Review Article

Prevalence of and Factors Influencing Suicide Ideation, Attempt, and Completion in Heroin Users: A Systematic Review and Meta-Analysis

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Abstract

Background: Suicide is considered a fundamental problem in discussions on public and global health. Thus, the current study aimed to review the prevalence of and reasons for successful suicide attempts in heroin users.

Methods: This study was conducted by systematically searching the electronic databases of PubMed, Scopus, Web of Science, and PsycINFO from 1960/1/1 to 2021/11/1 based on the PRISMA checklist and using MeSH keywords with no temporal or linguistic limitations. The primary and secondary impacts of suicide were identified, and all studies following an observational design (cohort, case-control, and cross-sectional studies) were included in the research. Data analysis was performed using Stata version 13. Finally, 17 studies were included in the work process for systematic review and meta-analysis.

Findings: The results showed the most frequent reasons for suicide among the studied individuals were gender (being female), youngness, heroin overdose, multi-drug abuse, history of repeated suicide attempts, history of psychiatric disorder (especially depression), joblessness, homelessness, distorted family relationships, etc. Moreover, the results of synthesizing the studies revealed the prevalence of suicide attempts equaled the effect size (95% CI = 0.3 [0.23-0.37]) among these individuals, and the prevalence of successful suicides approached the effect size (95% CI = 0.03 [0.01-0.05]).

Conclusion: The results of the present study showed the high prevalence of suicidal thoughts and suicide attempts among the heroin-abusing population. Furthermore, according to the findings, the prevalence of unsuccessful suicide attempts was ten times more than that of successful ones in the target population.

Keywords: Heroin, Suicide, Systematic review

Introduction

Suicide is a fundamental and important issue in public and global health.[1] Every year more than 700 000 people die due to suicide and this itself can affect the psychological, social, and economic conditions of the society.[2,3] Suicide is the fourth leading cause of mortality among 15-29-year-old individuals and imposes a financial cost of $1.4 on patients.[4,5] Typically, the standard suicide rate is somehow declining throughout the world. However, this recession does not equally take place in all countries and communities.[6] Mental health problems, like substance use, play a significant role in the occurrence of suicidal thoughts, suicide attempts, and successful suicides.[7-13] Suicide risk and depression are more prevalent in drug addicts than in the general population and they are closely related to each other.[14] Alcohol and substance use

led to the loss of disability-adjusted life years (DALYs) to 99.2 million years (95% CI: 88.3-111.2) being the cause of 4.2% (95% CI: 3.7-4.6) of DALYs.[15] Mood or anxiety disorders make substance, alcohol, and other narcotics users be targeted by suicide.[16] Risk factors for suicide attempts among addicts include drug addiction, duration of use, and intravenous heroin use.[12] Despite the efforts of forensic pathologists, clinical pathologists, and toxicologists, the mechanisms through which heroin overdose leads to death are not yet clear. A major cause of the lack of rationalization is that blood samples taken from humans who have died from heroin overdose show outstanding variation inside the quantities of biologically lively metabolites of heroin gift. Heroin, like other opioids, suppresses the respiratory system and eventually leads to death. Once in a while, this respiration depressive effect is

so profound that the addict dies.[17,18] Among the reported substances, alcohol and opioids increase the risk of suicide attempts.[19] Alcohol and drug abusers are 10 to 14 times more likely to die by suicide than the general population. The risk of suicide increases to 72.2% for substance users and 20.6% for alcohol users, because heroin and substance use increase the risk of depression in these people.[20] Somatization disorder is more frequent among heroin addicts than other substance users. Likewise, these individuals experience higher levels of anger, negative feelings, and interpersonal sensitivities and suffer from impulsivity, anger control, and aggression problems.[19-21] Several studies show that young people and women are the main groups who have low cholesterol and HDL and can experience trauma in childhood, suicide, anger, and drug treatment for drug use. Those who use alcohol have also previously used cocaine.[22,23]

