



Epidemiological Trend, Risk Factors, Prevention and Treatment Strategies of Self-directed Violent Behavior: A Critical Appraisal of Relevant Literature

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Authors' contributions

This work was carried out in collaboration among all authors who designed the study, performed the statistical analysis and wrote the protocol. Author NAQ wrote the first draft of the manuscript, revised the paper one time and managed the analyses of the study. All authors managed the literature searches, read and approved the final manuscript.

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ABSTRACT

Background: Suicide is an intentional fatal act of self-destruction and largely preventable phenomenon. Early Identification of suicide risk factors, proactive preventive steps and therapeutic interventions tend to reduce robustly its epidemiological trends including associated high mortality around the world.

Objective: This review study aimed to critically describe the identified potential risk factors underlying suicide together with a specific focus on its relevant preventive and management strategies.

Methods: A selective e-searches of Google Scholar, PubMed/MEDLINE and Science Direct of relevant English literature (2000-2019) was conducted by using keywords and Boolean operators, and following exclusion and inclusion criteria included 115 most influential articles for this critical review.

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Results: Suicide is a global preventable phenomenon determined by multiple interconnected risk factors and mechanisms embedded in several levels; population (indigenous people and social media), individual (distal predisposing factors), developmental (mediating factors) and proximal (precipitating factors). Evidently suicide needs multimodal intervention approach in terms of universal, selective and indicated prevention.

Conclusion: Suicide is a global heterogeneous phenomenon and needs continuing concerted efforts of multidisciplinary health team and multi-sector stakeholders because its risk pathways and protective factors dynamically changes overtime across the world.

Keywords: Epidemiological trend; violent behavior; suicide; self-destruction.

1. INTRODUCTION

Suicide is an ancient preventable phenomenon and relevant literature described its epidemiological trends [1,2], biopsychosocial and cultural determinants [3-15]. Numerous studies have also identified early warning signs (EWS) of suicide and suicidal attempts, healthcare provider reactions and strategies to prevent rising suicide deaths globally [7,16-18]. On the other hand, several studies have also recognized protective factors such as social and family supports, religious congregation and affiliation reflecting high religiosity, water lithium level and other important protective strategies [2] and evidenced-based drug and nondrug treatment interventions in clinical and nonclinical settings [17,19-22]. The determinants, early warning signs and prevention of suicide might be addressed using universal, selective and targeted/indicated strategies [7,23]. On clinical ground, neuropsychiatric disorders, genetic propensity, previous suicidal attempts, family history of suicide, sexual abuse, trauma and maltreatment, chronic physical diseases, cancers, chronic pain, hopelessness and their psychiatric comorbidities are major contributors to the pool of suicide and suicidal attempts across the world [24-29]. Concerning healthcare systems at three levels of care, barriers against timely access to healthcare and mental health (MH) help-seeking pathways, shortage of mental health (MH) professionals, social stigma, relative lack of Primary Mental Health Care (PMHC) services in the community (hybrid model services), inadequate supply of psychotropics, and lack of proper psychiatric referral system from PMHC to secondary or tertiary mental health care (MHC) system further add considerable variance to the suicide rate and preventable fatalities [7,10,30-34]. Notably, these dynamic risk factors as well as protective strategies of suicidal attempts, ideations and communications and suicides have been linked

concisely with individual biopsychosocial styles, healthcare systems, adverse human relationships, communities' organizations, societies structure, culture and religion, and healthcare policies and practices [29,31-33,35] and, hence, non-drug prevention strategies including barriers at suicide hotspots, firearms restrictions and limiting access to both pesticides and charcoal and improvements especially in surveillance of patients with severe suicidal intents in MH systems have resulted in prevention of suicide [2,19]. In the same vein, the psychotropic drug interventions such as selective serotonin re-uptake inhibitors (SSRIs), use of lithium, clozapine, ketamine, antipsychotics should target collaboratively these etiological models of suicide in order to reduce its incidence, prevalence and burden of disease around the world. This concise review of literature informs us that suicide is a preventable heterogeneous phenomenon with variable epidemiological trends, determined by a variety of biopsychosocial and cultural factors, multiple mental disorders (MDs) and their psychiatric and physical comorbid conditions (Table 1); however, its global burden and diverse devastating consequences can be reduced considerably by the concerted efforts of all stakeholders linked with health, labor, agriculture, education, trade, justice, law, security and defense, politics and the media worldwide.

1.1 Aim

This critical review aimed to describe the epidemiology, determinants, prevention strategies and treatment interventions directed towards people vulnerable to engage in self-directed violence (SDV). The significance of the review, first of its kind in Saudi Arabia, is to highlight main findings of suicide research over the past twenty years. This review will help MH professionals in updating their knowledge in different aspects of suicide and effectively manage patients with suicidal behaviors

Table 1. Determinants of Self-directed Violent (SDV) behaviors [3,15,24-35]

Determinants	Remarks
1. Age	Teens, young adults & elderly: vulnerable to suicide & suicidal attempts
2. Gender	Males and females are more susceptible to suicide and suicidal attempts, respectively.
3. Marital status	Suicide is common in single or divorced individuals compared to married persons
4. Family type	Nuclear families are more prone to suicide compared to joint families
5. Villagers/town dwellers	People living in metropolitan cities are less likely to commit suicide compared to villagers
6. Unemployed	Suicide and suicidal attempts commonly found in jobless people
7. Illiterate or low education	Uneducated individuals are reported to commit suicide more than educated persons
8. Smoking	First and second smoking is associated with suicide
9. Poverty	A vast literature suggests connectivity between poverty and suicide
10. Financial losses	Trade and accrued financial losses cause suicidal tendencies
11. Breakup relationships	Relationship discords are linked with suicidal behavior
12. Death of a loved one	Potentially strong predictor of suicide
13. Family conflicts	Dysfunctional families raise alarms for suicide and suicidal attempts
14. Overcrowded stresses	A multitude of stressors lead to suicidal attempts
15. Stigma	Self-stigma, stigma and discrimination all are strongly associated with suicide
16. Neighborhood	Hostile neighbors may relate to suicide
17. Ethnicity	Ethnic background and culture may be the reasons for suicide or vice-versa
18. Religion	Islam protects followers from suicide and suicidal attempts
19. Access to means of suicide	Suicide provoking messages on digital devices and Apps (suicide hotspot) provoke suicide
20. Pollution & climate change	Adverse environmental changes are associated with rising suicide rates
21. Crop damaging temperatures	Farmers especially in low-income countries tend to commit suicide
22. Wars, disasters and conflicts	Disastrous events are associated with high suicide rates
23. Immigration and displacement	Current reports suggest immigration is connected to suicide behavior
24. Acculturation	Adopting culture of a new nation is stressful and relates to suicidal behavior
25. Sexual orientation	Lesbian, gay, bisexual, transgender and intersex people commit suicide >in HIC
26. Inappropriate media reports	Increases suicide and suicidal attempts rate
27. Isolation & social exclusion	Linked with increased suicide.
28. Physical diseases & MDs	Both comorbidities linked with high suicidal behavior

Note: All the determinants of suicide and self-deliberate harm have bidirectional connectivity to MDs and serious physical diseases. Universal prevention includes approaches tailored for an entire population without regard to individual risk factors; selective prevention relates interventions directed towards vulnerable group in the population and these are gate-keeping training and crisis helpline; indicated prevention defines assessment and management of MDs including substance use disorders (SUDs) and SDV and follow-up of mentally ill patients with community support

including suicidal thoughts/ideations and expressions, early warning signs (EWSs) and suicidal attempts. The relevance of the appraisal of suicide is that there is minimal information about multiple perspectives of suicide including pre-suicide behaviors not only in Arabian Gulf countries but also eastern world.

methods of suicide and pre-suicide attempts and prevention strategies and suicide interventions and psychotherapy. Search strategy was modified in accordance to the specific databases.

2. METHODS

2.1 Search Strategy

The multiple e-searches of pertinent English language literature on suicide (2000-2019) published in PubMed, Google Scholar and Science Direct publishing houses were conducted. The focus was on full articles in open access journals and articles with abstracts in closed access journals. A cut-off point of last 20 years was chosen in order to comprehensively update suicide by incorporating the most recent published literature. The articles published prior to 2000 were also screened for selecting the most relevant and influential articles on several relevant items of competed suicides and attempted suicides. Keywords and Boolean operators were used for searching the relevant articles; suicide and epidemiological trend and suicide determinants or suicide risk factors and

2.2 Search Results

Hundreds of thousands of articles were retrieved and two authors independently screened retrieved papers for eligibility and included 115 articles most relevant to our research agenda, and mainly based on exclusion (full articles not accessible because of high price tags and inclusion (full articles available free of charge and closed access articles with abstract) criteria. Furthermore, it was sorted out retrieved material and included accessible book chapters on suicide, articles on self-injurious behaviors with no suicidal intentions (non-suicidal self-injuries but self-directed violent behaviors) and articles with abstract in English published in non-English language literature. We also identified articles from the references of selected articles and included only the high quality papers in this critical review. A total number of suicide studies specifically for this review were 115 (Fig. 1). Any discrepancy concerning inclusion or exclusion of any article was discussed with third party for a consensus.

