

# Geographical epidemiology of common methods of suicide and suicide attempts during the years 2010-2013 in Fars Province, Iran

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## Abstract

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**Background:** One of the important aspects of the epidemiologic study of suicide and its related behaviors is the identification of suicide methods. This study aimed to investigate the geographical epidemiology of common methods of suicide and suicide attempts in Fars Province located in Southwestern Iran during the years 2010-2013.

**Materials and Methods:** The present study was conducted on 17,342 suicide and suicide attempt cases in Fars Province. To collect the data, the monthly suicide prevention program checklist was used. Data were analyzed using the SPSS software, R software, and ArcGIS software. Using Bayesian hierarchical models, the standardized mortality ratios (SMRs) were prepared and calculated according to the common suicide and suicide attempt methods.

**Results:** On average, the suicide rate in Fars Province was 3.85 in one hundred thousand people per year. The geographic pattern of suicide in the mentioned province showed that the highest rates of hanging were reported in the cities of Firuzabad, Farashband, and Larestan, Iran, and the highest rates of self-immolation were reported in cities of Mamasani, Shiraz, and Firuzabad, Iran.

**Conclusions:** Despite the low rate of suicide in the cities of Fars Province, the rate of suicide-related behaviors, including suicide attempt and suicide by violent and deadly methods, was high in some areas of the province. Therefore, restricting access to lethal means and methods of suicide and planning to identify areas with high risk for suicide in the province is necessary.

**Keywords:** Epidemiology, Suicide, Suicide attempt, Iran.

## Introduction

Suicide is a social and mental health disorder and is considered as a serious public health issue; thus, it has gained attention in the first and second levels of healthcare (1).

One of the important aspects of the epidemiologic study of suicide and its related behaviors is the identification of suicide methods. The International Association for Suicide Prevention (IASP) has stressed that if access to the means and methods of suicide were limited, the number of suicide cases would decrease dramatically (2). For this reason, the World Health Organization (WHO)

has emphasized the investigation of the methods and practices used for this multidimensional phenomenon and its preventive programs (3). Previous studies have shown that geographical shifts, especially in the access to suicide methods that may affect the rate of regional suicides do exist. For example, it has been shown that stricter restrictions and laws on access to (4) and

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keeping firearms at home (5) have been associated with decreased rate of regional suicide by firearms in the United States of America.

There are many methods for committing suicide and its related behaviors. The use of some of these suicide methods such as the use of firearms, jumping from height, use of cold weapons, and poisoning by narcotics and drugs were more common due to their availability and ease of use (6). In Italy, the most common methods of suicide are hanging and jumping from heights (7). The most common method of suicide among women in the USA was use of drugs and poisons, while men more often used firearms to end their own life (8).

Drug intoxication and overdose were the most common methods of suicide in Iran due to easy access or lack of decisiveness (9). In a study in Iran, self-immolation was the most common method of suicide among women and the use of firearms and hanging were the most common methods among men (10). However, the results of a study showed that hanging and the use of firearms among men and self-immolation and hanging among women were the most common methods of suicide in Fars Province in Southwestern Iran (11).

Due to an increase in suicide-related behaviors in recent years in Iran, the identification and investigation of its geographical patterns can help to prevent and control this health problem. This study with a broader perspective aimed to investigate the geographical epidemiology of common methods of suicide and suicide attempt in Fars Province during the years 2010-2013.

### **Material and Methods**

This descriptive study was conducted to determine the geographical epidemiology of common methods of suicide and suicide attempt in Fars Province using census method. The study population consisted of all cases of suicide and suicide attempt referred to healthcare centers (emergency hospitals, and

forensics of the provinces) in the 27 cities of Fars Province since the beginning of the year 2010 until the end of 2013. To collect data on suicide and suicide attempt, the monthly suicide prevention program checklist was used. This checklist consisted of two parts. The first part was related to personal demographic information such as age, gender, occupation, education, marital status, and residence location. The second part was related to information regarding other variables related to suicide and suicide attempt, which included the history of suicide attempts, physical and mental illness history, suicide method, season, year, data source, and the result of suicide. In order to maintain confidentiality, the individual's name, address, and phone number were not used.

