



## Review article

## Risk of suicide attempt repetition after an index attempt: A systematic review and meta-analysis



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## ABSTRACT

**Objectives:** To estimate the risk of suicide attempt repetition among individuals with an index attempt. It also aims to study the role of risk factors and prevention programme in repetition.

**Methods:** This systematic review and meta-analysis was conducted in keeping with the PRISMA 2020 guidelines. Studies on attempt repetition (both cohort studies and intervention studies) were searched from inception to 2022.

**Results:** A total of 110 studies comprising 248,829 attempters was reviewed. The overall repetition rate was 0.20 (0.17, 0.22). Repetition risk linearly increased over time. A higher risk of attempt repetition was associated with female sex and index attempts in which self-cutting methods were used. Moreover, a mental disorder diagnosis was associated with an increasing repetition risk ( $OR = 2.02, p < .01$ ). The delivery of a preventive programme

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reduced the repetition risk,  $OR = 0.76, p < .05$ ; however, this effect was significant for psychotherapy interventions,  $OR = 0.38, p < .01$ .

**Conclusion:** One in five suicide attempters will engage in a new suicide attempt. An elevated repetition risk is associated with being female, more severe index methods and psychiatric disorder diagnosis. Preventive programmes, particularly psychotherapy, may contribute to reducing repetition risk and eventually save lives.

## 1. Introduction

Suicide constitutes a major public concern with global impact. >700,000 people died by suicide in 2019, estimating a global age-standardised suicide rate of 9.0 per 100,000 inhabitants [1]. Moreover, suicide constitutes one of the top 10 causes of death in five of the 21 Global Burden of Disease defined regions (i.e., Eastern Europe, high income Asia Pacific, Australasia, central Europe and high income North America) [2].

It is estimated that there are 25 attempts for one death by suicide [3,4]. Moreover, a previous suicide attempt constitutes the single most critical risk factor for suicide in both the general and clinical populations. Finally, suicide behaviour has become an important source of disability, with an age-adjusted rate of 16 per 100,000 inhabitants [5].

Numerous studies have aimed at providing estimates on the risk of suicide attempt repetition, reporting huge divergences between studies [6–9]. In this regard, discrepancies may be associated with methodological issues (i.e., case-control vs. cohort design), length of follow-up (short-term follow-up vs. long-term follow-up) and sample features (i.e., age group of participants, active psychiatric disorder). Some prior meta-analyses have also provided rough estimates on the risk of suicide-related behaviour repetition, overlooking the distinctive features of each suicidality form and their independent contribution to suicide attempt repetition [6,7,10,11]. Our study is focused on the critical role of a previous suicide attempt (index attempt), as a key risk factor for suicide attempt repetition. In this vein, a previous suicide attempt is highly related to elevated risk of suicide mortality and increased disability [12–14]. On the other hand, relevant risk factors (e.g., index method, psychiatric disorders) for attempt repetition, as well as protective factors (i.e., preventive programme delivery) have not been considered across the cited meta-analyses for attempt repetition.

Suicide prevention should become a crucial endpoint for national health plans as WHO has already stated a decade ago [5]. The number of patients admitted urgently to hospital increases year by year due to suicide attempt [14]. These patients are considered individuals at ultra-high risk to engage in another attempt, with a subsequent increased mortality risk [15]. Varying healthcare interventions, used as preventive strategies, have been developed to reduce attempt repetition likelihood after an index suicide attempt, taking into account that the first months after an index episode may be critical for attempt repetition [16–19]. Although some promising findings have been uncovered, results are far from being consistent due to divergences in design (e.g., lack of intensive follow-up, lack of control group), study protocols and intervention modality.

This study aims to provide some robust estimates on the probability of suicide attempt repetition after an index attempt. Moreover, it intended to study the role of risk factors (i.e., sex at birth, age, the follow-up length and index attempt method and psychiatric disorder diagnosis) to engage in attempt repetition. Finally, we were interested in analysing the overall effect of intervention programmes to prevent attempt repetition, with a clear focus on identifying key features (i.e., assessment of effects, intervention modality) that may be related to attempt repetition risk reduction.

## 2. Methods

This study was followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Protocols 2020 (PRISMA 2020)

guidelines [20], and was registered with PROSPERO database (ID: CRD42020163206).

### 2.1. Article selection criteria

We selected studies (both cohort and intervention studies) focused on human individuals who engaged in a suicide attempt (i.e., index attempt) and were admitted a hospital department, all ages. Intervention studies should monitor suicide attempt after the implementation of a prevention program to reduce the risk of suicide reattempt. Moreover, the cohort studies should have a group of individuals who did not engage in suicide attempt repetition. In case of interventions studies, no criteria on control group were set. In terms of study criteria, empirical studies (either longitudinal or clinical trials) reporting suicide attempt repetition outcomes, published in scientific literature in Spanish or English up to 2022 (January the 1st, 2022), were potential candidates to inclusion.