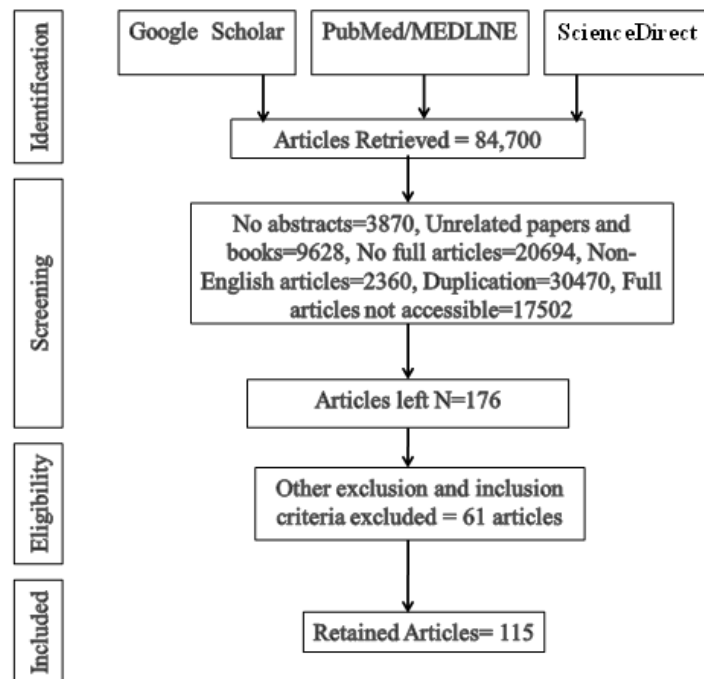


Fig. 1. PRISMA chart showing selection of articles

3. RESULTS

3.1 Definitions

Suicide has been defined since long ago, and Durkheim comprehensively described its technicalities and social underpinnings [36,37]. Recently Durkheim's scientific methods and concepts are criticized yet those models provide insights into understanding the complex origins of suicidal behavior (SB). One of the basic flaws of Durkheim's understanding of suicide is that mental illness is not a key determinant of SB. Currently, Durkheim's concepts of anomic, egoistic and altruistic suicide offer a means of comprehending global trends in SBs and suicide rates (SR) concerning nationalists, religious fanatics and political extremists [37]. Johnson (1965) conceptualized three causes of suicide into one cause based on "integration (egoism or altruism) or regulation (anomie or fatalism)", the two social variables in severe suicide that collectively determine rates of suicide. Altruism

and fatalism do not fit into Durkheim's scheme and egoism and anomie are identical and, hence, his four causes underlying suicide rates could be amalgamated into one cause, responsible for variation in suicide rate [38]. Since then, many new terms are created to precisely describe suicide, SB, SDV, suicidal attempts (SA), suicidal communication (SC) and suicidal ideation (SI) with or without plan, self-injurious behaviors (SIB) and others [39-43]. In a systematic review of definitions of suicide and suicidal behaviors, Goodfellow et al. (2019) identified agency (means), knowledge of a potential fatal outcome, intent, and outcome as four key concepts underpinning suicide definitions. However, intent and outcome remain the most consensual features of SBs, which might be used in tailoring a measurement instrument for looking at the meanings of suicide across the world [44]. Both suicides and suicidal attempts that no intention for die are the self-directed intentional violent behaviors. Anger with suicidal intent may create unpredictable consequences.

Table 2. Definitions of Self-directed Violence (SDV) and related terms [39-45]

Terms	Definitions	Remarks
Self-directed violence*	Behavior that is self-directed and intended to cause injury or the potential for injury oneself with or without suicide intent.	Gambling, drug abuse, smoking, rash driving, and parachuting result in injuries or death but are unintentional and not SDV.
Suicidal SDV	Behavior that is self-directed and deliberately results in injury or the potential for injury to oneself.	There is evidence of implicit** or explicit***of suicidal intent.
Non-suicidal SDV	Behavior that is self-directed and deliberately results in injury or the potential for injury to oneself.	There is no evidence of implicit or explicit, of suicidal intent.
Undetermined SDV	Behavior that is self-directed and results in injury or the potential for injury to oneself.	Evidently suicidal intent is <i>unclear</i> .
Suicide attempt (SA)	A self-directed potentially injurious behavior with any intent to die as a result of the behavior	A suicide attempt may or may not result in injury.
Interrupted SDV-by self or by other	1. By other-a person takes steps to injure self but is stopped by another person prior to fatal injury. 2.By self- a person takes steps to injure self but is stopped by self prior to fatal injury.	1. Interruption occurs at any point during the act-after the initial thought or after onset of behavior. 2.is "aborted" suicidal behavior
Suicidal preparatory acts	Preparation beyond ideation or verbalizations (PSI)towards making a suicide attempt, but before potential for harm has begun	These acts (Active SI) include buying a gun, collecting pills or writing a suicide note, or giving things away.

*Analogous to self-injurious behavior (SIB); **implicit- No doubt implied though not directly expressed and inherent in the nature of something; ***explicit- dully expressed without any ambiguity, and leaving no question as to meaning or intent. Active and passive suicidal intent (A&PSI); Unacceptable terms as decided are; completed suicide; failed attempt; nonfatal suicide; parasuicide; successful suicide; suicidality; suicidal gesture, manipulative acts (M.Act) and suicidal threat

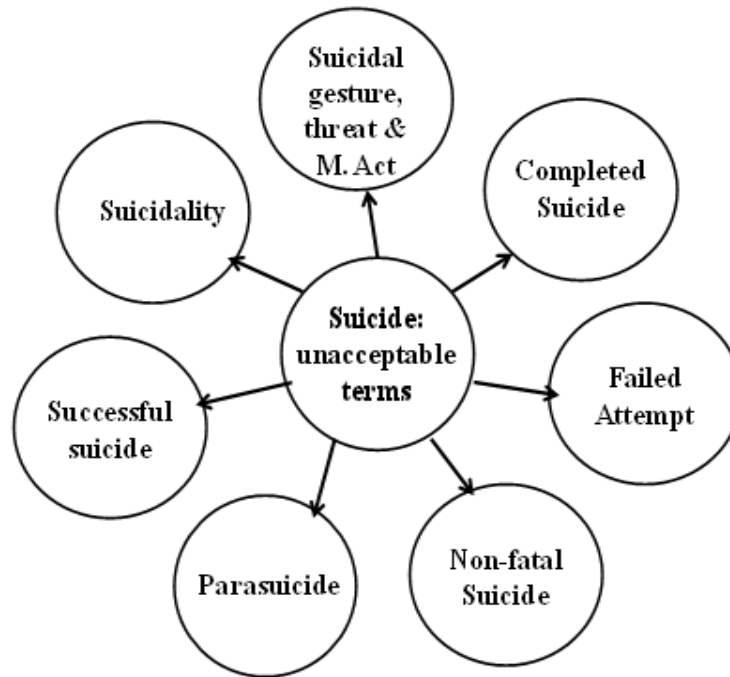


Fig. 2. Unacceptable words concerning suicide

Periodical rage with suicidal thought aggravates potential wish to die. In these cases, the committer may use potentially dangerous weapon implementing intended to die. Persons in the loop of SAs or self-harming behaviors somehow try to find solution for their severe problems. In other words, attempted suicides are “cry for help”. In this line self-harming behavior also constitutes SDV behaviors. Furthermore, SIs and SC are considered early signs of SDV behaviors [45]. Overall, SDV is categorized into non-suicidal and suicidal self-directed violent behaviors and well-defined, reformulated terms concerning suicide discourage researchers not to use its unacceptable terms given in the old literature (Table 2 and Fig. 2). Injury may or may not result from SBs or SDV. Nonetheless, suicide is strongly associated with emotional trauma or injuries that impact loved ones with adverse consequences.

3.2 Epidemiological Trends

Suicide and non-suicidal self-injuries (SDV), major public health problem, are on the rise in teens, youths and elderly population across the world [7,43,46-50]. According to WHO about 800,000 people die globally due to suicide every year. Moreover, suicide is the second leading

cause of death among 15-29 year-olds [7]. The incidence and prevalence of suicide dynamically vary in low-, middle- and high-income countries of the world, primarily attributed to their biopsychosocial, cultural and geopolitical determinants [7,47,46-49]. WHO reported 11.4 suicides per 100,000 people, i.e., 840,000 deaths from suicide globally and these estimates most likely underreported because many of the nations reporting suicide deaths to WHO do not have precise suicide reporting systems and many member states do not report suicide death at all [50]. Overall, rising rates of SAs, nonsuicidal behaviors and undetermined SBs are attributed to multifactorial etiologies including immigration [7,50-54]. Thus, diverse risk factors and changing etiologies tend to transform suicide into highly complex, challenging and dynamically unstable condition globally. WHO estimated that about 79% of global suicides occur in low- and middle-income countries [7,49,50]. By extension, 21% of global suicides tend to occur in high-income countries. In sum, suicide is preventable dynamic event with variable global epidemiological trends but, on pessimistic note, suicide cannot be rooted out completely from this chaotic and tumultuous world and, therefore all stakeholders must use continuing intensive efforts to globally prevent tragic deaths by suicide.

In Asian context, suicide contributes 60% to the global one million suicides annually, with China, India, and Japan accounting for more than 40% of this projection. Kazakhstan, Sri Lanka and South Korea are reported having high suicide rates. Young population constitutes majority of suicides and the use of pesticides being the most common methods. Concerning suicide, Asian countries showed male to female ratio much narrower and this ratio may be reverse [55]. Furthermore, Khan and Syed reported 10-20 attempts prior to suicide and, consequently, six people are directly affected by a suicide or a serious suicidal attempt. Accordingly, there may be approximately 60 million people in Asia suffering from the adverse consequences of a suicidal act every year. However, postvention remains a neglected area in Asia, in addition to vast knowledge and research gaps and underreported suicide rates. Moreover, 20% of

Asian countries tend not to collect national statistics on suicide and do not report to the WHO. Research on suicide needs to be scaled up to inform policy makers to developing culturally relevant suicide prevention strategies in Asia [56]. Overall suicide occurs variably throughout the lifespan (Table 3) and, hence, larger epidemiological samples with various age groups need to be selected to exactly identify suicide patterns across the world.