After collecting and coding the data, they were entered into SPSS software (version 21, SPSS Inc., Chicago, IL, USA) for analysis and calculation of the frequency of the most common methods of suicide and suicide attempts in Fars province. It should be noted that due to the reduced frequency of some methods of suicide and suicide attempts, the most common methods of suicide and suicide attempts were examined. To map out the geographical distribution according to common methods of suicide and suicide attempts, the frequency of the most common methods were first calculated according to gender. Nevertheless, the frequency of common methods in terms of gender were low in some cities; therefore, the most common methods of suicide (self-immolation, use of drugs, and hanging) and suicide attempts (use of drugs, pesticide poisoning, use of cold weapons) were generally determined at the provincial level, and then, in the 27 cities of the province. Then, for each of the three common methods of suicide and suicide attempts, raw standardized mortality ratio (SMR) was calculated using indirect method based on the following formula:

SMR = The number of observed cases/The number of expected cases

The number of expected cases was calculated using the following formula (12):

The number of expected cases = (The number of cases in the province/Population of the province) × The population of the city

In order to calculate the rate of suicide and suicide attempts, the demographics information of the 2012 census was used (13). Due to the small population and reduced incidence of suicide in some cities and also to (heterogeneity in all regions of the area under consideration) and structural variation (the correlation between neighboring areas) (14, 15). Bayesian hierarchical models were estimated using Markov Chain Monte Carlo (MCMC) methods in R software (version 3/1/2, R Core Team, Vienna, Austria) (12).

Subsequently, the divergent design of colors that represented the wide range of SMR for

show a clear spatial pattern of suicide and suicide attempt before mapping (14), Bayesian hierarchical models and smoothed SMR (12) were calculated to separate the common methods of suicide and suicide attempts. The Bayesian hierarchical models for observed cases of suicide were based on the Poisson assumption which allows the possibility of random effects for nonstructural diversity

suicide and suicide attempts were selected on the map. In other words, the two ends of this spectrum were identified by different colors that gradually turned to bright and lighter colors. Dark blue represented the "areas with the lowest risk", while dark red represented the "areas of greatest risk" and yellow represented the middle class (16).

**Table 1: Frequency distribution of the most common methods of suicide based on gender in Fars Province during the years 2010-2013**

Cities	Female N (%)			Male N (%)		
	Hanging	Self-immolation	Drug consumption	Hanging	Self-immolation	Drug consumption
Abadeh	1(6.7)	1(0.6)	1(1.1)	0	1(1.4)	1(1.0)
Arsanjan	0	0	1(1.1)	2(2.7)	0	0
Estahban	0	0	1(1.1)	0	2(2.7)	1(1.0)
Eqlid	1(6.7)	0	2(2.2)	1(1.4)	0	2(1.9)
Bavanat	0	3(1.7)	0	3(4.1)	0	0
Pasargad	0	0	1(1.1)	2(2.7)	0	0
Kharameh	0	1(0.6)	6(6.7)	0	0	3(2.9)
Khoram Bid	0	0	2(2.2)	2(2.7)	1(1.4)	1(1.0)
Khonj	0	0	0	2(2.7)	0	1(1.0)
Darab	0	9(5.1)	3(3.4)	0	0	2(1.9)
Rostam	1(6.7)	3(1.7)	4(4.5)	0	0	0
Zarin Dasht	0	2(1.1)	0	0	3(4.1)	0
Sepidan	0	0	2(2.2)	0	2(2.7)	1(1.0)
Sarvestan	0	0	2(2.2)	1(1.4)	0	0
Shiraz	2(13.3)	99(56.3)	28(31.5)	17(23.3)	47(63.5)	51(49.5)
Farashband	2(13.3)	4(2.3)	3(3.4)	1(1.4)	0	1(1.0)
Firuzabad	2(13.3)	7(4.0)	1(1.1)	14(19.2)	3(4.1)	5(4.9)
Qir-o Karzin	0	1(0.6)	1(1.1)	0	2(2.7)	1(1.0)
Kazerun	3(20.0)	12(6.8)	2(2.2)	4(5.5)	1(1.4)	5(4.9)
Kavar	0	0	0	0	0	0
Gerash	0	0	0	0	0	0
Larestan	0	5(2.8)	3(3.4)	11(15.1)	0	1(1.0)
Lamerd	0	4(2.3)	0	0	1(1.4)	0
Marvdasht	2(13.3)	9(5.1)	18(20.2)	8(11.0)	5(6.8)	20(19.4)
Mamasani	1(6.7)	8(4.5)	6(6.7)	3(4.1)	5(6.8)	3(2.9)
Mohr	0	4(2.3)	0	1(1.4)	1(1.4)	1(1.0)
Neyriz	0	4(2.3)	2(2.2)	1(1.4)	0	3(2.9)
<b>Total</b>	<b>15(100)</b>	<b>176(100)</b>	<b>89(100)</b>	<b>73(100)</b>	<b>74(100)</b>	<b>103(100)</b>

