiGuseppi, 2014). Better understanding the etiology of suicidal ideation and behaviors (SIBs) is key to developing better risk assessment and interventions.

Insomnia has been identified as independent risk factor for SIBs (Becker, Dvorsky, Holdaway, & Luebbe, 2018; Bernert, Hom, Iwata, & Joiner, 2017; Liu et al., 2020; Nadorff, Nazem, & Fiske, 2011; Pigeon, Piquart, & Conner, 2012). Pigeon et al.'s (2012) meta-analysis found insomnia to approximately double the risks of suicidal ideation, attempt, and death by suicide after controlling for covariates such as depression. By contrast, studies have found that insomnia no longer has a significant influence on SIBs when constructs such as depression or entrapment are controlled for (Bernert et al., 2005; Nadorff et al., 2014; Sami, Danielle, Lihi, & Elena, 2018; Woosley, Lichstein, Taylor, Riedel, & Bush, 2014). Additional research is required to better resolve the driving factors of the sleep–SIBs relationship.

First onset of SIBs typically occurs in adolescence (Mortier et al., 2018) and suicide rates increase rapidly through early adulthood (Martini et al., 2019; Snowden et al., 2017). Khader et al. (2020) reported a prevalence of 7.4% for 12-month suicidal ideation in a sample of over 100,000 university students. Further, 26% had experienced sleep disturbances in the same period. This sleep distress was associated with a significant increase in the likelihood of

having experienced suicidal ideation in the preceding year. Clearly suicidal ideation is still a significant problem in young adults, and remedying sleep disturbances may offer a malleable risk factor to improve this situation.

The Integrated Motivational–Volitional Model of Suicidal Behavior (IMV; O’Connor, 2011; O’Connor & Kirtley, 2018) attempts to integrate the complex biopsychosocial factors involved in the development of suicidal ideation and the transition to suicidal behaviors. Central to the IMV is Williams’ (2014) *Cry of Pain* model which posits that SIBs are a response to subjective experiences of *defeat* and *entrapment* (Gilbert & Allan, 1998). The role of defeat and entrapment in relation to SIBs is supported by empirical evidence (Branley-Bell et al., 2019; Littlewood, Gooding, Panagioti, & Kyle, 2016; Russell, Rasmussen, & Hunter, 2018; P. J. Taylor, Gooding, wood, & Tarrier, 2011; Tucker, O’Connor, & Wingate, 2016; Wetherall, Robb, & O’Connor, 2019). Russell et al. (2018) found that defeat and entrapment mediated the relationship between suicidal thoughts and insomnia in adolescents. Qualitative work by Littlewood, Gooding, Kyle, Pratt, and Peters (2016) also highlighted the role of sleep as a source of relief from entrapment. No studies to date have examined the role of defeat and entrapment in the insomnia–SIBs relationship in young adults. The aim of the present study was to test this relationship in a community sample.

Hypotheses

H₁: Insomnia symptom severity will be associated with higher scores on measures of negative affective outcomes, including suicidal ideation.

H₂: Suicidal ideation severity will be statistically dependent on insomnia symptom severity, after controlling for other relevant variables.

H₃: The relationship between insomnia symptom severity and suicidal ideation severity will be mediated by perceptions of defeat and entrapment.

Materials and Methods

Participants and Procedure

The study was designed in line with British Psychological Society guidelines. Ethical approval was granted by the University of Glasgow. Participants were recruited via social media, online forums, and university participant pools to complete an online survey in May–July 2019 and January–March 2020¹. The survey was described as being about sleep and mood/mental health. Information and warnings about the sensitive nature of the topic were presented with contact details for relevant support services. Consenting participants completed the measures described below. The only inclusion criterion was to be aged 18–24. Usable responses were obtained from 259 participants (170 females [65.6%], 89 males [34.4%]). The majority were students (202 students [78.0%], 45 employed [17.4%], 12 unemployed [4.6%]).

Measures

Demographics. Participants reported their age; gender; and whether they primarily identified as students, employed, or unemployed.

Insomnia. The Sleep Condition Indicator (SCI; Espie et al., 2014) is an 8-item measure of insomnia symptoms over the previous month. Each item is scored from 0–4, with higher scores usually indicating better sleep quality. However, SCI scores were reversed to allow for more intuitive interpretation of results. Internal consistency of the SCI was assessed by Cronbach's (1951) α and McDonald's (1999) ω_t statistics: $\alpha = .88$, $\omega_t = .91$.

¹ Data collection ended prior to CoViD-19-related restrictions being placed on people's behaviors across the world.