The prevalence of deliberate self-harm behavior is extensively observed among heroin users. Swallowing objects, jumping from heights, cutting hand fingers, slitting wrists, breaking bones, and hitting the head with a hammer are known behaviors among these individuals which can threaten their lives.[24] In addition, these individuals may use more severe self-harming behaviors as a means of escaping punishment; they gain the chance of being out on bail for medical services. Since heroin influences the central neural system, leads to alterations in the perception, mood, consciousness, attention, and behavior of abusers, and diminishes negative feelings in these individuals, the screening and clinical management of heroin-dependent individuals are among the crucial priorities of psychological services in many countries worldwide.[24] The trend of increasing suicides associated with drug overdose, however, shows that suicide overdose is associated with opioid use. As many people use drugs to attempt suicide, identifying the factors related to suicidal thoughts and behaviors can lead to the reduction of injuries and deaths in young people and disorders caused by suicide in aid organizations.[25]

Methods
This study was conducted according to the protocol registered in the PROSPERO database with the registration code CRD42022301397. As it was a review, the present study was not approved by an institutional review board. This study followed the Guideline for Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA).[26]

Search strategy
Through a systematic search in PubMed, Scopus, Web of Science, and PsycINFO electronic databases, those studies investigating suicide risk factors among heroin users (suicide ideation, attempt, and completion) were identified. Besides, the related review papers were also

searched for manually so as to cover all published papers in this domain. The search strategy was adopted by searching for Medical Subject Headings (MeSH) terms in the PubMed database as follows: "Risk" OR "Risk factor" OR "Behavioral risk factor" OR "Health risk behaviors" OR "Risk assessment" OR "Odd ratio" AND "Suicide" OR "Suicide attempted" OR "Suicide completed" OR "Suicide ideation" OR "Suicide attempt repetition" OR "Reattempts and suicide" AND "heroin substance user" OR "heroin users" OR "Heroin" OR "Heroin dependence" from 1960/1/1 to 2021/11/1.

Study selection and data extraction
The titles and abstracts were reviewed by two reviewers independently and the texts were fully evaluated to meet the conditions of inclusion. The differences were resolved through consensus with a third reviewer. The data extraction and qualitative evaluation form already designed in the Excel program was delivered to two assessors. For data extraction, the following variables were included: The name of the first author, year of publication, context and type of research, sample size, mean age, target population, age of first-time heroin use, duration of heroin use, type of suicide attempts (thoughts, actions, completed suicides), prevalence, consequences, type of attempted behavior, reasons for suicide (such as ideation in the past month), longevity, and standardized mortality ratios (SMRs).

The search yielded 53 336 potentially related papers from PubMed, Scopus, Web of Science, and PsycINFO electronic databases. Then, 60 studies were removed after reviewing all the texts, and after that, the titles and abstracts of the articles remained. On the whole, 161 studies were excluded due to their irrelevant topics, improper designs, and full-text unavailability. The diagram of the screening process and study selection is presented in Figure 1.

Inclusion and exclusion criteria
The inclusion criteria encompassed studies investigating suicides, suicidal thoughts, suicide attempts, successful suicides, as well as risk factors among heroin-using populations. No limitation was applied concerning the age, gender, ethnicity, language, and nationality of participants, the journal language, and the search time interval. Those non-English studies that were easily translatable into English by a web-based translation program were also included in the study, or they were omitted. Prospective and retrospective observational surveys (cross-sectional, cohort, and case-control studies) and cross-sectional experimental studies, including randomized controlled trials (RCTs), were included while case studies (case reports and case series) were eliminated. Furthermore, studies lacking full texts, targeting addictions other than heroin, like gambling or nutrients, or considering accompanying diseases, like

schizophrenia, were omitted. Studies addressing under-treatment heroin addicts and those reporting suicide factors among heroin users but not designed for this purpose were excluded from the screening process.

Outcome

The primary outcome concerned in this study was investigating the reasons for suicidal behaviors, including thinking, considering, and planning to engage in self-harming behaviors with suicidal intentions, self-harming behaviors without suicidal intentions, and potentially self-harming behaviors with suicidal intentions.[28] The secondary outcome was successful suicide attempts. Studies tackling suicide-related conditions, such as depression and hopelessness, were also excluded.

The search strategy was adopted for every electronic database and POLIS (population, outcome, location, indicator, study design) was used for selecting the studies (Table 1). POLIS is one of the most commonly applied models for formulating observational studies for evidence synthesis which ensures the respective components of the questions have been thoroughly defined.