The ArcGIS software (version 9.3, Esri, Redlands, CL, USA) was used to display the geographical distribution of standard deaths by suicide and suicide attempts according to common methods of suicide and suicide attempts in each city. For the spatial correlation in the smoothed values of common methods of suicide and suicide attempts, Moran's I statistical index was used in R software (17). The index value of zero showed lack of spatial correlation and the positive values indicated correlation between regions

(the maximum value of Moran's I was 1) (18). The significant level was considered as 0.05.

## Results

During the studied years, 17342 cases including 646 cases of suicide with forensic records and 16696 cases of attempted suicide had occurred in Fars Province. On average, the incidence of suicide in Fars Province was 3.85 in one hundred thousand people a year.

**Table 2: Frequency distribution of the most common methods of suicide attempt based on gender in Fars Province during the years 2010-2013**

Cities	Female N (%)			Male N (%)		
	Drug consumption	Cold weapons	Pesticide poisoning	Drug consumption	Cold weapons	Pesticide poisoning
Abadeh	286(3.1)	3(2.3)	8(1.4)	169(3.0)	11(4.1)	10(2.4)
Arsanjan	93(1.0)	2(1.6)	8(1.4)	74(1.3)	4(1.5)	4(0.9)
Estahban	183(2.0)	3(2.3)	13(2.2)	157(2.8)	8(3.0)	22(5.2)
Eqlid	151(1.7)	1(0.8)	12(2.1)	89(1.6)	0	10(2.4)
Bavanat	45(0.5)	0	8(1.4)	19(0.3)	0	8(1.9)
Pasargad	91(1.0)	0	5(0.9)	36(0.6)	2(0.7)	10(2.4)
Kharameh	86(0.9)	2(1.6)	7(1.2)	40(0.7)	3(1.1)	7(1.6)
Khoram Bid	95(1.0)	2(1.6)	8(1.4)	46(0.8)	7(2.6)	4(0.9)
Khonj	148(1.6)	1(0.8)	11(1.9)	58(1.0)	2(0.7)	3(0.7)
Darab	513(5.6)	1(0.8)	26(4.5)	291(5.2)	2(0.7)	20(4.7)
Rostam	103(1.1)	0	0	46(0.8)	0	1(0.2)
Zarin Dasht	35(0.4)	0	0	24(0.4)	2(0.7)	1(0.2)
Sepidan	139(1.5)	1(0.8)	11(1.9)	49(0.9)	1(0.4)	9(2.1)
Sarvestan	59(0.6)	1(0.8)	1(0.2)	36(0.6)	2(0.7)	6(1.4)
Shiraz	3926(43.0)	97(75.2)	241(41.4)	2483(44.2)	174(64.9)	128(30.1)
Farashband	97(1.1)	2(1.6)	6(1.0)	50(0.9)	7(2.6)	7(1.6)
Firuzabad	24(0.3)	0	7(1.2)	16(0.3)	0	0
Qir-o Karzin	213(2.3)	0	13(2.2)	109(1.9)	0	8(1.9)
Kazerun	543(6.0)	2(2.3)	76(13.1)	415(7.4)	9(3.4)	83(19.5)
Kavar	130(1.4)	0	0	51(0.9)	0	0
Gerash	32(0.4)	0	0	17(0.3)	0	0
Larestan	284(3.1)	5(3.9)	5(0.9)	178(3.2)	8(3.0)	4(0.9)
Lamerd	145(1.6)	1(0.8)	4(0.7)	43(0.8)	4(1.5)	2(0.5)
Marvdasht	910(10.0)	1(0.8)	85(14.6)	656(11.7)	8(3.0)	63(14.8)
Mamasani	550(6.0)	1(0.8)	14(2.4)	304(5.4)	3(1.1)	6(1.4)
Mohr	33(0.4)	1(0.8)	2(0.3)	8(0.1)	3(1.1)	0
Neyriz	208(2.3)	1(0.8)	11(1.9)	160(2.8)	8(3.0)	9(2.1)
Total	9122(100)	129(100)	582(100)	5624(100)	268(100)	425(100)