Chronotype. The reduced Morningness–Eveningness Questionnaire (rMEQ; Adan & Almirall, 1991; Loureiro & Garcia-Marques, 2015) is a five-item self-report measure of chronotype. Scores can range from 4–25, with higher scores indicating preference for mornings. ($\alpha = .57$, $\omega_t = .67$.)

Depression, Anxiety, and Stress. The 21-item Depression, Anxiety, and Stress Scales (DASS-21; Henry & Crawford, 2005; Lovibond & Lovibond, 1995) is a composite measure of depression, anxiety and stress symptoms. Participants respond to seven questions per subscale using a four-point Likert-type scale. Item scores range from 0 (*‘Did not apply to me at all’*) to 3 (*‘Applied to me very much or most of the time’*). Subscale scores are doubled to make comparable with the original 42-item DASS, and summed to give a total score. Potential subscale scores range from 0–42. ($\alpha = .95$, $\omega_t = .96$; $\alpha_{depression} = .93$, $\omega_{t,depression} = .95$; $\alpha_{anxiety} = .87$, $\omega_{t, anxiety} = .90$; $\alpha_{stress} = .87$, $\omega_{t, stress} = .91$.)

Defeat. The Defeat Scale (Gilbert & Allan, 1998) comprises 16 mixed-valence statements related to subjective experiences of defeat. Participants respond to items using a five-point Likert-type scale from *‘I never feel like this’* (0) to *‘I always feel like this’* (4). Potential scores range from 0–64, with higher scores indicating increased perceptions of defeat. ($\alpha = .96$, $\omega_t = .96$.)

Entrapment. The Entrapment scale (Gilbert & Allan, 1998) comprises 16 statements related to subjective experiences of feeling trapped. Responses are given using a five-point Likert-type scale from *‘Not at all like me’* (0) to *‘Extremely like me’* (4). Potential scores range from 0–64, with higher scores indicating increased perceptions of entrapment. ($\alpha = .96$, $\omega_t = .97$)

Suicidal Ideation. The Suicidal Ideation Attributes scale (SIDAS; van Spijker et al., 2014) is a 5-item measure of suicidal ideation severity over the previous month which uses an 11-point Likert-type response scale. Each item asks about a different aspect of suicidal

ideation including the frequency of suicidal thoughts, their impact on daily functioning, and how much control a person has over suicidal thoughts. One item also asks how close a person has come to making a suicide attempt with the option to indicate they have made an attempt. Potential scores range from 0–50 with higher scores indicating increased severity of suicidal ideation. A cut-off score of 20 or greater is suggested to indicate high suicide risk. ($\alpha = .90$, $\omega_t = .92$.)

Data Screening and Analysis

Survey responses were obtained from 261 participants that responded to all measures. Data were screened for partial responses. One participant's responses were removed for missing a single item on the chronotype measure; the heterogeneous nature of the item content makes individual mean value replacement inappropriate. Individual mean substitution was applied per-measure if a participant missed a single item on any or all of the DASS-21 subscales, a single item on the SCI, or up to two items on the Defeat and/or Entrapment scales. One participant was removed for missing two items on the DASS-21 Stress subscale, leaving a final sample of 259. Data missingness in this sample was 0.16% (27 items of a possible 17,094). Outliers were identified in the suicidal thoughts scores distributions (see Figure S2) but were retained as individuals reporting extremely negative outcomes are relevant to the research question.²

Data was analyzed using R v.3.6.3 (R Core Team, 2020). Significance was set at $p < 0.05$. Shapiro–Wilk tests and visual inspection indicated all measures deviated from normality. Therefore, nonparametric methods were used throughout. H_1 was assessed using bivariate Kendall's τ_b rank correlations and Mann-Whitney U tests. H_2 was tested by

² Results of analysis using Winsorized data is available in supplementary online material. There are minimal differences in results compared with using baseline data.

hierarchical multiple regression with suicidal ideation as the dependent variable and depression, sleep-wake variables, gender (Miranda-Mendizabal, 2019), and vocational status (Dalglish, Melchior, Younes, & Surkan, 2015) as independent variables. H_3 was tested using serial multiple mediation analysis using the *lavaan* R package (v.0.6-3) and nonparametric bootstrap resampling with 50000³ iterations (Rosseel, 2012; Shrout & Bolger, 2002). Depression was included as a covariate in the mediation analysis at all stages (Weis, Rothenberg, Moshe, Brent, & Hamdan, 2015). Mediation analysis on cross-sectional data must be justified based on existing theory (Fairchild & McDaniel, 2017; Shrout & Bolger, 2002); the empirically- and theoretically-supported defeat–entrapment pathway of the IMV model provides this justification. Holm-Bonferroni corrections (Holm, 1979) were applied to correlation and Mann-Whitney U tests, with each treated as separate families of tests for pragmatic reasons.