3.3 Determinants of Suicide at Several Levels

Biopsychosocial model addresses comprehensively predisposing and precipitating factors of suicide and the determinants of SBs with specific remarks are partly described up in the introduction. Biological risk factors focus on the individual genetic susceptibilities and their

Table 3. Prevalence of suicidal behaviors [52,53,56-61]

Condition	Prevalence Rate (PR)	Remarks
1. Suicide	11.4/100,000	804,000 deaths worldwide; M to F suicide ratio higher in HIC than LMIC (3·5 vs. 1·6) and Western vs. Asian/Pacific countries (3·6-4·1 vs. 0·9-1·6)
2. Suicide	Second leading cause of death in individuals 15-29 age band	Higher rate of suicide in elderly with physical disorders, depression, and anxiety and comorbidities.
3. Non-fatal SDV	Average 12-month PR	In HIC and LMIC, respectively.
3.1 Suicidal ideation (SI)	2.0% and 2.1%	
3.2 Suicidal attempt (SA)	0.3% and 0.45	
4. SAs	12-Month rate 15.1% and 20.2%	In HIC & LMIC, respectively. SAs significantly linked with SIs and plans.
5. SI & SAs	Life-time prevalence is 12.1-33% and 4.1-3.9%	In adolescents and young adults, respectively. SI and SAs relatively more common than suicide among women
6. SI in adolescents (13-17 years)	12-month prevalence of SI and SI with plan	16.2% among F and 12.2% among M; 8.3% among F and 5.8% among M; common risk factors were bullying, physical violence, loneliness, relative lack of parental support and alcohol and tobacco abuse.
7. SI and SA in University students (n=8417, 54.4% F)	22% reported SI, 8.6% SA;	Across 12-Muslim countries, SI and SA were variable, more common among females, and one third required medical attention and SDV occurs despite religious prohibition in Muslim nations. Escape mechanism was the main driver of suicidal behaviors.
8. Suicidal attempts in OCD patients	SA reported to be ~15%	Linked with previous SA, psychiatric and physical comorbidities and history of hospitalization

contribution to the pool of suicide. The clinical risk factors and MH conditions linked with suicide include depression, anxiety disorders, personality disorders, alcohol and other substance abuse, dementia, family history of suicide, repeated suicidal attempts, physical diseases and cancers, chronic pain, low mental health literacy (MHL)rate, sexually active girls, low religiosity, psychiatric and physical comorbidities [55,62,63]. Suicide is rising in the elderly population, and attributed to gender, means of suicide (hanging, fall from height, drowning and use of firearms), depression (women) and chronic pain diseases among men [62]. A systematic review reported suicide by hanging is the most common method; however, methods vary in the Eastern and western world. Suicide is increasing in the United Kingdom and other countries over thirty years, and Gunnell et al. (2004) highlighted multiple potential strategies to reduce suicide [64]. Both individual and social factors are further embedded in education, marriage, residence and geographical location, employment, financial losses, early life trauma (ELT) such as physical or emotional abuse and neglect, breakup with romantic partner, bullying and shooting in schools and conflicts with friends. Persistent

misconceptions, stigma, and taboo about the suicide in various cultures and for some repeated SAs means being not in danger for suicide, the latter is a myth needs to be corrected. A prior suicide attempt is the single most important risk factor for suicide in the general population [7,50]. Realizing the tremendous significance of suicide, WHO included suicide in the Mental Health Gap Action Programme (mhGAP) launched in 2008. The mhGAP provides evidence-based technical guidance to scale up service provision and care in countries for MDs. WHO Member States decided to reduce the suicide rate in countries by 10% by 2020. The suicide mortality rate is an indicator of target 3.4 of the Sustainable Development Goals (SDGs): by 2030, to reduce by 33% premature mortality from non-communicable diseases through prevention and treatment, and to promote MH and well-being [65]. Overall, the diverse biological, psychological, social and cultural factors (Fig. 3) determine the rate of suicide, suicidal attempts, suicide ideations/thoughts, suicidal expression, and methods of SDV behaviors and finally guide prevention strategies and policies directed towards combating suicide around the world [62-76].

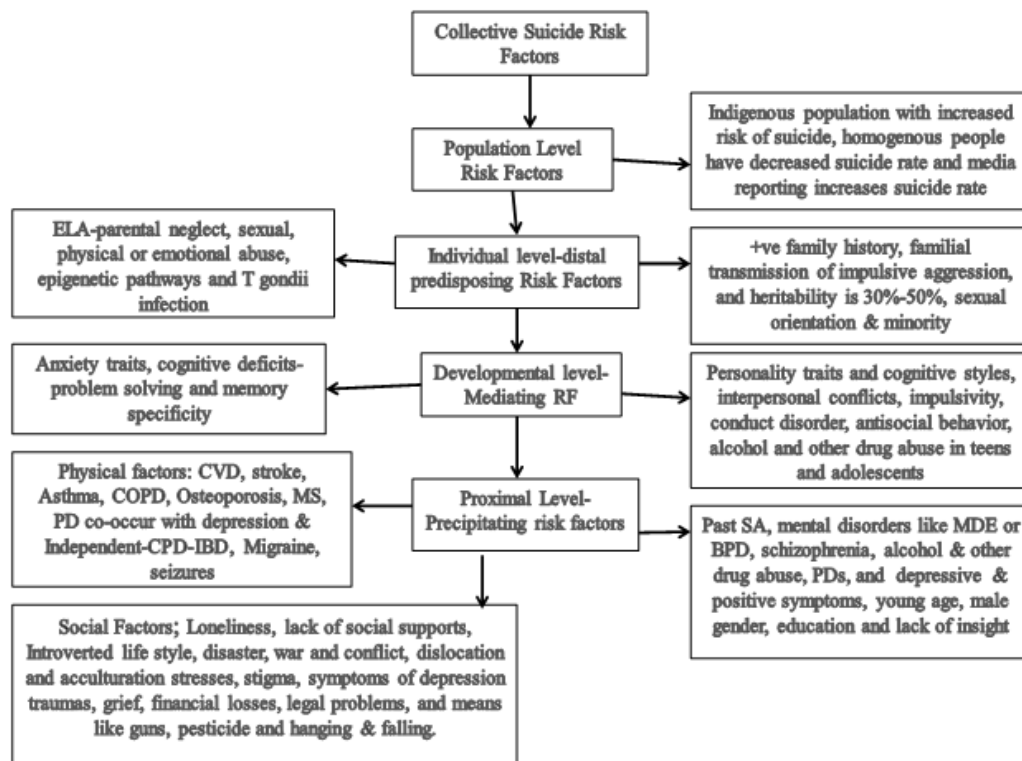


Fig. 3. Determinants of SDV behaviors at different levels

3.4 Early Warning Signs of Suicide

Early warning signs (EWSs) are important indicators of imminent suicidal behaviors and, therefore, their early recognition has considerable impact on prevention of suicide. The suicidal threatening pathways include expression of wanting to die, strong feelings of hopelessness, worthlessness, and helplessness, living without purpose, trapped in various stressful troubles including financial and legal, acute psychosis and chronic unbearable pain [77,78]. Furthermore, suicides also communicate EWSs in terms of being a constant burden to others, looking means to kill oneself and abuse of alcohol or other drugs. Suicides tend to be anxious, highly agitated and reckless, express chronic sleep difficulties, often show isolated or withdrawal behavior, extreme mood swings and give away belongings or treasured objects [79]. Most of these EWS including early life traumas (ELTs) are encountered in all age groups of people from teens to elderly [80,81]. In a nutshell, the EWS are mostly rooted in severe psychopathologies primarily depression and psychosis. Suicides tend to communicate EWSs to the nearest family members and consulting MH professionals whose role is to take such patients seriously and intervene appropriately.