### 2.2. Search strategy and data extraction

Papers published were searched on six scientific databases: Web of Science, PubMed, PsycInfo, SCOPUS, CINAHL, Cochrane Library. The database search was conducted between January and March 2022. Queries were created by combining two main key terms and related thesaurus (Table S1 in Supplementary material): suicide attempt and repetition.

Articles were screened on an initial review of title, abstract, and keywords. Pre-selected papers were fully read to ratify the selection. An independent peer reviewer endorsed the selection of every paper to be included in this study. Discrepancies on paper selection were resolved by discussion.

Relevant data were extracted from each article: bibliometric features, methodological features of the study, index attempt method, source for attempt data collection and ascertainment (i.e., data collected directly from patient and family vs. data from hospital records and national registers), psychiatric disorder at baseline (i.e., affective, anxiety, psychotic disorders, drug use disorder and personality disorder) and preventive programme type (i.e., intensive/prioritized care, phone/letter follow-up, psychotherapy or other intervention) for intervention studies (see the Supplementary material for further details).

### 2.3. Data analysis

Overall repetition rate was calculated under random-effects models. The restricted maximum-likelihood estimator was used (under the inverse variance method). The forest plot was used to visually display the individual and overall repetition rate estimates. Publication bias was studied by means of Egger's regression asymmetry test.

Heterogeneity among the individual effect sizes was analysed by means of the Cochran's  $Q$  statistic and the Higgins and Thompson  $I^2$  statistic. Multilevel mixed-effects meta-regression was used to study the influence of risk factors (i.e., sex, age, follow-up length, attempt data source, NOS score). Multivariate sensitivity analysis was conducted for covariates with lower sample size (i.e., index attempt method and psychiatric disorder), including the significant covariates from the multilevel regression.

On the other hand, we calculated the overall repetition rate derived from treatment delivery. In turn, the overall risk (using the odds ratio

estimate, highly appropriate when coming from a case-control perspective and most of our studies were not representative from populations of interest) was calculated comparing the risk of attempt repetition for individuals undergoing the preventive intervention compared to those under treatment-as-usual (TAU) conditions. Finally, multilevel regression was conducted to study the effect of key factors (follow-up length and type of intervention) on repetition risk after preventive programme delivery.

All the analyses were conducted using the software R, version 3.6.2, with packages meta, metafor and mvmeta. Further details on Data analysis are presented in the Supplementary material.

### 3. Results

A total of 110 articles (77 cohort studies on attempt repetition and 33 intervention studies) was selected for this meta-analysis (see Fig. 1 and Table S2). Sample in analysis was 102 studies for repetition rate analysis (77 cohort studies and 25 intervention studies providing data from the control group sample). The list of reviewed articles and their features may be consulted in the Supplementary material.

Studies were more frequently conducted in the United States, France (13.6% in both cases) and Spain (12.7%). Almost 60% of articles were published in 2011 onwards. The follow-up period of the studies ranged from 2 to 328 months ( $M = 36.29$ ,  $SD = 47.01$ ,  $Median = 15$ ). Almost 2 in 3 studies (64.3%; vs. 35.7% of studies using either self-reports or interviews) used either hospital recordings or national registers to ascertain a suicide attempt event. The articles comprised a total sample size in analysis of 248,829 attempters ( $M = 3578.51$ ,  $SD = 11,998.05$ ,  $Median = 365$ ). Mean age of participants was 34.49 years old ( $SD = 12.34$ ,  $Median = 36.3$ ).

The overall repetition rate derived from pooling the 102 studies was 0.20,  $CI_{95} = [0.17, 0.22]$ ,  $Z = 28.98$ ,  $p < .01$ . Heterogeneity between the individual effect sizes was large,  $Q(101) = 9538.35$ ,  $p < .01$ ;  $I^2 = 98.9\%$ . Individual effect size of studies is displayed in the Fig. 2. There was a large variation in attempt repetition rate, with the largest rate being 0.76,  $CI_{95} = [0.69, 0.82]$ , from a study conducted in the United States. The sample in analysis comprised borderline personality disorder patients. The lowest repetition rate (0.00,  $CI_{95} = [0.00, 0.06]$ ), was found in a study conducted in Germany, on patients who had experienced a traumatic event. [22] The patients were followed over  $6.1 \pm 3$  years after the trauma. The authors reported that none of the patients repeated suicide attempt.