Results

Preliminary Results

One hundred participants (38.6%) met the cut-off score of the insomnia measure to indicate probable insomnia disorder. Fifty people (19.3%) met the cut-off score of the suicidal ideation measure to suggest a high level of suicidal ideation. Of participants experiencing high levels of suicidal ideation, 40 met the insomnia cut-off score (15.4% of overall sample, 80.0% of high suicidal subgroup). Two participants reported a suicide attempt in the previous month (0.8%). See Table 1 for descriptive statistics and bivariate association coefficients.

³ This is an order of magnitude higher than the typical 5,000 bootstrap iterations. A sensitivity analysis showed that using 5,000 iterations led to variation in the results of the mediation analysis with repeated runs. By using 50,000 iterations this variation was negated.

TABLE 1 ABOUT HERE.

Groupwise comparison

Results of Mann-Whitney U tests comparing participants that met cut-off for probable insomnia disorder and participants that did not are shown in Table 2. The insomnia group had significantly worse outcomes on all measures and were more inclined towards eveningness.

TABLE 2 ABOUT HERE.

Multiple Regression

Results of hierarchical multiple regression analysis with suicidal ideation as the dependent variable are shown in Table 3. In the final model (Model 3; $F[7,251] = 36.03$, $p < .001$, $R^2 = .50$, adjusted $R^2 = .49$), both insomnia ($\beta = .34$, $SE = 0.09$, $t = 3.76$, $p < .001$) and depression severity ($\beta = .56$, $SE = 0.06$, $t = 9.42$, $p < .001$) were significant independent variables.

TABLE 3 ABOUT HERE.

Mediation Analysis

Results of the mediation analysis based on the defeat–entrapment pathway of the IMV model are presented in Table 4. Point estimates of bootstrapped unstandardised coefficients and bias-corrected confidence intervals are shown in Figure 1.

TABLE 4 ABOUT HERE.

FIGURE 1 ABOUT HERE.

Discussion

The present study tested the role of perceived defeat and entrapment as mediators of the relationship between insomnia symptoms and suicidal ideation in young adults. Our key novel finding is that multiple mediation pathways via defeat and entrapment partially mediate this relationship. This result supports previous work (Russel et al., 2018; Littlewood, Gooding, Kyle, Pratt, and Peters, 2016) and provides additional empirical evidence for the IMV model.

The insomnia–defeat–suicidal ideation pathway was responsible for a large proportion of the indirect effect (as opposed to the insomnia–defeat–entrapment–suicidal ideation pathway). This may be a consequence of the suicide-related measure used as it focuses solely on suicidal ideation. We suggest that the dominant effect of the defeat-only pathway arises because defeat and ideation are the early stages of an increasingly distressful process. Suicidal ideation is an attempt to create a hypothetical ‘solution’ to the problem of defeat. Fortunately, feelings of defeat are often temporary and are resolved by escape from and/or de-escalation of the relevant stressors. In turn, the perceived entrapment associated with chronic defeat does not develop (Griffiths, Wood, Maltby, Taylor, & Tai, 2014; McManama O’Brien, Nicolopoulos, Almeida, Aguinaldo, & Rosen, 2019). This explains why the indirect pathway encompassing both defeat and entrapment plays a minor role in the partial mediation of the insomnia–suicidal ideation relationship in our results.

Identifying modifiable sources of defeat and entrapment in young adults, such as insomnia, is important for the development of suicide interventions. Cognitive behavioral therapy for insomnia (CBTI) has demonstrated efficacy and can be delivered without clinical supervision (Espie et al., 2019; Friedrich & Schlarb, 2018). It can be offered essentially immediately to young people experiencing low or moderate levels of suicidal ideation and coincident sleep disturbances. Our results suggest that addressing symptoms of insomnia

using CBTI may lead to reduced perceptions of defeat and entrapment. In turn, this could lead to improved mental health outcomes and reduced SIBs in individuals experiencing symptoms of insomnia.

A strength of this study is its use of the empirically supported IMV Model of Suicidal Behavior. Additionally, as highlighted by Tubbs, Perlis, and Grandner (2019), many studies use single items to measure suicidal outcomes and/or sleep disturbances. Our work overcomes this by using multi-item measures of suicidal ideation, insomnia, and affective outcomes.