3.5 Muslim Culture and Suicide

Although cultural literature concerning suicide abounds worldwide, it is beyond the scope of this review. Islam, the second largest religion, helps to prevent suicide by two ways, directly by prohibiting it as declared in Holy Quran and indirectly, by lowering the causes of suicide such as psychiatric disorders and alcohol and other substance abuse and thus maintaining mental well-being of Muslim world in particular but general population at large [82,83]. In Islam, suicide is strictly prohibited. The Holy Quran mentions "... [do not] kill (or destroy) yourselves, for surely God has been Most Merciful to you" [84]. Prophet Muhammad (PBUH) said "He who commits suicide by throttling shall keep on throttling himself in the Hell Fire (forever) and he who commits suicide by stabbing himself shall keep on stabbing himself in the Hell-Fire." [85]. Of note, a Muslim must remember Allah (SWT) during times of suffering and pain, and must have faith and hope in Allah's mercy and compassion to ease the suffering rather than taking one's life. Despite suicide being prohibited and considered as a great sin by Muslims, it

should not be viewed as wrong or right because a person with psychosis who is not fully capable of making correct decision is not held accountable for suicidal behaviors. Most Muslim scholars agree that it is God alone who will judge the actions of each individual. This may help to reduce the guilt feeling that may affect the mentally ill patients after attempting suicide. Although the Prophet Mohammed did not pray at the funeral of a man who killed himself, he did not forbid his companions from praying at the funeral; this indicates a possibility to forgiveness. In a review article, an epidemiologist reported increasing suicide among young females of Middle Eastern region attributed to selected methods, psychiatric disorders, marriage and male dominant role [86]. However, most studies have reported higher male to female ratio concerning suicide. Conversely, suicidal attempts are preferentially reported among females across the world. The caveat of this review is that it did not include males and, therefore, results will apply to female population in Middle East region [86]. In an updated review, Malakouti reviewed 13 articles with a focus on the epidemiology of SB in the general population of the Eastern Mediterranean Region (EMR). The incidence of suicide ranged from 0.55 to 5.4/per 100,000 whereas the lifetime prevalence of attempted suicide, suicidal plan and thoughts were 0.72-4.2%, 6.2-6.7% and 2.9-14.1%, respectively. The epidemiological trends of suicide and its relevant components in EMR may not reflect true projections attributable to multiple factors including socio-cultural, religious and legal barriers, lack of registries and limitations of public surveys [87]. A retrospective 1-year study involving records of inpatients (n=165) with nearly fatal deliberate self-harm (n=47 fulfilled criteria of DSH), majority of patients used two methods-hanging and jumping-for DSH, and important risk factors were adult males, widowed or divorced and psychotic disorders [13]. In sum, Islam strictly prohibits suicide, promotes mental health and wellbeing of people through advocating diverse therapeutic religious and traditional practices around the world.

3.6 Interventional Strategies and Suicidal Behaviors

3.6.1 Non-pharmacological interventions

There are several psychosociocultural models that help considerably reduce suicide globally. In a comprehensive review on suicide, Larsen & colleagues (2016) identified 123 apps, each one

with an evidence-based strategy or best-practice guidelines. About 40% apps contained one interactive suicide prevention item, which included social and family supports (n = 27), safety planning (n = 14) and the imminent crisis support (n = 13), the latter linked with the strongest evidence. Apps tended to focus on a single suicide prevention strategy (mean = 1.1), although safety plan apps provided several techniques (mean = 3.9). According to this review, access to lethal means and encouraging risky behavior in a crisis were potentially dangerous contents [88]. Social media play an important role in suicide prevention especially by appropriate reporting of suicide, engaging individuals with severe SBs, informing through online various stakeholders to deal with individuals having suicidal ideation and providing an anonymous, accessible and non-judgmental forum for sharing their joint experiences. Robinson et al. (2016) identified a number of challenges such as potential difficulties controlling user behaviour and accurately assessing risk, privacy and confidentiality and the possibility of contagion. Of note, social media has a great potential for suicide prevention, though needs additional research into its safety and efficacy [89].

Psychotherapies have definite role in the prevention of suicidal behaviors. In fact psychotherapeutic interventions explore in depth the SB and emphasize on change-oriented strategies to encourage positive behaviors, cope with suicidal impulses and emotional-cognitive signatures of SBs [90,91]. Dialectic Behaviour Therapy (DBT) has been used in patients with SB and borderline personality disorder (BPD), and found to promote self-efficacy, interpersonal effectiveness, emotional regulation and to reduce the repeated SB compared to treatment as usual (TAU) and expert community care [92]. Cognitive behavior therapy is also effective in the reduction of SB, with larger effects in individual adults provided suicide is an explicit treatment focus [93,94]. The mentalization-based therapy (MBT), based on psychodynamic tenet, teaches the patient with BPD as to how conceptualize thoughts and feelings, was also found to be effective in reducing SBs among patients with BPD. Concerning adolescents, a meta-analysis of studies addressing self-harm found an overall effect of treatment vs. TAU. The most promising interventions were CBT, DBT, MBT and family therapy. The successful interventions linked to a family component offered in multiple sessions [95]. Stigma and taboo against mental disorders

and especially suicide posit major challenges that need to be discussed with the patients having suicidal ideations anytime during interview or psychotherapeutic sessions. Furthermore, well-developed social support network, strong reasons for living, responsibility for young children, religiosity in terms of frequent attendance of religious service, detailed discussion of religious views on suicide, social support from the religious community, extraversion and optimism, effective coping and problem solving are some of the effective means for reducing suicide and other suicidal behaviors. Overall, psychotherapeutic interventions along with strong social and family supports are effective in preventing suicidal behaviors linked to various psychiatric disorders and diverse overwhelming social problems.

3.7 Perspectives-Policies and Digitalization

Mental health policies concerning SBs tend to help reduce suicide and SAs rooted in psychiatric disorders. The MH policies must target individual and structural risk factors of suicide; use of alcohol and other drugs, access to healthcare services, access to means of suicide including gun control, pesticide, jumping from heights and hanging, and social media report of suicide. In addition, raising awareness of public about mental health in general (mental health literacy) and suicide in specific terms at community level will further reduce prevalence of SAs, SIs, SCs and suicide [2,19,29,31-33,35,63]. Technological advances have helped globally in developing various health monitoring devices. For example, Smartwatches indicate the bodily changes especially emotional and cognitive prior to stress and suicidal attempts and suicide, which are proactive strategic steps to prevent suicide. Similarly using high tech devices, restricted access to means and encourage help-seeking interventions that increase the likelihood of intervention by health experts are associated with a reduction in yearly suicide rate [15]. High tech equipment also help 24-hrs observation and surveillance of those in- and out-patients at risk of committing suicide and SAs. In addition, intranet links-primary, secondary and tertiary MH care services (multilevel strategies) further help in prevention of suicide [96]. Multilevel healthcare strategies assist in early detection of vulnerable patients, speedy referral to MH hospitals, and voluntary or involuntary hospitalization with 24-hour observation and surveillance. Most importantly, web- and mobile- based suicide

prevention programs are developed globally to help patients at risk of suicide [97]. Other ways of reducing suicide include 24-Hours suicide hotline or a national suicide prevention lifeline and widely established community mental health teams (CMHTs). In this context, WHO has developed a suicide prevention tool that worked effectively at community level [98]. This instrument has the following items; suicide prevention through communities; initial preparation with key elements including defining broad goals; organize first meeting with community stakeholders for mapping exercise; creating a community action plan; mobilization of the media; monitor and evaluate community action plan; and community feedback meeting. Overall, this tool is very comprehensive and if applied in its entirety in community settings around the world will help substantially in reducing suicide rate. Indigenous communities are prone to suicidal behaviors and their participation in specific community programs provide them protection from suicide [99].

3.8 Pharmacological Interventions

Suicidal behaviors are integral components of numerous mental disorders and patients especially with depression mostly communicate suicidal symptoms. A number of meta-analyses of randomized controlled trials concerning depression found that both fluoxetine and venlafaxine decrease SIs in young and older individuals [100]. A couple of studies in adolescents and older with depression reported SSRIs being more effective in reducing SI than either venlafaxine or bupropion [101,102]. Gibbons et al. (2012) reported further that young patients (age 18 to 24) respond to antidepressant treatment but their SI do not always improve [100]. Old literature concerning adolescents (age<25) treated with antidepressants suggested that their suicidal behavior either worsen or new SI/SAs tend to emerge [103]. As a result, the US Food and Drug Administration (FDA) issued a Black Box Warning in 2004 about the possibility of increased suicidal behaviors associated with antidepressants in youth. Consequently, both the diagnosis of depression and antidepressant prescriptions for youth has declined [104]. Conversely, overdoses of psychotropics and suicide among adolescents have increased [105]. Pharmacoepidemiological studies showed that sales and prescriptions of SSRIs are inversely correlated with suicide rates in youth and adult population [106]. The methodological differences regarding pharmacoepidemiological

studies and RCTs conducted in youth population might explain the inconsistency between the protective effect of antidepressants and increased incidence of suicidal behaviors in youth. Overall, the use of SSRIs in youth with depression and suicidal behaviors produced consistent results regarding substantial improvement in depression but discrepant findings related to suicide, SAs, SCs and SI.

The pharmacological interventions such as lithium other than antidepressants used in mood disorders have shown reduction in SB [107]. Several studies reported that lithium content in water is inversely correlated with regional suicide rates [108]. Other studies found exposure to lithium is linked with a lower suicide and SA rate compared to antiepileptic agents [109,110]. Notably, meta-analyses of 48 RCTs concerning mood disorders further substantiated the protective role of lithium against suicide compared to placebo and reduction in DSH relative to carbamazepine [111]. Although the exact mechanisms of lithium to decrease SBs are unknown, it possibly acts by multiple ways; reducing episodes of mood disorder, impulsivity and aggression [112]. Another known antisuicidal drug is clozapine, an atypical antipsychotic, has been used effectively in resistant schizophrenia, and found to decrease SAs and emergency referrals for SIs compared to olanzapine in patients with chronic schizophrenia or schizoaffective disorder [113]. Many studies showed that patients with chronic schizophrenia treated with clozapine (and citalopram) have one-third the incidence of suicide and attempted suicide compared to patients treated with other antipsychotics [114,115]. In a systematic review, Zalsman et al. (2016) reported that clozapine and lithium are less specific antisuicidal in patients with schizophrenia and mood disorders, respectively [19]. Overall, lithium and clozapine have some degree of antisuicidal effect when used with or without other psychotropic medications in mood disorders and schizophrenia, respectively.