Quality assessment of studies

To implement this phase, two assessors independently used the modified form of the instrument developed by the Department of Health and Human Services for observational, cohort, and case-control studies.[29] This instrument consists of 14 questions designed for the examination of the risk of bias. Discrepancies were assessed and resolved by a third reviewer.

Statistical Analysis and Data Synthesis

A narrative synthesis of the data of studies addressing the prevalence of suicide risks among heroin users was conducted using meta-analysis techniques through the metaprop command in the STATA 13 software package at the confidence interval of 95%. The I-square (I^2) test was used to determine heterogeneity among studies. In this test, 12% < 25 indicates non-heterogeneity, 12% = 25-50 means moderate heterogeneity, and 12% > 50 depicts substantial heterogeneity.[29] The funnel plot, trim-and-fill, and Egger methods were used to evaluate publication bias, and a P value of < 0.05 was considered statistically significant.

Findings

Characteristics of the included studies

The characteristics of 17 systematically investigated studies are presented in Table S1.[22,23,30-44] Six of these studies addressed the reasons for successful suicide attempts among heroin-using individuals, and the rest
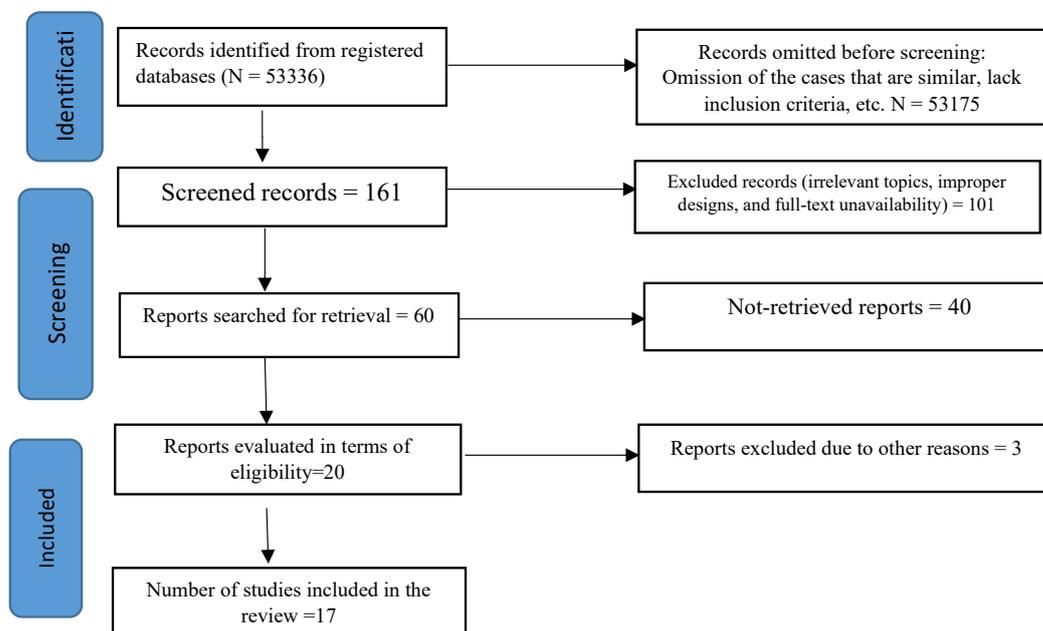

Figure 1. Identifying studies from databases and records according to PRISMA flowchart (2020).[27]

Table 1. POLIS criteria

Criteria				
Population	**Outcome**	**Location**	**Indicator**	**Study Design**
Heroin substance users	Attempted suicide, suicide Ideation, completed suicide	All over the world	Prevalence of suicide or attempted suicide	Observational study with cross-sectional, case-control, and cohort design

POLIS: population, outcome, location, indicator, study design.

tackled the factors affecting suicide attempts or the suicidal thoughts in this population.

Qualitative evaluation
Almost 76.4% of the studies revealed moderate bias, 23.6% showed substantial bias, and there was no paper with insignificant bias. Many studies had not mentioned the participation rate of the participants and the way they had calculated their sample size in their surveys. These were the major weaknesses in the quality of the evaluated studies (Table 2).