Regarding the publication bias for the overall estimate, the Egger's test showed that the hypothesis of symmetry should be upheld,  $t(100) = 0.87$ ,  $p = .38$ . This evidence supports the absence of publication bias on the results of this study. Contour-enhanced funnel plot for visual inspection of publication bias is displayed in Fig. S1 (Supplementary material).

Regarding risk factor analysis, the meta-regression model with covariates (sex, age, follow-up length, attempt data source and methodological quality of studies) and a linear effect of follow-up length fitted better to data ( $AIC = 49.73$ ), than the model without covariates ( $AIC = 4127.29$ ) and the model with the squared effect of follow-up length ( $AIC = 264.43$ ). This model ( $k = 88$ ) showed a random-effects variance,  $\sigma^2 = 0.02$ ; and  $Q_M(5) = 4128.20$ ,  $p < .01$ . The linear meta-regression model explained 5% of outcome variance. Two covariates showed a significant loading in the model: the follow-up length,  $OR = 1.08$ ,  $CI_{95} = [1.07, 1.08]$ ,  $z = 45.26$ ,  $p < .01$ ; and proportion of females within study sample,  $OR = 1.05$ ,  $CI_{95} = [1.01, 1.07]$ ,  $z = 2.49$ ,  $p < .05$ .

In terms of follow-up length, we found that the longer the follow-up, the higher the risk of attempt repetition (Fig. 3). The risk of suicide attempt repetition was relatively similar from the shortest follow-up period (up to 6 months after the index attempt),  $OR(k = 21) = 1.49$ ,  $CI_{95} = [1.43, 1.56]$ , and from two intermediate follow-ups: between 7 and 12 months,  $OR(k = 32) = 1.49$ ,  $CI_{95} = [1.41, 1.56]$ ; and between 13 and 24 months,  $OR(k = 22) = 1.56$ ,  $CI_{95} = [1.47, 1.64]$ . Nevertheless,

with longer follow-up periods ( $> 2$  years) increased risk of suicide attempt repetition was reported,  $OR(k = 35) = 1.69$ ,  $CI_{95} = [1.59, 1.79]$ . This may suggest that the risk of suicide attempt repetition becomes high right after the index attempt (during the first six months after the index attempt) and linearly increases over time. On the other hand, we found that the higher the proportion of women on study samples, the higher the risk of attempt repetition.

A much smaller number of studies reported on the methods of index attempt. For that reason, we conducted a sensitivity analysis for index method and significant covariates from previous analysis (i.e., follow-up length and proportion of females within sample). Only estimates on three methods were included for this analysis due to limited sample size: self-poisoning ( $k = 20$ ), self-cutting ( $k = 3$ ) and suffocation ( $k = 2$ ). Covariates did not contribute to outcome explanation, as model with covariates did not converged. The multivariate (unconstrained) analysis revealed a significantly effect of index method on suicide attempt repetition, with  $Q(22) = 1791.69$ ,  $p < .01$ . In this regard, patients using cutting on the index attempt ( $OR = 1.58$ ,  $CI_{95} = [1.39, 1.81]$ ,  $Z = 6.88$ ,  $p < .01$ ) and those involved in self-poisoning ( $OR = 1.27$ ,  $CI_{95} = [1.02, 1.59]$ ,  $Z = 2.15$ ,  $p < .05$ ), showed an increased risk of suicide attempt repetition. Conversely, patients engaging in suffocation or drowning methods ( $OR = 0.37$ ,  $CI_{95} = [0.17, 0.81]$ ,  $Z = -2.48$ ,  $p < .05$ ) showed a reduced risk of attempt repetition.

Finally, the sensitivity analysis using the mental health diagnoses revealed the influence of all the studied diagnoses on attempt repetition risk (see Fig. 4). Note that the model without covariates ( $AIC = 157.46$ ) fitted better than the model with covariates (i.e., proportion of females within sample and follow-up length;  $AIC = 163.99$ ). The multivariate Cochran test was significant,  $Q(59) = 614.99$ ,  $p < .01$ . Studies with data on mental disorders showed a significant odds ratio for affective disorders ( $k = 18$ ),  $OR = 1.57$ ,  $Z = 2.39$ ,  $p < .05$ ; for substance use disorders ( $k = 12$ ),  $OR = 1.90$ ,  $Z = 9.12$ ,  $p < .01$ ; and personality disorders ( $k = 13$ ),  $OR = 2.22$ ,  $Z = 7.97$ ,  $p < .01$ . The highest odds ratio was observed for anxiety disorders ( $k = 7$ ),  $OR = 2.62$ ,  $Z = 2.85$ ,  $p < .05$ ; and psychotic disorders ( $k = 13$ ),  $OR = 3.17$ ,  $Z = 7.62$ ,  $p < .01$ , respectively. The overall effect size derived from samples with diagnosed disorders was  $OR = 2.02$ ,  $CI_{95} = [1.74, 2.35]$ ,  $Z = 9.27$ ,  $p < .01$ .