Ketamine, a glutamatergic, dissociative, anesthetic agent with rapid onset of action (lasts three days), has been used effectively among patients with severe depression and resistant-depression. A systematic review and meta-analysis showed antidepressant rapid response of ketamine in patients with MDD, bipolar disorder and resistant depression [116]. Preliminary studies have shown that single and repeated doses of ketamine (a derivative of

phencyclidine) having diverse mechanism of actions and effects can reduce SIs among patients attending emergency department [117-120]. The ketamine is not without disadvantages, which are abuse potential and addiction, the transient nature of the response and untoward cardiac (tachycardia, hypertension) and psychotomimetic (psychedelic) side effects (dreams, hallucinations, worsen psychosis) [121-123]. In a related development, physician should avoid using angiotensin receptor blockers (instead of angiotensin converting enzyme inhibitors) in patients with suicidal tendencies because these medications cause suicide [124]. Another somatic intervention such as electroconvulsive therapy (ECT) is reported to improve suicidal behavior among patients with depression. In an open study of depressed patients at high suicidal risk, over three-fourths had no suicidal ideations assessed after 9 ECT sessions [125,126]. Several neuromodulatory interventions such as repetitive transcranial magnetic stimulation (rTMS) used in major depression tend to have similar effects on SIs, and high doses of rTMS applied to the left prefrontal cortex found to rapidly decrease SI [127]. In sum, each person intending for harming oneself will require a comprehensive plan including early conversation or formal interview, detailed diagnostic evaluation, focus on problematic issues, psychiatric and physical disorders and the comorbidities and explore unrecognized thoughts of suicide and needs to be managed with multimodal treatment approaches.

3.9 Local Landscape

Suicide is relatively uncommon in Muslim countries around the world. This is because of Islamic Law (Shariya) and Quranic guidance completely prohibit SDV behavior resulting in injuries or death. Therefore, suicide is rarely seen in Saudi Arabia. Local e-searches of relevant databases found limited studies on SBs in Saudi Arabia. A retrospective autopsy study of 160 suicides from Dammam reported males (81.9%) to females (18.1%) ratio 4.5:1, most of them were adults between the age of 30 to 40 years, Indians (41.3%) followed by Saudis (20.6%) constituted the largest share, hanging (83.1%) and shooting (5%) were the commonest methods used by suicides. Most were unskilled workers with mental illnesses (19%) and family difficulties (10%). Other findings reported were suicide notes in 5% of cases and abuse of alcohol (5.6%), amphetamine (2.5%) and

cannabinoids (1.9%) found in blood analysis. Overall suicide was substantially decreased, 2.6% in 2003 to 1.2% in 2007 [128]. Another study also conducted in Dammam used similar methods found more or less similar results but the trend of suicide rate was unstable from year 2000 to 2003, in 2000 there were 33 cases, with fewer in 2001, more in 2002, and the fewest in 2003[129]. Another study that explored the records of 133 suicides who used hanging as a method found that the peak of suicide was in the month of June and the trend reflected a decrease in suicide rate over a period of half decade (2003-2007) [130]. A study also from Medico-Legal Center Dammam identified 221 suicides over a decade (1986-1995) reported similar findings as described up with few differences; hanging was followed by jumping from height and then gun shooting and suicide trend increased from first five years to second half of decade, and the yearly average suicide rate was 1.1/100,000[131]. In a two-years retrospective study of 145 suicides (not suicidal attempters) reported that majority were males (122, 84.1%), male to female ratio was 5.3:1 and about 39% of them were in their third decade with non-Saudis (116, 80%) topping the list followed by Saudis (29, 20%) and the most of suicides were Indians (65, 45%) and hanging was the most common method (110, 75.9%) with regional variations of suicides in Dammam [132]. Overall, similar findings have been reported in most of retrospective studies from Dammam.

In a cross-sectional 1-year study, Alhabeeb and colleagues estimated the prevalence of suicide with identification of the risk factors for suicidal and non-suicidal self-injurious behaviors among patients with depression. A convenience sample of 557 out- and inpatients diagnosed with mood disorders was selected from 3 treatment settings in Riyadh, Saudi Arabia. Eligible patients completed data on sociodemographic variables and the Columbia suicide severity rating scale risk assessment version. The reported prevalence of SAs in the previous week was 36.6%, interrupted SAs 29.8%, aborted SA 34.6% and SIB without suicide intent 7.7%. Concerning SI, 47.2% reported suicidal thoughts, 36.6% suicidal thoughts with methods but without a specific plan and 35.4% suicidal intent without a specific plan. Male sex, joint family type, literate education, being in employment, smoking and physical co-morbidities were significantly associated with all types of suicide behavior [41]. In Islamic countries, and primarily in KSA and other Gulf countries, Sharia is the definitive

Islamic law or doctrine derived from Islamic religious sources including the Holy Quran, Sunnah of the Prophet Mohammad (PBUH), independent deduction of Islamic laws through religious scholars' juristic consensus (Ijma) and reasoning by analogy (Qiyas) [133]. According to Sharia, suicide is stigmatized and condemned and considered to be a criminal act. Allah says explicitly in the Holy Quran: "And do not kill yourselves. Surely, Allah is Most Merciful to you" [Surah An-Nisa (the women)]. In another verse of the Holy Quran, Allah says: "And do not throw yourselves in destruction" [85,133,134]. In sum, Islamic laws (Sharia) and Hadith of Prophet Mohammed (PBUH) protect the life of a Muslim as suicide is strictly prohibited. Therefore, the incidence and prevalence of suicidal behaviors are relatively lesser in Islamic countries of the world. India.

4. DISCUSSION

This critical review of suicide - a self-directed violent behavior- described its epidemiological trends, biopsychosocial determinants, early warning signs, cultural perspectives, prevention strategies and psychological and pharmacological interventions. The epidemiological trends of SDV behaviors vary considerably across the world attributed mainly to a variety of risk factors and methodological differences [1-18,23]. The rising rate of suicide globally but specifically in the Eastern world affecting youth population is of grave concern and might be due to a variety of collective risk factors including mainly poverty, global economic downturn, and geopolitics, the latter is constantly changing dynamically creating international competitions for land expansion, mini-pocketed wars in some rich resource countries and most importantly climate change [14,135]. Biopsychosocial and cultural risk factors and psychophysical disorders concerning SDV behaviors are critical described throughout this paper; however, their implications are wider globally and most importantly these determinants must be addressed while targeting SDV behaviors [1-18,23,136]. It is no surprise that determinants of suicide crowd in an individual life trajectory and this will definitely require specific multimodal intervention including pharmacological [19,100-123] and psycho-therapies [88,90-95], social media, campaigns, policies and guidelines [2,7,15,19,31-33,35,63,89,96-99,136], medical therapeutic devices [88,125,127], social and family supports [88] and culturally sensitive therapies [82-85,133,134,136]. The recognition

of early warning signs of SDV behaviors and preemptive specific interventions tend to decrease robustly SBs among patients with MH problems [77-81].

This critical review has some limitations. Two biases in terms of publication and selection are very obvious, though efforts are made to include most influential and latest articles published in open access journals to present an update on self-directed violent behavior. The strengths of this narrative review are that it is first of its kind in Saudi Arabia and would help MH professionals and physicians globally as how to address patients with suicidal behaviors at all levels of healthcare. This review emphasized on religious interventions directed towards SDV behaviors in Muslim world in specific but generally across the globe. Although this review identified that cultural literature on suicide in religious Holy scriptures and international Islamic scientific journals is abundant, further research is needed in self-directed violent behaviors not only in Saudi Arabia but also other Arabian Gulf countries. Finally, a dozens of local studies reported data about epidemiological trends, risk factors, methods of suicide, suicidal behavioral patterns, and management strategies more or less compatible with international data on SDV behaviors.