Limitations of this study are its observational cross-section design and the varying time periods interrogated by the measures used (e.g. insomnia over previous month, depression over previous week). This prohibits conclusions being drawn about the temporal ordering of how defeat and entrapment develop and drive suicidal ideation in relation to insomnia. Although there is longitudinal evidence for a causal relationship between sleep disturbance and suicide (Berman, 2017; Chaïb, Segovia, Baca-Garcia, & Lopez-Castroman, 2020; Fawcett et al., 1990; Littlewood et al., 2019), this limitation is particularly important to keep in mind when assessing the results of the mediation analysis. Additionally, the proportion of people meeting the cut-off for probable insomnia disorder is high (38.6%). This is potentially a self-selection bias due to the survey being described as about sleep and mental health, and may limit the generalisability of results.

While work remains to be done exploring the underlying mechanisms linking sleep disturbances to suicide, monitoring sleep disturbances (either objectively or subjectively) offers a practical method for assessing suicide risk in vulnerable individuals.

References

- Adan, A., & Almirall, H. (1991). Horne & Östberg morningness-eveningness questionnaire: A reduced scale. *Personality and Individual Differences*, *12*(3), 241–253.
[https://doi.org/10.1016/0191-8869\(91\)90110-W](https://doi.org/10.1016/0191-8869(91)90110-W)

- Becker, S. P., Dvorsky, M. R., Holdaway, A. S., & Luebke, A. M. (2018). Sleep problems and suicidal behaviors in college students. *Journal of Psychiatric Research, 99*, 122–128. <https://doi.org/10.1016/j.jpsychires.2018.01.009>
- Berman, A. (2017). Risk factors proximate to suicide and suicide risk assessment in the context of denied suicide ideation. *Suicide and Life-Threatening Behavior, 48*. <https://doi.org/10.1111/sltb.12351>
- Bernert, R. A., Hom, M. A., Iwata, N. G., & Joiner, T. E. (2017). Objectively assessed sleep variability as an acute warning sign of suicidal ideation in a longitudinal evaluation of young adults at high suicide risk. *J Clin Psychiatry, 78*(6), e678–e687. <https://doi.org/10.4088/JCP.16m11193>
- Bernert, R. A., Joiner Jr, T. E., Cukrowicz, K. C., Schmidt, N. B., & Krakow, B. (2005). Suicidality and sleep disturbances. *Sleep, 28*(9), 1135–1141. <https://doi.org/10.1093/sleep/28.9.1135>
- Branley-Bell, D., O'Connor, D. B., Green, J. A., Ferguson, E., O'Carroll, R. E., & O'Connor, R. C. (2019). Distinguishing suicide ideation from suicide attempts: Further test of the Integrated Motivational–Volitional Model of Suicidal Behavior. *Journal of Psychiatric Research, 117*, 100–107. <https://doi.org/10.1016/j.jpsychires.2019.07.007>
- Brown, G. K., Beck, A. T., Steer, R. A., & Grisham, J. R. (2000). Risk factors for suicide in psychiatric outpatients: a 20-year prospective study. *Journal of Consulting and Clinical Psychology, 68*(3), 371.
- Chaïb, L. S., Segovia, A. P., Baca-Garcia, E., & Lopez-Castroman, J. (2020). Ecological studies of sleep disturbances during suicidal crises. *Current Psychiatry Reports, 22*, 1–8. <https://doi.org/10.1007/s11920-020-01155-2>
- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334.
- Dalglisch, S. L., Melchior, M., Younes, N., & Surkan, P. J. (2015). Work characteristics and suicidal ideation in young adults in France. *Social Psychiatry and Psychiatric Epidemiology, 50*(4), 613–620. <https://doi.org/10.1007/s00127-014-0969-y>
- De Silva, S., Parker, A., Purcell, R., Callahan, P., Liu, P., & Hetrick, S. (2013). Mapping the evidence of prevention and intervention studies for suicidal and self-harming behaviors in young people. *Crisis, 34*(4), 223–232. <https://doi.org/10.1027/0227-5910/a000190>
- Espie, C. A., Emsley, R., Kyle, S. D., Gordon, C., Drake, C. L., Siriwardena, A. N., ... Luik, A. I. (2019). Effect of digital Cognitive Behavioral Therapy for Insomnia on health, psychological well-being, and sleep-related quality of life: A randomized clinical trial. *JAMA Psychiatry, 76*(1), 21–30. <https://doi.org/10.1001/jamapsychiatry.2018.2745>
- Espie, C. A., Kyle, S. D., Hames, P., Gardani, M., Fleming, L., & Cape, J. (2014). The sleep condition indicator: a clinical screening tool to evaluate insomnia disorder. *BMJ Open, 4*(3). <https://doi.org/10.1136/bmjopen-2013-004183>
- Fairchild, A. J., & McDaniel, H. L. (2017). Best (but oft-forgotten) practices: mediation analysis. *Am. J. Clin. Nutr., 105*(6), 1259–1271. <https://doi.org/10.3945/ajcn.117.152546>
- Fawcett, J., Scheftner, W. A., Fogg, L., Clark, D. C., Young, M. A., Hedeker, D., & Gibbons, R. (1990). Time-related predictors of suicide in major affective disorder. *American Journal of Psychiatry, 147*(9), 1189–1194.
- Field, A. P., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. London: Sage.
- Friedrich, A., & Schlarb, A. A. (2018). Let's talk about sleep: a systematic review of psychological interventions to improve sleep in college students. *Journal of Sleep Research, 27*(1), 4–22. <https://doi.org/10.1111/jsr.12568>