In table 1, the most common methods of suicide in terms of gender based on the

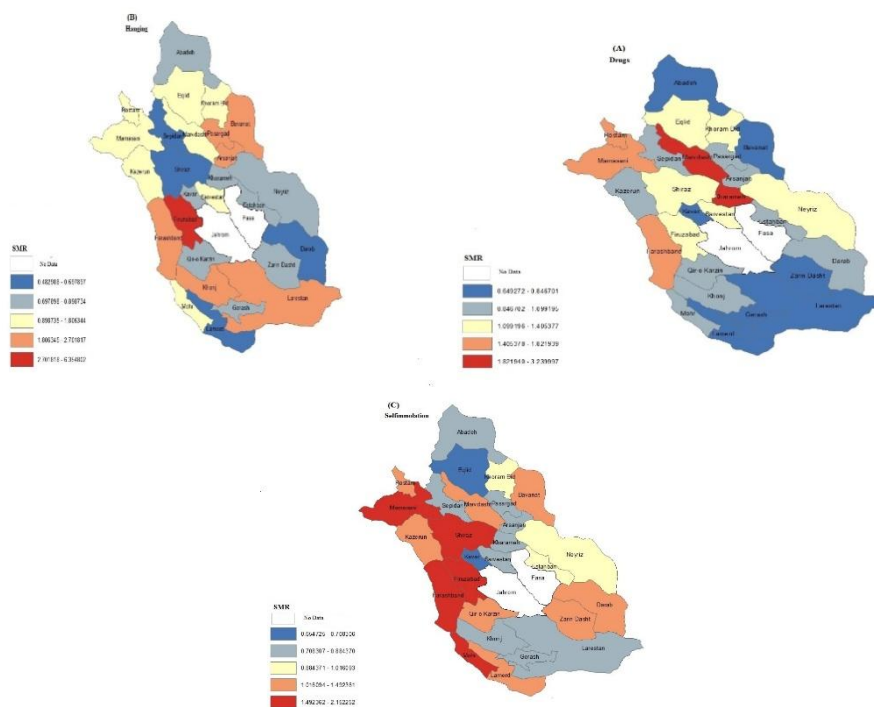
division by cities are shown in Fars Province. In the comparison between the means of

suicide in men and women, the frequency distribution of hanging, self-immolation, and drug consumption among women was related to the cities of Kazerun and Shiraz, while in men, the highest rates of the mentioned three methods were observed in Shiraz. In contrast, table 2 illustrates the most common methods of suicide attempts in terms of gender in each city in the Fars Province. As shown in table 2, Shiraz had the most cases of suicide attempts

according to the three most common methods in both genders.

The results of maps related to the geographical patterns of suicide and suicide attempts according to common methods in 27 cities of Fars Province

There were significant changes in geographical patterns of suicide by the three common methods (drugs consumption, hanging, and self-immolation) (Figure 1).



**Figure 1: Map of the smoothed standardized mortality ratio (SMR) of suicide according to the common methods of drug consumption (A), hanging (B) and self-immolation in the 27 cities of Fars Province during the years 2010-2013**

The ratio of deaths of smoothed standard of suicide by self-immolation compared to other methods of suicide had the least spatial diversity. The highest rates were observed in Mamasani, Shiraz, and Firuzabad, and the lowest rates were observed in Eqlid, Kavar, and Larestan. SMR values ranged from 0.65472 to 2.15225 (3.29 times). Significant changes were observed in smoothed rates of suicide by hanging [SMR values ranged from 0.48298 to 6.35480 (13.16 times)], with highest rates in the cities of Firuzabad, Farashband, and Larestan and lowest values in

the cities of Darab, Shiraz, and Sepidan. Suicide by drug overdose had the highest rates in the cities of Marv Dasht, Kharameh, and Farashband, and the lowest in the cities of Lamerd, Kavar, and Zarin Dasht [with values range from 0.64927 to 3.23999 (4.99 times)] (Maps A to C).