5. CONCLUSION

In a nutshell, the term of suicide as a global heterogeneous phenomenon has variable epidemiological trends, a variety of biopsychosocial and cultural risk factors, early warning signs and effectively managed by specific multimodal pharmacological and psychotherapeutic interventions with better outcome. Self-directed violent behaviors need continuing concerted efforts of multidisciplinary healthcare team at all levels of healthcare delivery and multi-sector stakeholders because its determinant risk pathways, early warning signs and protective factors dynamically change overtime across the world.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bachmann S. Epidemiology of suicide and the psychiatric perspective. *International Journal Environmental Research Public Health*. 2018;15(7):1425.
2. Sinyor M, Tse R, Pirkis J. Global trends in suicide epidemiology. *Current Opinion Psychiatry*. 2017;30(1):1-6.
3. Dumitru MM, Constantin BS. The effects of the last global economic crisis on the suicide rate in Europe. *European Psychiatry*. 2016;33:S112-113.
4. Arya V, Page A, Dandona R, Vijayakumar L, Mayer P, Armstrong G. The geographic heterogeneity of suicide rates in India by religion, caste, tribe, and other backward classes. *Crisis*. Advanced publication; 2019.
5. Lempert D. The logic of cultural suicide and application to contemporary global strategies: Drawing from models in psychology and biology. *Globalistics and Globalization studies: Global Evolution, Historical Globalistics Globalization Studies*. 2017;72.
6. Jin Y, Sun LH, Yang W, Cui RJ, Xu SB. The Role of BDNF in the Neuroimmune axis regulation of mood disorders. *Frontiers Neurology*. Advanced Publication. 2019;10.
7. World Health Organization. *Suicide Prevention: A global imperative*. Geneva: WHO; 2014.
8. Erlangsen A, Nordentoft M, Conwell Y, Waern M, De Leo D, Lindner R, et al. International research group on suicide among elderly. Key Considerations for Preventing Suicide in Older Adults. *Crisis*. 2011;32(2):106-109.
9. Allen J, Mohatt GV, Beehler S, Rowe HL. People awakening: Collaborative research to develop cultural strategies for prevention in community intervention. *American Journal Community Psychology*. 2014;54: 100-111.
10. Caldwell TM, Jorm AF, Dear KB. Suicide and mental health in rural, remote and metropolitan areas in Australia. *Medical Journal Australia*. 2004;181:S10-14.
11. Blossnich JR, Brown GR, Shiphard JC, Kauth M, Piegari RI, Bossarte RM. Prevalence of gender identity disorder and suicide risk among transgender veterans utilizing Veterans Health Administration care. *American Journal Public Health*. 2013;103(10):e27-32.
12. Fleischmann A, Arensman E, Berman A, Carli V, De Leo D, Hadlaczky G, et al. Overview evidence on interventions for population suicide with an eye to identifying best-supported strategies for LMICs. *Global Mental Health*. 2016;3:e5.
13. Sankaranarayanan A, Al-Amin H, Ghuloum S. Correlates of near-fatal deliberate self-harm in Qatar: A retrospective study of psychiatric admissions for suicidal behaviors. *Crisis: Journal Crisis Intervention Suicide Prevention*. Advance publication; 2019.
14. Carleton TA. Crop-damaging temperatures increase suicide rates in India. *Proceedings National Academy Sciences*. 2017;114(33):8746-8751.
15. Pirkis J, San Too L, Spittal MJ, Kryszynska K, Robinson J, Cheung YT. Interventions to reduce suicides at suicide hotspots: A systematic review and meta-analysis. *The Lancet Psychiatry*. 2015;2(11):994-1001.
16. Shaughnessy MF, Johnson A. Depression and suicide: The need for awareness of signs of suicidal cognitions and lethality. *Journal Advances Medicine Medical Research*. 2019;1-8.
17. Wuebbolt J, Dick G. Effectiveness of suicide prevention programs in schools among adolescents. *Undergraduate Scholarly Showcase Program (Spring)*; 2019.
18. Andersen K, Hawgood J, Klieve H, Kolves K, De Leo D. Suicide in selected occupations in Queensland: evidence from the state suicide register. *Australian New Zealand Journal Psychiatry*. 2010;44:243-249.
19. Zalsman G, Hawton K, Wasserman D, van Heeringen K, Arensman E, Sarchiapone M, et al. Suicide prevention strategies revisited: 10-year systematic review. *The Lancet Psychiatry*. 2016;3(7):646-59.
20. Breux P, Boccio DE, Brodsky BS. Creating Suicide Safety in Schools: A public health suicide prevention program in New York State. *Suicidology*. 2017;22(2).
21. Barzilay S, Apter A, Snir A, Carli V, Hoven CW, Sarchiapone M, et al. A longitudinal examination of the interpersonal theory of suicide and effects of school-based suicide prevention interventions in a multinational

- study of adolescents. *Journal Child Psychology Psychiatry*. 2019;60(10):1104-1111.
22. Brodsky BS, Spruch-Feiner A, Stanley B. The zero suicide model: Applying evidence-based suicide prevention practices to clinical care. *Frontiers Psychiatry*. 2018;9:33.
 23. Sakashita T, Oyama H. Developing a hypothetical model for suicide progression in older adults with universal, selective, and indicated prevention strategies. *Frontiers Psychiatry*. 2019;10:161.
 24. Sequeira L, Strudwick G, Bailey SM, De Luca V, Wiljer D, Strauss J. Factors influencing suicide risk assessment clinical practice: protocol for a scoping review. *BMJ Open*. 2019;9(2):e026566.
 25. Maina G, Quarato F, Bramante S. Risk factors for suicide in bipolar disorder. *Further Exploration Suicidal Behavior*. 2019;25:149-154.
 26. McGarry A, McDermott MP, Kiebertz K, Fung WL, McCusker E, Peng J, de Bliëck EA, Cudkovicz M. Risk factors for suicidality in Huntington disease: An analysis of the 2CARE clinical trial. *Neurology*. 2019;92(14):e1643-51.
 27. Pham TT, Talukder AM, Walsh NJ, Lawson AG, Jones AJ, Bishop JL, Kruse EJ. Clinical and epidemiological factors associated with suicide in colorectal cancer. *Supportive Care Cancer*. 2019;27(2):617-621.
 28. Clapham E, Bodén R, Brandt L, Jönsson EG, Bahmanyar S, Ekblom A, et al. Suicide ideation and behavior as risk factors for subsequent suicide in Schizophrenia: A nested case-control study. *Suicide Life-Threatening Behavior*. 2019;49(4):996-1005.
 29. Fazel S, Wolf A, Larsson H, Mallett S, Fanshawe TR. The prediction of suicide in severe mental illness: Development and validation of a clinical prediction rule (OxMIS). *Translational Psychiatry*. 2019;9(1):98.
 30. Czyz EK, Horwitz AG, Eisenberg D, Kramer A, King CA. Self-reported barriers to professional help seeking among college students at elevated risk for suicide. *Journal American College Health*. 2013;61(7):398-406.
 31. Cleary A. Help-seeking patterns and attitudes to treatment amongst men who attempted suicide. *Journal Mental Health*. 2017;26(3):220-224.
 32. Schomerus G, Evans-Lacko S, Rüsçh N, Mojtabai R, Angermeyer MC, Thornicroft G. Collective levels of stigma and national suicide rates in 25 European countries. *Epidemiology Psychiatric Sciences*. 2015;24(2):166-171.
 33. Leavey G, Mallon S, Rondon-Sulbaran J, Galway K, Rosato M, Hughes L. The failure of suicide prevention in primary care: Family and GP perspectives—a qualitative study. *BMC Psychiatry*. 2017;17(1):369.
 34. Malakouti SK, Nojomi M, Ahmadkhaniha HR, Hosseini M, Fallah MY, Khoshalani MM. Integration of suicide prevention program into primary health care network: a field clinical trial in Iran. *Medical Journal Islamic Republic Iran*. 2015;29:208.
 35. Coppens E, Van Audenhove C, Iddi S, Arensman E, Gottlebe K, Koburger N, et al. Effectiveness of community facilitator training in improving knowledge, attitudes, and confidence in relation to depression and suicidal behavior. Results of the OSPI-Europe intervention in four European countries. *Journal Affective Disorder*. 2014;165:142-150.
 36. Robertson M. Books reconsidered: Emile Durkheim, Le Suicide. *Australasian Psychiatry*. 2006;14(4):365-368. Available:<https://doi.org/10.1080/j.14401665.2006.02305.x>
 37. Durkheim E. *Suicide: A study in sociology*. Routledge; 2005.
 38. Johnson BD. Durkheim's one cause of suicide. *American Sociological Review*. 1965;30(6):875-886.
 39. Hanzlick R, Hunsaker JC, Davis GJ. Guide for manner of death classification. National Association of Medical Examiners. Available:<http://www.charlydmiller.com/LIB03/2002NAMEmannerofdeath.pdf>
 40. Posner K, Oquendo MA, Gould M, Stanley B, Davies M. Columbia classification algorithm of suicide assessment (C-CASA): Classification of suicidal events in the FDA's pediatric suicidal risk analysis of antidepressants. *American Journal Psychiatry*. 2007;164:1035-1043. Available:<http://cssrs.columbia.edu/>
 41. Al-Habeeb AA, Sherra KS, Al Sharqi AM, Qureshi NA. Assessment of suicidal and self-injurious behaviours among patients with depression. *Eastern Mediterranean Health Journal*. 2013;19(3):248-254.
 42. Al-Sharqi AM, Sherra KS, Al-Habeeb AA, Qureshi NA. Suicidal and self-injurious