Primary consequence (suicide attempts)
The primary outcome concerned in this study was investigating the prevalence of and reasons for suicidal behaviors, including thinking, considering, and planning to engage in self-harming behaviors with suicidal intentions, self-harming behaviors without suicidal intentions, and potentially self-harming behaviors with suicidal intentions.[23] Out of 17 included studies, one lacked the necessary qualifications, and ten studies were inserted into the meta-analysis to investigate the prevalence of suicide attempts in the target population. In this randomly-estimated model, the prevalence rate of

this behavior equaled the effect size (95% CI = 0.3 [0.23-0.37]). The magnitude of heterogeneity was reported at $I^2 = 91.58\%$, which was significant ($P = 0.000$) and reflected the high heterogeneity of the studies (Figure 2). Besides, these studies lacked the requirements of subgroup analysis for the reduction of heterogeneity.

The funnel plot, Egger's test, and trim-and-fill methods were used for evaluating the publication bias. As Figure 3 shows, the studies have not been regularly distributed in the funnel plot and thus indicate publication bias. The P value was reported at 0.825 in Egger's test, which investigated the effect of small-scale studies. The insignificance of this value implicates the absence of any publication bias. No extra study was proposed in the trim-and-fill method, hence showing no publication bias. Therefore, the conclusion made in this study was not considerably influenced by publication bias ($P = 0.000$).

Secondary consequence (death)
The secondary outcome concerned in this study was investigating the reasons for behaviors associated with successful suicide attempts or death among the heroin-using population, and the prevalence of these behaviors was probed as the secondary consequence. Out of 17

Table 2. Evaluating the quality of the studies to investigate the bias risk

First author, Year	Q1	Q2	Q3	Q4	Q6	Q7	Q8	Q9	Results of quality assessment [a]
Roy, 2010 [22]	Yes	Yes	No	Yes	No	Yes	CD	Yes	Moderate quality
Pan, 2014 [30]	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Moderate quality
Pavarin, 2021 [31]	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Moderate quality
Kazour, 2015 [32]	Yes	Yes	No	Yes	No	Yes	CD	No	Moderate quality
Kalyoncu, 2007 [23]	Yes	Yes	No	Yes	No	Yes	CD	No	Moderate quality
Brådvik, 2007 [33]	Yes	Yes	Yes	Yes	No	Yes	CD	No	Moderate quality
Maremmani,2007 [34]	Yes	Yes	No	No	No	Yes	No	Yes	Moderate quality
Heale, 2003 [35]	Yes	Yes	Yes	Yes	No	No	No	No	Low quality
Onge, 2013 [36]	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Moderate quality
Quaglio, 2001 [37]	Yes	Yes	No	Yes	No	Yes	Yes	No	Moderate quality
Latkin, 2005 [38]	No	No	No	Yes	No	No	Yes	Yes	Low quality
Oppenheimer, 1994 [39]	No	No	No	Yes	No	No	No	No	Low quality
Darke, 2000 [40]	No	Yes	No	Yes	No	Yes	No	No	Low quality
Vingoe, 1999 [41]	Yes	Yes	No	Yes	No	No	CD	No	Low quality
Darke, 2004 [42]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Moderate quality
Darke, 1996 [43]	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Moderate quality
James, 1967 [44]	Yes	Yes	No	Yes	No	No	No	No	Low quality