#### 3.1. Preventive intervention effect size and moderators

Overall repetition rate derived from pooling studies ( $k = 33$  and 37 effect sizes) on preventive intervention groups was 0.36,  $CI_{95} = [0.30, 0.41]$ ,  $Z = 13.53$ ,  $p < .01$ . The overall risk for attempt repetition in preventive program attendance was,  $OR = 0.76$ ,  $CI_{95} = [0.62, 0.94]$ ,  $Z = -2.50$ ,  $p < .05$ . This result suggests that the delivery of an intervention to prevent suicide attempt reduced the risk of suicide attempt repetition, in comparison to a TAU condition. The main features of the intervention studies are displayed in Table S3 and Fig. S2 (Supplementary material).

Heterogeneity between effect size across intervention studies was significant,  $Q(35) = 116.59$ ,  $p < .01$ ; but low,  $I^2 = 70\%$ . The meta-regression showed that the model with covariates (i.e., follow-up length and type of intervention) under a linear effect of the follow-up length fitted better to data ( $AIC = 98.38$ ), than the model without covariates ( $AIC = 103.18$ ) and the linear follow-up effect model ( $AIC = 100.17$ ). This model showed a random-effects variance,  $\sigma^2 = 0.13$  and significant  $Q_M(3) = 9.26$ ,  $p < .05$ . Note that the studies on the 'other type of intervention' category were removed from analysis due to limited sample size. In the regression model, only the type of intervention was significant to explain individual effect size variability. More concretely, the studies on psychotherapy interventions ( $B = -0.61$ ,  $SE = 0.24$ ,  $Z = -2.57$ ,  $p < .05$ ) showed a significantly different loading in comparison to reference category (i.e., intensive/prioritized intervention). The psychotherapy studies  $OR$  was 0.38,  $CI_{95} = [0.23, 0.63]$ . The overall  $OR$  for each intervention modality is displayed in the Fig. 5.

#### 4. Discussion

This study aimed to provide accurate estimates on the risk of suicide attempt repetition after an index attempt, as well as to study the role of risk and protective factors in repetition risk. We adopted a robust methodology based on meta-analysis and covering a wide number of studies ( $K = 110$ ).

Our results highlight that one in five people may engage in a suicide attempt after a previous one (index attempt). Carroll et al. found a suicide-related behaviour repetition (i.e., fatal or non-fatal self-harm forms) between 16.7 and 19% among patients with a previous attempt, pooling data from 64 studies [23]. Liu et al. reported an overall self-harm repetition rate ( $k = 76$  studies) between 15.01% (on a 6-month follow-up) to 24.20% (on a 3-year follow-up) [10]. Our findings extend the results from the aforementioned meta-analyses and provide more focused results on the relationship between a suicide attempt (as a distinctive outcome) and a previous one that needed hospital admission (i.e., index attempt), considered as the single most critical risk factor for suicide attempt repetition and mortality [6,13,15]. In this sense, a previous suicide attempt may enhance a sense of acquired capability to act upon suicidal desires, due to exposure and habituation to self-injury [24,25]. Consequently, it may be more likely to be engaged in another attempt.

Our results endorse the relevance of some risk factors on suicide attempt repetition. First, a linear relationship between repetition risk and follow-up length was endorsed. In other words, the risk of attempt repetition steadily increases over time. These results are partially free from the cumulated prevalence effects due to our analytical approach (i.e., multilevel mixed-effects meta-regression controlling for repeated measures). Even though, a significant risk of attempt repetition was evident from earlier after the basal attempt (i.e., during the six first months after the index attempt). Increasing risk rates may be seen thereafter. Mounting evidence points to an increasing trend of varying forms of self-harm and suicide attempt from the six first months after a basal episode [10,26,27]. Sex at birth was also associated with a higher risk of attempt repetition. More specifically, studies with a higher proportion of female participants showed higher repetition risk. Mounting evidence supports the increased attempt repetition risk of female patients, in comparison to males who often engage in more lethal attempts [1,28,29].