- Gilbert, P., & Allan, S. (1998). The role of defeat and entrapment (arrested flight) in depression: an exploration of an evolutionary view. *Psychol Med*, 28(3), 585–598. <https://doi.org/10.1017/S0033291798006710>
- Griffiths, A. W., Wood, A. M., Maltby, J., Taylor, P. J., & Tai, S. (2014). The prospective role of defeat and entrapment in depression and anxiety: A 12-month longitudinal study. *Psychiatry Research*, 216(1), 52–59. <https://doi.org/10.1016/j.psychres.2014.01.037>
- Harrod, C. S., Goss, C. W., Stallones, L., & DiGuseppi, C. (2014). Interventions for primary prevention of suicide in university and other post-secondary educational settings. *The Cochrane Database of Systematic Reviews*(10), CD009439. <https://doi.org/10.1002/14651858.cd009439.pub2>
- Henry, J. D., & Crawford, J. R. (2005). The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, 44(2), 227–239. <https://doi.org/10.1348/014466505X29657>
- Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics*, 65–70.
- Khader, S., Tubbs, A. S., Haghghi, A., Athey, A., Killgore, W. S., Hale, L., ... Grandner, M. A. (2020). Onset insomnia and insufficient sleep duration are associated with suicide ideation in university students and athletes. *Journal of Affective Disorders*, 274. <https://doi.org/10.1016/j.jad.2020.05.102>
- Littlewood, D. L., Gooding, P., Kyle, S. D., Pratt, D., & Peters, S. (2016). Understanding the role of sleep in suicide risk: qualitative interview study. *BMJ Open*, 6(8). <https://doi.org/10.1136/bmjopen-2016-012113>
- Littlewood, D. L., Gooding, P. A., Panagioti, M., & Kyle, S. D. (2016). Nightmares and suicide in posttraumatic stress disorder: The mediating role of defeat, entrapment, and hopelessness. *Journal of Clinical Sleep Medicine*, 12(03), 393–399. <https://doi.org/10.5664/jcsm.5592>
- Littlewood, D. L., Kyle, S. D., Carter, L.-A., Peters, S., Pratt, D., & Gooding, P. (2019). Short sleep duration and poor sleep quality predict next-day suicidal ideation: an ecological momentary assessment study. *Psychological Medicine*, 49(3), 403. <https://doi.org/10.1017/S0033291718001009>
- Liu, R. T., Steele, S. J., Hamilton, J. L., Do, Q. B., Furbish, K., Burke, T. A., ... Gerlus, N. (2020). Sleep and suicide: A systematic review and meta-analysis of longitudinal studies. *Clinical Psychology Review*, 81, 101895. <https://doi.org/10.1016/j.cpr.2020.101895>
- Loureiro, F., & Garcia-Marques, T. (2015). Morning or evening person? Which type are you? Self-assessment of chronotype. *Personality and Individual Differences*, 86, 168–171. <https://doi.org/10.1016/j.paid.2015.06.022>
- Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33(3), 335–343. [https://doi.org/10.1016/0005-7967\(94\)00075-U](https://doi.org/10.1016/0005-7967(94)00075-U)
- Martini, M., da Fonseca, R. C., de Sousa, M. H., de Azambuja Farias, C., de Azevedo Cardoso, T., Kunz, M., ... da Silva Magalhães, P. V. (2019, mar). Age and sex trends for suicide in Brazil between 2000 and 2016. *Social Psychiatry and Psychiatric Epidemiology*, 54(7), 857–860. <https://doi.org/10.1007/s00127-019-01689-8>
- McDonald, R. P. (1999). *Test theory: a unified treatment*. Lawrence Erlbaum Associates Publishers.