Abbreviation: CD, Cannot determine.
Q1: Was the research question or objective in this paper clearly stated?
Q1: Was the study population clearly specified and defined?
Q3: Was the participation rate of eligible persons at least 50%?
Q4: Were all the subjects selected or recruited from the same or similar populations (including the same period)?
Q6: Was a sample size justification, provided?
Q7: Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?
Q8: For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome?
Q9: Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?
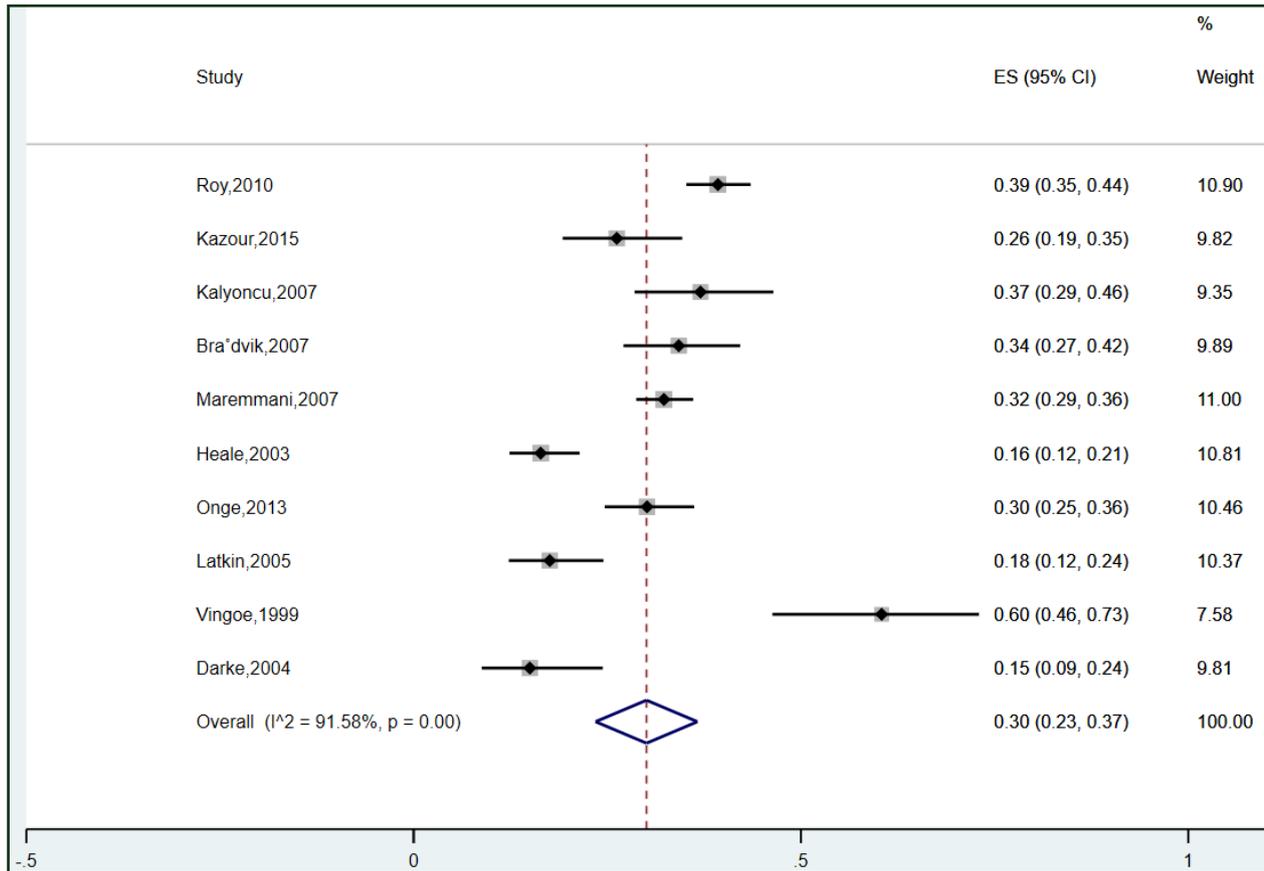[a] 0- 3: low quality, 4-7: moderate quality, 8-10: high quality.

Figure 2. Forest plot illustrating the prevalence of suicide attempts in the target population
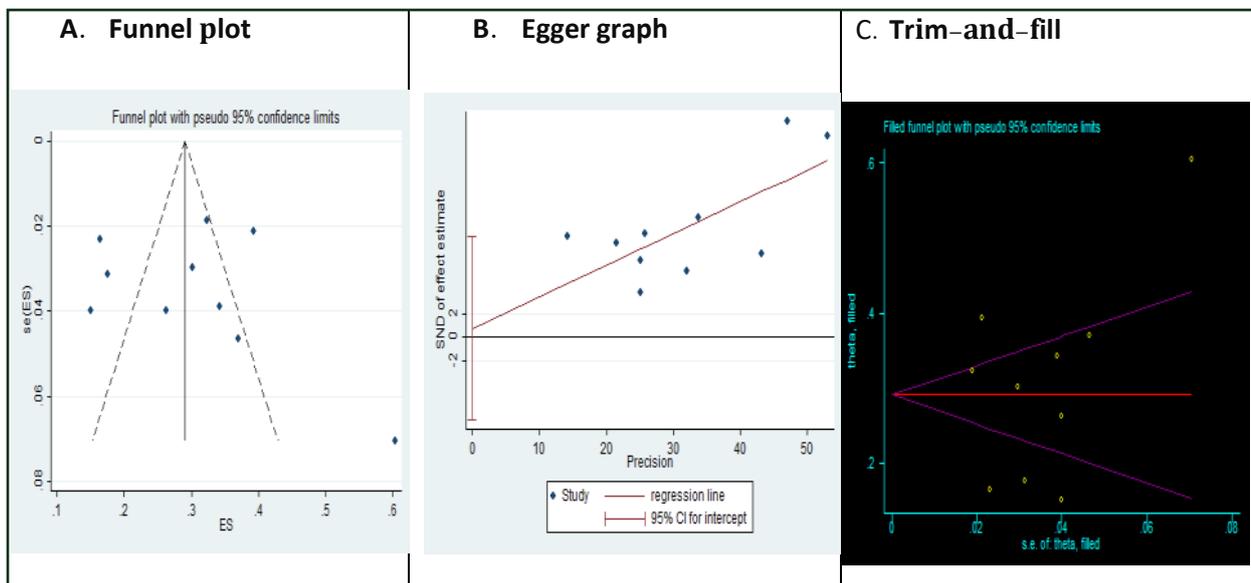