It is also important to stress the role of index attempt method in attempt repetition. Our study revealed a higher risk of attempt repetition in attempters with an index featured by self-cutting. This result is consistent with those from some studies on self-harm repetition [26,27,30]. However, it is important to mention that methods combining varying means tend to be more associated with higher repetition risk. In line with Larkin et al. [31], attempters engaging in self-cutting may show a more complex clinical profile with higher probability of comorbidity with severe conditions, such as psychosis [32]. Moreover, it is less likely these patients to access preventive interventions after a basal attempt. On the other hand, our meta-analysis revealed that patients engaging in either suffocation or drowning methods showed a reduced risk of attempt repetition. However, this result should be taken cautiously, as it is based on pooling data from only two studies.

Finally, our meta-analysis provides some interesting data on the relationship between mental health conditions and suicide attempt repetition. In line with previous studies on varying forms of suicide-related behaviour [11,33–36], our results support the elevated likelihood of attempt repetition among patients with an active mental disorder. In this regard, all the studied disorders (i.e., affective disorder, anxiety, substance use disorders, psychotic and personality disorders) were associated with a higher risk of attempt repetition. Even though, the diagnosis of either a psychotic disorder or a personality disorder showed a more elevated risk of repetition ( $OR > 2.20$ ). Patients with any (or both) of these disorders are more likely to show a wider number of

cognitive and volitional mediators for suicide (e.g., higher number of previous suicide attempts, a history of traumatic experiences, higher impulsivity and acquired capacity for suicide), with the subsequent increased risk of suicide attempt repetition [24,37–40].

Regarding repetition prevention, our study revealed that preventive programme delivery does contribute to reducing the risk of suicide attempt repetition. In this sense, the risk of attempt repetition was significantly lower among individuals undergoing prevention programmes in comparison to those in TAU conditions ( $OR = 0.76$ ). Our results go in line with those presented in previous meta-analyses in terms of effectiveness of preventive interventions to tackle suicide repetition after a basal attempt [17,41]. Although some studies found that preventive effect may not last more than one year, our results put the spotlight on the role of intervention modality rather than follow-up length. In this regard, we found a significant reduction of repetition risk among individuals undergoing a psychotherapy programme ( $OR = 0.38$ ), but not for the other intervention modalities. No significant effect was shown regarding the follow-up length. That may go in line with a long-term protective effect of the preventive programme (i.e., note that some studies followed participants more than five years after the index attempt). Psychotherapy programmes are based on integrated protocols to ameliorate clinical symptoms (e.g., depression and anxiety) and tackle suicide mediators (e.g., emotional dysregulation, dysfunctional thoughts of hopelessness). Hawton et al. [16] highlighted the long-lasting effects of psychotherapy (more concretely, dialectical behaviour therapy) on attempt repetition prevention. Other psychotherapy modalities have also been proven to be effective, but evidence is mixed due to the variety of suicidality forms studied and the high heterogeneity of clinical profiles presented among attempters [42–44].

This study has some shortcomings to mention. First, our robust approach does not cover article selection from grey literature sources. However, analysis on publication bias risk points our results to be probably free from its negative influence. Second, the high heterogeneity between the individual effect sizes observed in the study was not substantially covered by moderators in analysis. This may point to the multifactor nature of suicide and its complex nature. Further meta-analytic studies should be done on other clinical moderators involved in suicide behaviour development (e.g., psychiatric comorbidity, history of suicide attempts, suicidal ideation) and hospital management factors (e.g., hospitalization, drug therapy). Moreover, variations of sample size between analyses were quite evident. That is related to the high diversity of study designs and topics of interest between studies in this meta-analysis. Anyway, all the analyses rely on a wide sample of studies that may endorse the quality of data derived. Finally, further studies should focus on other outcomes related to repetition risk, such as time up to repetition and completed suicide after an index attempt.

Some clinical implications are derived from this study. First, one in five patients will engage in a suicide attempt after a previous one. The delivery of a preventive intervention considerably decreases the risk of attempt repetition with enduring effects. It becomes critical to conduct an exhaustive assessment of risk factors to reduce risk of attempt repetition. Healthcare follow-up should comprise intensive contact and long-term monitoring. The delivery of a prevention program should be mandatory due to its protective role against attempt repetition. Moreover, it should be delivered as soon as possible, as repetition risk may already be evident right after the index attempt. Finally, time-varying analysis (meta-regression) may provide a wide snapshot of suicide repetition risk but precision to forecast outcome (suicide reattempt) may be compromised, taking into account the discrepancy between the follow-up length of studies and exact time of the attempt event.

Suicide constitutes a global major concern. Even though suicide is preventable. This study provides accurate data on how prevalent may be suicide attempt repetition with its subsequent impact on health. Enforcing preventive strategies becomes crucial to tackle suicide and save lives.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.genhosppsych.2023.01.007>.

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