- McGraw, K. O., & Wong, S. P. (1992). A common language effect size statistic. *Psychological Bulletin*, *111*(2), 361–365.
- McManama O'Brien, K. H., Nicolopoulos, A., Almeida, J., Aguinaldo, L. D., & Rosen, R. K. (2019). Why adolescents attempt suicide: A qualitative study of the transition from ideation to action. *Archives of Suicide Research*, *0*(0), 1-18. <https://doi.org/10.1080/13811118.2019.1675561>
- Miranda-Mendizabal, A., Castellví, P., Parés-Badell, O. et al. Gender differences in suicidal behavior in adolescents and young adults: systematic review and meta-analysis of longitudinal studies. *Int J Public Health*, *64*, 265–283 (2019). <https://doi.org/10.1007/s00038-018-1196-1>
- Mortier, P., Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., ... Bruffaerts, R. (2018). Suicidal thoughts and behaviors among college students and same-aged peers: results from the World Health Organization World Mental Health Surveys. *Social Psychiatry and Psychiatric Epidemiology*, *53*(3), 279–288. <https://doi.org/10.1007/s00127-018-1481-6>
- Nadorff, M. R., Anestis, M. D., Nazem, S., Harris, H. C., & Winer, E. S. (2014). Sleep disorders and the Interpersonal Psychological Theory of Suicide: Independent pathways to suicidality? *Journal of Affective Disorders*, *152-154*, 505–512. <https://doi.org/10.1016/j.jad.2013.10.011>
- Nadorff M. R., Nazem S., Fiske A. (2011). Insomnia symptoms, nightmares, and suicidal ideation in a college student sample. *Sleep*, *34*(1): 93-98. <https://doi.org/10.1093/sleep/34.1.93>
- O'Connor, R. C., Wetherall, K., Cleare, S., Eschle, S., Drummond, J., Ferguson, E., ... O'Carroll, R. E. (2018). Suicide attempts and non-suicidal self-harm: national prevalence study of young adults. *BJPsych Open*, *4*(3), 142–148. <https://doi.org/10.1192/bjo.2018.14>
- O'Connor, R. C., & Kirtley, O. J. (2018). The Integrated Motivational–Volitional Model of Suicidal Behaviour. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *373*(1754), 20170268. <https://doi.org/10.1098/rstb.2017.0268>
- Pigeon, W. R., Piquart, M., & Conner, K. (2012). Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *The Journal of Clinical Psychiatry*, *73*(9). <https://doi.org/10.4088/JCP.11r07586>
- R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>
- Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, *48*(2), 1–36. <https://doi.org/10.18637/jss.v048.i02>
- Russell, K., Rasmussen, S., & Hunter, S. C. (2018). Insomnia and nightmares as markers of risk for suicidal ideation in young people: Investigating the role of Defeat and Entrapment. *Journal of Clinical Sleep Medicine*, *14*(5), 775–784. <https://doi.org/10.5664/jcsm.7104>
- Sami, H., Danielle, L., Lihi, D., & Elena, S. (2018). The effect of sleep disturbances and internet addiction on suicidal ideation among adolescents in the presence of depressive symptoms. *Psychiatry Research*, *267*, 327–332. <https://doi.org/10.1016/j.psychres.2018.03.067>
- Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: new procedures and recommendations. *Psychological Methods*, *7*(4), 422. <https://doi.org/10.1037/1082-989X.7.4.422>
- Snowdon, J., Phillips, J., Zhong, B., Yamauchi, T., Chiu, H. F., & Conwell, Y. (2017). Changes in age patterns of suicide in Australia, the United States, Japan and Hong