Figure 3. (A) funnel plots (with pseudo 95% CIs), (B) Egger graph, (C) Trim-and-fill for publication bias in attempted suicides

included studies, six were entered into the meta-analysis for the investigation of the prevalence of successful suicide attempts in the target population. In this randomly-estimated model, the prevalence of this behavior equaled the effect size (95% CI = 0.03 [0.01-0.05]). The degree of heterogeneity equaled $I^2 = 97.62\%$, which was significant ($P = 0.000$) and indicated the high heterogeneity of these studies (Figure 4). In addition, these studies lacked the requirements of subgroup analysis for the reduction of heterogeneity.

The funnel plot, Egger, and trim-and-fill methods were used to evaluate the publication bias. As Figure 5 illustrates, the studies have not been regularly distributed in the funnel plot and thus reflect publication bias. The P value was reported at 0.825 in Egger's test, which investigated the effect of small-scale studies. The insignificance of this value implicates the absence of any publication bias. Three extra studies were suggested in the trim-and-fill method, and the difference between the fixed and random models was considered significant. Hence, the evidence was indicative of publication bias, and the conclusion was extensively influenced by publication bias ($P = 0.000$).

Discussion

This study reviewed the results of the studies investigating the reasons for suicide among heroin users and found out the most frequent reasons for committing suicide among these individuals were gender (being female), youngness, heroin overdose, multi-drug use, history of repeated suicide attempts, history of psychiatric disorder (especially depression), joblessness, homelessness, distorted family
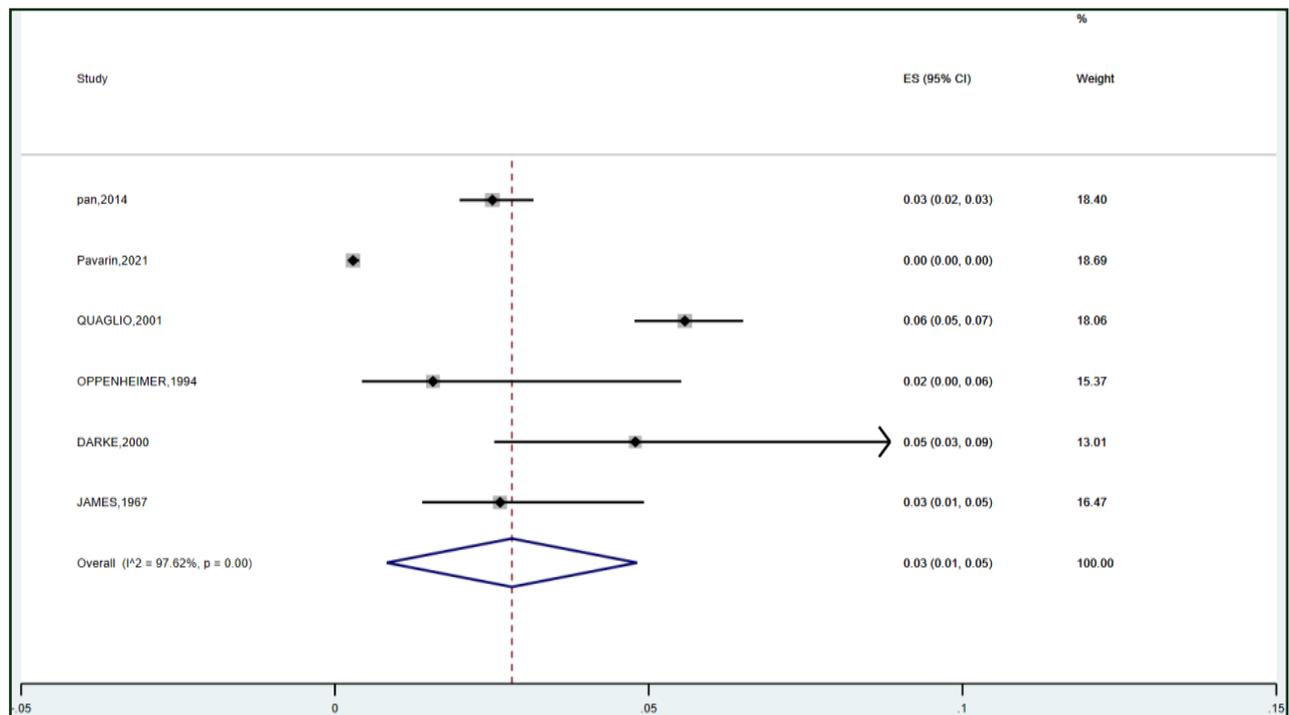