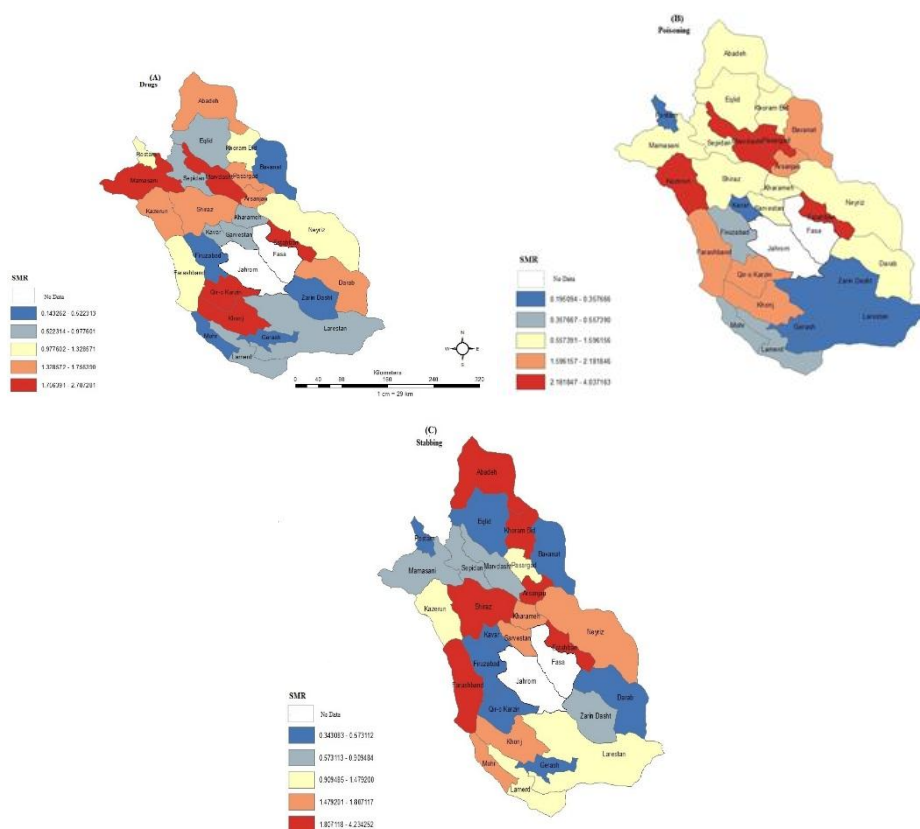
There was no evidence regarding spatial correlation (i.e. areas adjacent to each other tend to have similar suicide rates) between the three common methods of suicide. The highest value of Moran's I index was related to excessive drug use (Moran's I = 0.0276, P =

0.0754), and the lowest value to self-immolation (Moran's I = -0.0340, P = 0.9090), and hanging (Moran's I = -0.0385, P = 0.9970), respectively.

Figure 2 (Maps A to C) illustrates the geographical distribution of common methods of suicide in Fars Province. The standard mortality ratio for suicide by cold weapons showed that it had the lowest spatial diversity. The highest rates were related to the cities of Farashband, Shiraz, and Khoram Bid and the lowest values to the cities of Firuzabad, Kavar, and Qir-o karzin [with values ranging from 0.34308 to 4.23425 (12.34 times)]. Significant variations were observed in suicide attempt rates by pesticide poisoning. The highest rates were observed in the cities of Kazerun, Estahban, and Marv Dasht and the lowest rates

in the cities of Kavar, Gerash, and Zarin Dasht, respectively [SMR rates ranged from 0.19509 to 4.03716 (20.69 times)]. Suicide attempts by drug overdose had the highest rates in Mamasani, Marv Dasht, and Khonj cities and the lowest rates in Firuzabad, Mohr, and Zarin Dasht, respectively [SMR rates ranged from 0.14326 to 2.78728 (19.46 times)] (Maps A to C).

No evidence of spatial correlation was observed in suicide by the three common methods of suicide attempts. The highest rate of Moran's I was observed in pesticide poisoning method (Moran's I = 0.0162, P = 0.1549) and the lowest rates in excessive drug use (Moran's I = -0.0462, P = 0.8398) and cold weapons use (Moran's I = -0.0616, P = 0.5470), respectively.