- Kong. *Journal of Affective Disorders*, 211, 12–19.
<https://doi.org/10.1016/j.jad.2017.01.007>
- Taylor, P. J., Gooding, P., Wood, A. M., & Tarrier, N. (2011). The role of defeat and entrapment in depression, anxiety, and suicide. *Psychological Bulletin*, 137(3), 391–420. <https://doi.org/10.1037/a0022935>
- Tubbs, A. S., Perlis, M. L., & Grandner, M. A. (2019). Surviving the long night: The potential of sleep health for suicide prevention. *Sleep Medicine Reviews*, 44, 83–84. <https://doi.org/10.1016/j.smr.2019.01.001>
- Tucker, R. P., O'Connor, R. C., & Wingate, L. R. (2016). An investigation of the relationship between rumination styles, hope, and suicide ideation through the lens of the Integrated Motivational–Volitional Model of Suicidal Behavior. *Archives of Suicide Research*, 20(4), 553–566. <https://doi.org/10.1080/13811118.2016.1158682>
- van Spijker, B. A. J., Batterham, P. J., Calear, A. L., Farrer, L., Christensen, H., Reynolds, J., & Kerkhof, A. J. (2014). The suicidal ideation attributes scale (SIDAS): Community-based validation study of a new scale for the measurement of suicidal ideation. *Suicide and Life-Threatening Behavior*, 44(4), 408–419. <https://doi.org/10.1111/sltb.12084>
- Weis, D., Rothenberg, L., Moshe, L., Brent, D. A., & Hamdan, S. (2015). The effect of sleep problems on suicidal risk among young adults in the presence of depressive symptoms and cognitive processes. *Archives of Suicide Research*, 19(3), 321–334. <https://doi.org/10.1080/13811118.2014.986697>
- Wetherall, K., Robb, K. A., & O'Connor, R. C. (2019). An examination of social comparison and suicide ideation through the lens of the Integrated Motivational–Volitional Model of Suicidal Behavior. *Suicide and Life-Threatening Behavior*, 49(1), 167–182. <https://doi.org/10.1111/sltb.12434>
- Williams, J. M. G. (2014). *Cry of pain: Understanding suicide and the suicidal mind*. London: Piatkus.
- Woosley, J. A., Lichstein, K. L., Taylor, D. J., Riedel, B. W., & Bush, A. J. (2014). Hopelessness mediates the relation between insomnia and suicidal ideation. *J Clin Sleep Med*, 10(11), 1223–1230. <https://doi.org/10.5664/jcsm.4208>
- World Health Organisation. (2019). *Suicide in the world* (Tech. Rep.). Retrieved from <https://www.who.int/publications-detail/suicide-in-the-world>

Tables

Table 1 – Descriptive statistics and bivariate associations assessed using Kendall's τ_b coefficients.

		1	2	3	4	5	6	7	8	9	10	M (SD)	Mdn (IQR)
1.	Age	-										21.15 (2.11)	21 (19–23)
2.	Insomnia	.00	-									13.80 (7.81)	14 (7–20)
3.	Chronotype	.07	-.25***	-								13.30 (3.85)	13 (10–16)
4.	DASS-21	-.11	.48***	-.23***††	-							42.19 (29.48)	36 (16–64)
5.	Depression	-.11	.44***	-.24***†††	.74***	-						13.91 (12.19)	10 (4–22)
6.	Anxiety	-.11	.43***	-.20***†	.72***	.50***	-					12.00 (10.29)	10 (2–20)
7.	Stress	-.06	.43***	-.17**NS	.76***	.53***	.60***	-				16.29 (10.34)	14 (8–24)
8.	Defeat	-.11	.43***††	-.22***	.59***	.67***	.46***	.44***	-			24.05 (14.98)	20 (12–34)
9.	Entrapment	.09	.40***	-.27***	.63***	.69***	.49***	.50***	.67***	-		18.96 (16.49)	15 (5–29.5)
10.	Suicidal thoughts	-.06	.38***	-.15*NS	.53***	.53***	.44***	.40***	.54***	.55***	-	9.59 (12.15)	4 (0–15)

Crude significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Significance levels following Holm-Bonferroni correction remained mostly unchanged. Where significance levels changed these are indicated with the following superscripts: † $p < 0.05$, †† $p < 0.01$, NS no longer significant. Note: Age was not significantly associated with any measure either pre- or post-correction.

Table 2 – Mann-Whitney test statistics and comparison of outcomes between participants meeting DSM insomnia cut-off and participants not meeting this cut-off.

	<i>No insomnia</i> <i>N = 159</i>	<i>Insomnia</i> <i>N = 100</i>			
	<i>Mdn (IQR)</i>	<i>Mdn (IQR)</i>	<i>U</i>	<i>r</i>	<i>f</i>
Age	21 (19–23)	21 (20–23)	7879	.01	.50
Insomnia	9 (5–12)	21.5 (19–25)	0	.84	.00
Chronotype	14 (12–17)	11 (9–14.25)	4823.5	.33	.70
DASS-21	22 (14–39)	66 (45.5–88)	2423	.59	.15
Depression	6 (2–13)	22 (12–32)	3027.5	.52	.19
Anxiety	6 (2–12)	20 (12–26)	2973.5	.53	.19
Stress	10 (6–16)	24 (14–32)	2979	.53	.19
Defeat	15 (10–23)	37 (24.5–44)	3003.5	.52	.19
Entrapment	9 (3–17.5)	29 (17–41)	3205	.50	.20
Suicidal thoughts	2 (0–7)	15 (3.75–28)	3503.5	.48	.22

All differences significant at $p < 0.001$ level with the exception of age which was not significantly different between groups. Significance levels unchanged after application of Holm-Bonferroni correction to this set of ten tests. Mdn = median, IQR = interquartile range, U = Mann Whitney U test statistic, r = effect size ($|Z|/N$; range 0–1; Field, Miles, & Field, 2012), f = common language effect size (McGraw & Wong, 1992).