Figure 4. Forest plot illustrating the prevalence of completed suicides in the target population
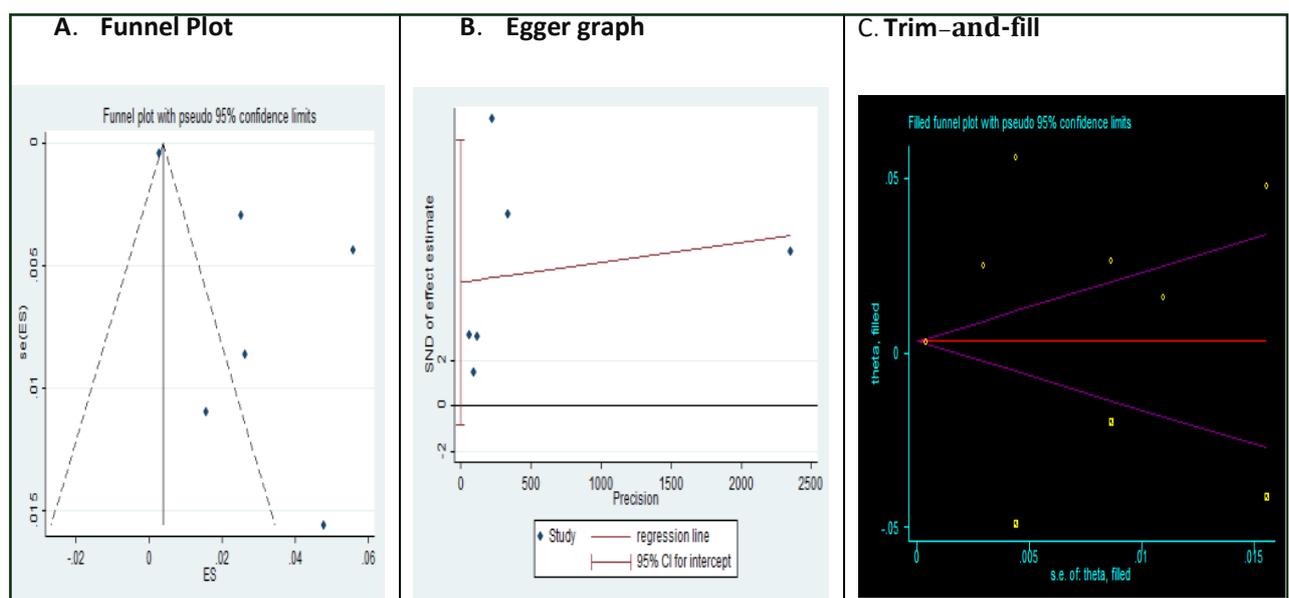

Figure 5. Forest plot illustrating the prevalence of completed suicide in the target population

relationships, etc. Furthermore, the prevalence of suicide among suicide-attempting individuals and successful suicides in the target population were reported separately and the prevalence of suicide-attempting behaviors surpassed the prevalence of successful suicides in this population. The studies were also analyzed in terms of the publication bias and the results were reported.