- behavior among patients with alcohol and drug abuse. *Substance Abuse Rehabilitation*. 2012;3:91-99.
43. Turecki G, Brent DA. Suicide and suicidal behaviour. *Lancet*. 2016;387(10024):1227-1239.
 44. Goodfellow B, Kölves K, De Leo D. Contemporary definitions of suicidal behavior: A systematic literature review. *Suicide Life-Threatening Behavior*. 2019; 49(2):488-504.
 45. Crosby AE, Ortega L, Melanson C. Self-directed violence surveillance: Uniform definitions and recommended data elements, version 1.0. Atlanta (GA): Centers Disease Control and Prevention. National Center for Injury Prevention and Control; 2011.
 46. Goldsmith SK, Pellmar TC, Kleinman AM, Bunney WE, eds. *Reducing Suicide: A national imperative*. Washington, DC: National Academy Press; 2002.
 47. O'Connor RC, Nock MK. The psychology of suicidal behaviour. *Lancet Psychiatry*. 2014;1(1):73-85.
 48. Hawton K, van Heeringen K. Suicide. *Lancet*. 2009;373(9672):1372-1381.
 49. Suicide Rate by Country Population; 2019. (Retrieved 2019-10-04)
Available:<http://worldpopulationreview.com/countries/suicide-rate-by-country/>
 50. World Health Organization. Practice manual for establishing and maintaining suicide attempts and self-harm surveillance systems. WHO, Geneva; 2016.
Available:http://www.who.int/mental_health/suicideprevention/attempts_surveillance_systems/en/
 51. King M, Smith A, Gracey M. Indigenous health part 2: The underlying causes of the health gap. *Lancet*. 2009;374(9683):76-85.
 52. Borges G, Nock MK, Haro Abad JM, Hwang I, Sampson NA, Alonso J, et al. Twelve-month prevalence of and risk factors for suicide attempts in the World Health Organization World Mental Health Surveys. *Journal Clinical Psychiatry*. 2010; 71(12):1617-1628.
 53. Nock MK, Green JG, Hwang I, McLaughlin KA, Sampson NA, Zaslavsky AM, et al. Prevalence, correlates and treatment of lifetime suicidal behavior among adolescents: Results from the National Co-Morbidity Survey Replication Adolescent Supplement. *JAMA Psychiatry*. 2013;70 (3):300-310.
 54. Spallek J, Reeske A, Norredam M, Nielsen SS, Lehnhardt J, Razum O. Suicide among immigrants in Europe-a systematic literature review. *European Journal Public Health*. 2014;25(1):63-71.
 55. Park S, Jang H. Correlations between suicide rates and the prevalence of suicide risk factors among Korean adolescents. *Psychiatry Research*. 2018;261:143-147.
 56. Khan MM, Syed EU. Suicide in Asia: Epidemiology, risk factors and prevention. In R. C. O'Connor S. Platt, J. Gordon (Eds.), *International Handbook of Suicide Prevention: Research, policy and practice*. Wiley-Blackwell. 2011;487-506.
Available:<http://dx.doi.org/10.1002/9781119998556.ch28>
 57. Brezo J, Paris J, Barker ED, et al. Natural history of suicidal behaviors in a population-based sample of young adults. *Psychological Medicine*. 2007;37(11): 1563-1574.
 58. Conwell Y, Van Orden K, Caine ED. Suicide in older adults. *Psychiatric Clinics North America*. 2011;34(2):451-68.
 59. McKinnon B, Gariépy G, Sentenac M, Elgar FJ. Adolescent suicidal behaviours in 32 low-and middle-income countries. *Bulletin World Health Organization*. 2016; 94(5):340-350F.
 60. Eskin M, Albuhairan F, Rezaeian M, Abdel-Khalek AM, Harlak H, El-Nayal M, et al. Suicidal thoughts, attempts and motives among university students in 12 Muslim-majority countries. *Psychiatric Quarterly*. 2019;90(1):229-248.
 61. Dell' Osso B, Benatti B, Arici C, Palazzo C, Altamura AC, Hollander E, Fineberg N, Stein DJ, Nicolini H, Lanzagorta N, Marazziti D. Prevalence of suicide attempt and clinical characteristics of suicide attempters with obsessive-compulsive disorder: A report from the International College of Obsessive-Compulsive Spectrum Disorders (ICOCS). *CNS Spectrums*. 2018;23(1):59-66.
 62. Crestani C, Masotti V, Corradi N, Schirripa ML, Cecchiet R. Suicide in the elderly: A 37-years retrospective study. *Acta Biomedica*. 2019;90(1):68-76.
 63. Kutcher S, Wei Y, Costa S, Gusmão R, Skokauskas N, Sourander A. Enhancing mental health literacy in young people. *European Child Adolescents Psychiatry*. 2016;25(6):567-569.
 64. Gunnell D, Bennewith O, Hawton K, Simkin S, Kapur N. The epidemiology and

- prevention of suicide by hanging: A systematic review. *International Journal Epidemiology*. 2005;34(2):433-442.
65. World Health Organization. WHO Mental Health Action Plan 2013–2020. WHO: Geneva; 2013.
 66. Jollant F, Malafosse A, Docto R, Macdonald C. A pocket of very high suicide rates in a non-violent, egalitarian and cooperative population of South-East Asia. *Psychological Medicine*. 2014;1-7.
 67. Fountoulakis KN, Kawohl W, Theodorakis PN, et al. Relationship of suicide rates to economic variables in Europe: 2000–2011. *British Journal Psychiatry*. 2014;205(6): 486-496.
 68. Reeves A, McKee M, Stuckler D. Economic suicides in the great recession in Europe and North America. *British Journal Psychiatry*. 2014;205(3):246-247.
 69. Gould MS. Suicide and the media. *Annals New York Academy Sciences*. 2001;932 (1):200-24.
 70. Haas AP, Eliason M, Mays VM, et al. Suicide and suicide risk in lesbian, gay, bisexual and transgender populations: Review and recommendations. *Journal Homosexuality*. 2011;58(1):10-51.
 71. Pedersen MG, Mortensen PB, Norgaard-Pedersen B, Postolache TT. *Toxoplasma gondii* infection and self-directed violence in mothers. *Arch General Psychiatry*. 2012; 69(11):1123-1130.
 72. Flegr J. How and why *Toxoplasma* makes us crazy. *Trends Parasitology*. 2013;29 (4):156-63.
 73. Seguin M, Beauchamp G, Robert M, DiMambro M, Turecki G. Developmental model of suicide trajectories. *British Journal Psychiatry*. 2014;205(2):120-126.
 74. Brent DA, Melhem NM, Oquendo M, et al. Familial pathways to early-onset suicide attempt: A 5.6-year prospective study. *JAMA Psychiatry*. 2015;72(2):160-168.
 75. Lee FS, Heimer H, Giedd JN, et al. Mental health. adolescent mental health-opportunity and obligation. *Science*. 2014; 346(6209):547–549.
 76. King CA, Grupp-Phelan J, Brent D, Dean JM, Webb M, Bridge JA, Spirito A, Chernick LS, Mahabee-Gittens EM, Mistry RD, Rea M. Predicting 3-month risk for adolescent suicide attempts among pediatric emergency department patients. *Journal of Child Psychology and Psychiatry*. 2019;21.
 77. Teen Suicide: Understanding the Risk and Getting Help. Available:newsinhealth.nih.gov/2019/09
 78. Harkavy-Friedman J. Suicide risk, assessment and intervention in early psychosis. *Intervening Early in Psychosis: A Team Approach*. 2019;335.
 79. Walker RL, Talavera DC, Nomamiukor F, Madubata IJ, Alfano C, Vujanovic AA. Sleep-related problems and suicide behavior and ideation among Black and White trauma-exposed psychiatric inpatients. *Comprehensive Psychiatry*. 2019;91:22-28.
 80. Dilillo D, Mauri S, Mantegazza C, Fabiano V, Mameli C, Zuccotti GV. Suicide in pediatrics: epidemiology, risk factors, warning signs and the role of the pediatrician in detecting them. *Italian Journal Pediatrics*. 2015;41(1):49.
 81. Kjøseth I, Ekeberg Ø, Steihaug S. Why do they become vulnerable when faced with the challenges of old age? Elderly people who committed suicide, described by those who knew them. *International Psychogeriatrics*. 2009;21(5):903-912.
 82. Sarfraz A, Castle D. A Muslim suicide. *Australasian Psychiatry*. 2002;10:49.
 83. Sabry WM, Vohra A. Role of Islam in the management of Psychiatric disorders. *Indian Journal Psychiatry*. 2013;55(Suppl 2):S205-214.
 84. The Holy Quran; Surah An-Nisa, verses. 4:29.
 85. Sahih al-Bukhari. 2:23:446.
 86. Rezaeian M. Suicide among young Middle Eastern Muslim females. *Crisis*. 2010;31: 36-42.
 87. Malakouti SK, Davoudi F, Khalid S, Asl MA, Khan MM, Alirezaei N, Mirabzadeh A, De Leo D. The epidemiology of suicide behaviors among the countries of the Eastern Mediterranean Region of WHO: A Systematic Review. *Acta Medica Iranica*. 2015;53(5):257-265.
 88. Larsen ME, Nicholas J, Christensen H. A systematic assessment of smartphone tools for suicide prevention. *PloS One*. 2016;11(4):e0152285.
 89. Robinson J, Cox G, Bailey E, Hetrick S, Rodrigues M, Fisher S, Herrman H. Social media and suicide prevention: A systematic review. *Early Intervention Psychiatry*. 2016;10(2):103-21.
 90. Weinberg I, Ronningstam E, Goldblatt MJ, Schechter M, Wheelis J, Maltzberger JT. Strategies in treatment of suicidality:

- Identification of common and treatment-specific interventions in empirically supported treatment manuals. *Journal Clinical Psychiatry*. 2010;71(6):699-706.
91. Rabon JK, Hirsch JK, Chang EC. Positive psychology and suicide prevention: An introduction and overview of the literature. In: *A Positive Psychological Approach to Suicide*. Springer, Cham. 2018;1-15.
 92. Stoffers JM, Vollm BA, Rucker G, Timmer A, Huband N, Lieb K. Psychological therapies for people with borderline personality disorder. *Cochrane Database Systematic Review*. 2012;8:CD005652.
 93. Tarrrier N, Taylor K, Gooding P. Cognitive-behavioral interventions to reduce suicide behavior: A systematic review and meta-analysis. *Behavior Modification*. 2008;32(1):77-108.
 94. Rudd MD, Bryan CJ, Wertenberger EG, Peterson AL, Young-McCaughan S, Mintz J, et al. Brief cognitive-behavioral therapy effects on post-treatment suicide attempts in a military sample: Results of a randomized clinical trial with 2-year follow-up. *American Journal Psychiatry*. 2015; 172(5):441-449.
 95. Ougrin D, Tranah T, Stahl D, Moran P, Asarnow JR. Therapeutic interventions for suicide attempts and self-harm in adolescents: Systematic review and meta-analysis. *Journal American Academy Child Adolescent Psychiatry*. 2015;54(2):97–107.e2.
 96. Harris F, Maxwell M, O' Connor R, Coyne C, Arensman E, Coffey C, et al. Exploring synergistic interactions and catalysts in complex interventions: longitudinal, mixed methods case studies of an optimized multi-level suicide prevention intervention in four European countries (Ospi-Europe). *BMC Public Health*. 2016;16:268.
 97. Perry Y, Werner-Seidler A, Caelear AL, Christensen H. Web-based and mobile suicide prevention interventions for young people: A systematic review. *Journal Canadian Academy Child Adolescent Psychiatry*. 2016;25(2):73.
 98. Preventing suicide: A community engagement toolkit. Geneva: World Health Organization; Licence: CC BY-NC-SA 3.0 IGO; 2018.
 99. Kral M, Wiebe P, Nisbet K, Dallas C, Okalik L, Enuaraq N, et al. Canadian Inuit community engagement in suicide prevention. *International Journal Circumpolar Health*. 2009;68(3):292-308.
 100. Gibbons RD, Brown CH, Hur K, Davis J, Mann JJ. Suicidal thoughts and behavior with antidepressant treatment: Reanalysis of the randomized placebo-controlled studies of fluoxetine and venlafaxine. *Archives General Psychiatry*. 2012;69(6): 580–587.
 101. Vitiello B, Emslie G, Clarke G, Wagner KD, Asarnow JR, Keller M, et al. Long-term outcome of adolescent depression initially resistant to selective serotonin reuptake inhibitor treatment: A follow-up study of the TORDIA sample. *Journal Clinical Psychiatry*. 2011;72(3):388-396.
 102. Grunebaum MF, Ellis SP, Duan N, Burke AK, Oquendo MA, John Mann J. Pilot randomized clinical trial of an SSRI vs bupropion: Effects on suicidal behavior, ideation, and mood in major depression. *Neuropsychopharmacology*. 2012;37(3): 697-706.
 103. Stone M, Laughren T, Jones ML, et al. Risk of suicidality in clinical trials of antidepressants in adults: Analysis of proprietary data submitted to US Food and Drug Administration. *British Medical Journal*. 2009;339:b2880.
 104. Libby AM, Orton HD, Valuck RJ. Persisting decline in depression treatment after FDA warnings. *Archives General Psychiatry*. 2009;66(6):633-639.
 105. Lu CY, Zhang F, Lakoma MD, Madden J M, Rusinak D, Penfold RB, et al. Changes in antidepressant use by young people and suicidal behavior after FDA warnings and media coverage: Quasi-experimental study. *BMJ*. 2014;348:g3596.
 106. Ludwig J, Marcotte DE, Norberg K. Antidepressants and suicide. *Journal Health Economy*. 2009;28(3):659-676.
 107. Baldessarini RJ, Tondo L, Davis P, Pompili M, Goodwin FK, Hennen J. Decreased risk of suicides and attempts during long-term lithium treatment: A meta-analytic review. *Bipolar Disorders*. 2006;8(5p2):625-639.
 108. Vita A, De Peri L, Sacchetti E. Lithium in drinking water and suicide prevention: A review of the evidence. *International Clinical Psychopharmacology*. 2015;30(1):1-5.
 109. Sondergard L, Lopez AG, Andersen PK, Kessing LV. Mood-stabilizing pharmacological treatment in bipolar disorders and risk of suicide. *Bipolar Disorder*. 2008;10(1):87-94.
 110. Goodwin FK, Fireman B, Simon GE, Hunkeler EM, Lee J, Revicki D. Suicide

- risk in bipolar disorder during treatment with lithium and divalproex. *JAMA*. 2003; 290(11):1467-1473.
111. Cipriani A, Hawton K, Stockton S, Geddes JR. Lithium in the prevention of suicide in mood disorders: Updated systematic review and meta-analysis. *BMJ*. 2013;346: f3646.
 112. O'Donnell KC, Gould TD. The behavioral actions of lithium in rodent models: Leads to develop novel therapeutics. *Neuroscience Biobehavior Review*. 2007; 31(6):932-962.
 113. Meltzer HY, Alphas L, Green AI, Altamura AC, Anand R, Bertoldi A, et al. Clozapine treatment for suicidality in schizophrenia: international suicide prevention trial (InterSePT). *Archives General Psychiatry*. 2003;60(1):82-91.
 114. Hennen J, Baldessarini RJ. Suicidal risk during treatment with clozapine: A meta-analysis. *Schizophrenia Research*. 2005; 73(2-3):139-145.
 115. Haukka J, Tiiho Haukka J, Tiihonen J, Härkänen T, Lönnqvist J. Association between medication and risk of suicide, attempted suicide and death in nationwide cohort of suicidal patients with schizophrenia. *Pharmacoepidemiology Drug Safety*. 2008;17(7):686-696.
 116. Fond G, Loundou A, Rabu C, et al. Ketamine administration in depressive disorders: A systematic review and meta-analysis. *Psychopharmacology (Berl)*. 2014;231(18):3663-76.
 117. Luke LG, Radu R. Low-Dose Ketamine for Depression and suicide ideation in the Emergency Department: An open-label feasibility study. *EC Emergency Medicine Critical Care*. 2019;3:425-431.
 118. Zhan Y, Zhang B, Zhou Y, Zheng W, Liu W, Wang C, et al. A preliminary study of anti-suicidal efficacy of repeated ketamine infusions in depression with suicidal ideation. *Journal Affective Disorders*. 2019; 251:205-212.
 119. Witt K, Potts J, Hubers A, Grunebaum MF, Murrough JW, Loo C, et al. Ketamine for suicidal ideation in adults with psychiatric disorders: A systematic review and meta-analysis of treatment trials. *Australian & New Zealand Journal Psychiatry*. 2019; 54(1):29-45.
 120. De Berardis D, Fornaro M, Valchera A, Cavuto M, Perna G, Di Nicola M, et al. Eradicating suicide at its roots: Preclinical bases and clinical evidence of the efficacy of ketamine in the treatment of suicidal behaviors. *International Journal Molecular Sciences*. 2018;19(10):2888.
 121. Trujillo KA, Heller CY. Ketamine sensitization: Influence of dose, environment, social isolation and treatment interval. *Behavioral Brain Research*. 2020; 378:112271.
 122. Bowdle AT, Radant AD, Cowley DS, Kharasch ED, Strassman RJ, Roy-Byrne PP. Psychedelic effects of ketamine in healthy volunteers relationship to steady-state plasma concentrations. *Anesthesiology: Journal American Society Anesthesiologists*. 1998;88(1):82-88.
 123. Pai A, Heining M. Ketamine. Continuing education in anaesthesia. *Critical Care & Pain*. 2007;7(2):59-63.
 124. Mamdani M, Gomes T, Greaves S, Manji S, Juurlink DN, Tadrous M, et al. Association between angiotensin-converting enzyme inhibitors, angiotensin receptor blockers and suicide. *JAMA network open*. 2019;2(10):e1913304.
 125. Fink M, Kellner CH, McCall WV. The role of ECT in suicide prevention. *Journal ECT*. 2014;30(1):5-9.
 126. Avery D, Winokur G. Suicide, attempted suicide and relapse rates in depression. *Arch General Psychiatry*. 1978;35(6):749-753.
 127. Hadley D, Anderson BS, Borckardt JJ, Arana A, Li X, Nahas Z, George MS. Safety, tolerability and effectiveness of high doses of adjunctive daily left prefrontal repetitive transcranial magnetic stimulation for treatment-resistant depression in a clinical setting. *Journal ECT*. 2011;27(1):18-25.
 128. Al Madni OM, Kharoshah MA, Zaki MK, Murty OP. Trends of suicide in Dammam Kingdom of Saudi Arabia. *Journal Forensic Medicine Toxicology*. 2010;27(2):58-62.
 129. Madadin M, Mahmoud A, Alsowayigh K, Alfaraidy M. Suicide deaths in Dammam, Kingdom of Saudi Arabia: retrospective study. *Egyptian Journal Forensic Sciences*. 2013;3(2):39-43.
 130. Al Madni OM, Kharoshah MA, Zaki MK, Ghaleb SS. Hanging deaths in Dammam, Kingdom of Saudi Arabia. *Journal Forensic Legal Medicine*. 2010;17(5):265-268.
 131. Elfawal MA. Cultural influence on the incidence and choice of method of suicide in Saudi Arabia. *American Journal*

- Forensic Medicine Pathology. 1999;20(2): 163-168.
132. Issa SY, El Dossary M, Salam MA, Al Madani O, Al Mazroua MK, Alsowayigh K, et al. Suicidal deaths in depth-Eastern Province-Saudi Arabia. *Egyptian Journal Forensic Sciences*. 2016;6: 240-247.
133. Payne-James J, Busuttil A, Smock W. (editors). Shari'ah law and the judicial system. In: *Forensic Medicine: Clinical and Pathological Aspects*, Greenwich Medical Media Ltd., UK. 2003;3:29-37.
134. The Holy Quran. Surah Al-Baqarah (Cow/Heifer), verses 2:195.
135. Gao J, Cheng Q, Duan J, Xu Z, Bai L, Zhang Y, et al. Ambient temperature, sunlight duration, and suicide: A systematic review and meta-analysis. *Science Total Environment*. 2001;646: 1021-1029.
136. Krug BG, et al. Self-directed violence. In: *World Report on Violence and Health*. Geneva, World Health Organization. Geneva; 2002.

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