Table 3 – Results of hierarchical multiple regression analysis with suicidal ideation as the dependent variable.

<i>IV</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Age	-0.59	0.19	0.07
Gender ^a :			
Male	-1.09	-0.06	0.29
Vocation ^b :			
Employed	1.07	-0.26	-0.44
Unemployed	13.44***	1.71	2.18
Depression		0.68***	0.563***
Insomnia			0.34***
Chronotype			0.18
<i>P</i>	0.004	< 0.001	< 0.001
<i>R</i> ²	0.06	0.47	0.50
Adjusted <i>R</i> ²	0.04	0.46	0.49
Δ Adjusted <i>R</i> ²		+0.42	+0.03

*Unstandardised regression coefficients. IV = independent variable. Significance levels: *** $p < 0.001$. ^a Reference category: female. ^b Reference category: student.*

Table 4 - Point estimates and 95% confidence intervals of indirect and direct pathways resulting from multiple serial mediation analysis.

Path	Estimate	Lower	Upper	$P_M(\%)$	Ratio
Insomnia > Defeat > Suicide	0.100**	0.042	0.195	31.3	0.064
Insomnia > Defeat > Entrapment > Suicide	0.041*	0.016	0.088	12.9	0.026
Insomnia > Entrapment > Suicide	0.009	-0.027	0.051	2.9	0.006
Total indirect effect size	0.151**	0.067	0.257	47.2	0.096
Direct effect size	0.169*	0.007	0.334	52.8	0.108
Total effect size	0.319***	0.144	0.501	100.0	0.04

*Depression included as a covariate at all stages. P_M = proportion mediated as percentage of total effect size. Ratio = scale-normalised change in suicide score scale-normalised change in insomnia. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*

Figures

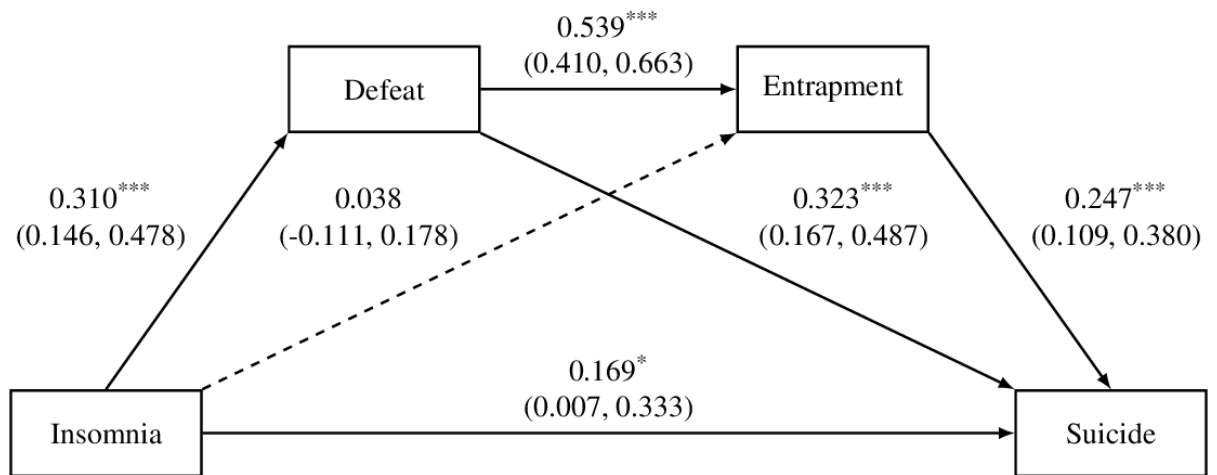


Figure 1.

Figure captions

1. Serial multiple mediation model for insomnia and suicidal ideation with defeat and entrapment as mediators (controlling for depression in all regressions). Unstandardised regression coefficients with 95% bias corrected confidence intervals in parentheses. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Dashed lines indicate insignificant relations.