**Figure 2: Map of the smoothed standardized mortality ratio (SMR) of suicide attempts according to the common methods of drug consumption (A), hanging (B), and cold weapons in the 27 cities of Fars Province during the years 2010-2013**

## Discussion

Significant and individual geographical variations were observed in the patterns of

spatial components of the common methods of suicide and suicide attempts in Fars Province. In this study, the technique and method of suicide and suicide attempts differed based on

gender in different cities. Therefore, most suicide cases in women based on the three common methods were observed in Kazerun and Shiraz and in men were observed in Shiraz. However, the city of Shiraz had the highest rate of suicide attempts based on the three common methods in both genders. Geographical differences in specific suicide methods have been reported among different countries (19), and smaller areas in a country (20). It was shown that distinct geographical patterns in specific suicide and suicide attempt methods can be explained to a large extent by the availability of or access to lethal methods of suicide. Two examples of this case are the high rates of the use of pesticides in most Asian countries with agricultural economy and the high rate of the use of firearms for suicide in the United States of America, where the use of firearms is legal (19, 20).

In addition, in this study, the greatest variety of the ratio of smoothed standard death was hanging, which had the highest rates in the city of Firuzabad, Farashband, and Larestan and the lowest values in the cities of Darab, Shiraz, and Sepidan. Therefore, the identification of areas at risk for suicide using spatial statistical techniques may be of great importance for the more efficient use of resources and interventions for suicide prevention efforts in the future (21). It should be noted that due to the lack of similar studies in the country, the direct comparison of the findings with other studies cannot be allowed.

Self-immolation was considered as one of the most violent, fatal, and painful suicide methods (22). Every year about 310,000 individuals lose their lives due to self-immolation (23). It was estimated that the rate of death due to self-immolation in low-income and average income countries was about 11 times higher than high-income countries and 95% of self-immolations cases have occurred in those countries (24). In this regard, the results of this study showed that the smoothed SMR of suicide by self-immolation compared to other methods of suicide had the lowest spatial diversity. The highest rates were

observed in Mamasani, Shiraz, and Firuzabad and the lowest rates were observed in Eqlid, Kavar, and Larestan, respectively. It is expected that through implementation of lifestyle changes, such as replacing alternative fuels with gas, among the inhabitants of those areas, their access to fuels such as petroleum will be reduced, and thus, the number of cases of suicide by self-immolation will also be reduced (22).

The results of this study also showed significant variation in smoothed rates of suicide attempts by pesticide poisoning. The highest rates were observed in the cities of Kazerun, Estahban, and Marv Dasht (most of the inhabitants were engaged in agriculture). However, cities located in the South and Southeast of Fars Province, such as Kavar, Gerash, and Zarin Dasht (non-agricultural due to reduced rainfall) had the lowest rates of suicide attempts by pesticide poisoning. In accordance with the results of this study, the findings of a study in Taiwan showed that almost half (47%) of all suicide by pesticide cases had occurred in areas where only 13% of Taiwan's population lived (12). The areas where the majority of its inhabitants were engaged in agriculture had the highest rates of suicide by pesticides (12). Therefore, it appears that strategies such as restricting access to pesticides, particularly highly toxic pesticides, and improving medical care services for poisoned individuals can help to reduce the rate of suicide by pesticides.

The limitations of this study included failure to register the causes of and motivation for suicide and suicide attempts, the type of pesticide and fuel used, and socio-economic conditions of the individual in the checklist, and unknown and missing data (about 1.75%) during the study years. Moreover, lack of access to the study population regarding age-gender groups to calculate the required indices was another limitation of the present study.

Similar studies are recommended to allow comparisons and more accurate understanding of geographical patterns of suicide methods. Furthermore, further studies are recommended

on geographical distribution of all suicide and suicide attempt methods regarding gender and age group distribution in Fars Province and other provinces in the country over a longer period.

### Conclusion

In general, the geographical pattern of common methods of suicide and suicide attempts in Fars Province showed that most cases of hanging were observed in the cities of Firuzabad, Farashband, and Larestan and the highest rates of self-immolation cases were observed in Mamasani, Shiraz, and Firuzabad. Therefore, restricting access to lethal means and methods of suicide, planning for high-risk areas for suicide, and conducting further studies on the causes of and motivation for turning to violent and lethal means of suicide is essential.

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**Conflict of interest:** None declared

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