The results of the present study clearly showed the prevalence of suicidal thoughts and suicide attempts among the heroin-using population. Besides, according to the findings, the prevalence of unsuccessful suicides was ten times more than that of successful ones in the target population. Attempting suicide and having suicidal thoughts are the most significant predictors of successful suicidal behaviors in the future.[42] Studies show that the probability of committing suicide in heroin-using patients is 14 times that of the general population, and heroin users suffering from major depression attempt suicide in the last year of their lives 5.5 times more than normal individuals.[45] Likewise, these individuals should be examined in terms of psychological risk factors, such as depression and impulsivity.[46,47] Methadone maintenance treatment (MMT) is one of the best opioid substitution treatments and MMT was significantly associated with lower rates of death among opioid-dependent individuals.[48] Therapists must continually consider the thoughts and actions of previous suicides to rehabilitate and assess the risk of suicide in heroin users.[49] Moreover, the regular assessment of clients in terms of deliberate self-harming behaviors, like slitting wrists, burning, and self-injuring, can assist with promptly identifying individuals vulnerable to the self-harm risk.[50]

Methadone is an appropriate option as a replacement for heroin in order to reduce damage in individuals.[25] Treatment with methadone and buprenorphine reduces the risk of death from opioid overdose.[51]

Women are less likely to attempt suicide than men, but they try harder, because women have more suicidal thoughts throughout their lives than men. Research indicates that substance use makes the risk of suicide among women 6.5-9 times the risk among non-addicted women.[52] A study in China revealed that heroin-using women treated with methadone were exposed to suicidal thoughts in their lives 1.69 times more than heroin-using women treated differently.[47] In fact, population-based studies show substance-using women are more likely to suffer from mental disorders, like depression and anxiety, compared to their male peers.[53] Likewise, social stigmas tied to substance-using women (such as being pregnant and sex worker) make them refrain from visiting the centers and continuing their treatments, and these are the predisposing factors that raise the risk of suicide in this population.[54]

Many of the included studies were carried out in developed western and industrial countries. Thus, the results cannot be generalized to developing or less-privileged societies. Furthermore, many of these studies had not mentioned the types of suicide attempts and their frequencies in the target population, hence making it impossible to subgroup the analyses. For a better and more accurate synthesis of the data, the SMR or estimation of the SMR was taken into account. Nevertheless, only two studies had reported this index. In addition, the reviewed studies had considered age and gender while neglecting other potential confounding variables.

Conclusion
Although the findings of the present study showed the occurrence of overdose among young addicts, the results of a review study disclosed overdoses were specifically recurrent in individuals who had started using heroin for several years. Furthermore, the use of multi-drugs, such as alcohol and benzodiazepines, can be both lethal and non-lethal and weaken the neural system.[55] Thus, heroin users should be informed of overdoses and the risks of mixing heroin with other substances. Pharmaceutical interventions, psychotherapies, on-time provision of rehabilitation counseling, and training can reduce the rate of mortality, suicidal thoughts, and suicide attempts and help the rehabilitation of this population.

To provide information services, the physical and mental health personnel should be thoroughly aware of their assigned roles. Besides, users should be encouraged to contact emergency medical services if they overdose. Moreover, the government should consider several preventive and therapeutic programs, such as providing naloxone to needle exchange centers, pharmacies, and general practitioners, nursing in heroin-users' houses in the case of overdose, and developing mental training programs. These programs can include teaching life skills and providing rehabilitation counseling and psychotherapy for this population with special needs. Therefore, they can help with rehabilitation and reduction of mortality by decreasing the rate of poisoning.

Authors' Contribution
Conceptualization: Mohammad Saeed KHanjani.
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Funding acquisition: Kianoush Abdi.
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Methodology: Marjan Mardani Hamooleh.
Project adminestration: Mohammad Saeed KHanjani.
Supervision: Sayed Jalal Younesi.
Validation: Kianoush Abdi.
Writing–review & editing: Sajad Sohrabnejad.

Competing Interests

The authors declared no conflict of interests.

Ethical Approval

Not applicable.

Supplementary File

Supplementary file contains Table S1.

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