

Epidemiology of Suicide by Hanging in Fars Province, Iran (2011-2019): A Population-based Cross-sectional Study

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Objectives: Hanging is a common method of attempted suicide. This study investigated the epidemiological profile of attempted and completed suicides by hanging in southern Iran.

Methods: This cross-sectional study was performed on 1167 suicide attempts by hanging between 2011 and 2019. All data related to suicide attempts by hanging were collected from the Fars Suicide Surveillance System. The trends in suicide cases and the mean age of attempted and completed suicides were plotted. The chi-square test was used to identify suicide-related factors. Crude rates of incidence, mortality, and standardized fatality during the study period were calculated. Finally, logistic regression was used to identify the predictors of death in individuals who attempted suicide.

Results: The mean age of those who attempted suicide was 33.21 ± 16.82 years; the majority were male (80.5%). The rate of attempted and completed suicide by hanging were 3.50 and 2.79 per 100 000 people, respectively. The case-fatality rate was calculated as 79.34%. The results of our study indicated an increasing trend in suicide attempts by hanging. The likelihood of death was 2.28 times higher in individuals with a previous history of suicide attempts and 1.85 times higher in those with a psychological disorder.

Conclusions: The findings of this study suggest an increasing trend in attempted and completed suicide by hanging, especially among individuals with a history of suicide attempts and psychological disorders. It is necessary to take action to reduce the rate of suicide attempts and identify the underlying causes of suicide attempts by hanging.

Key words: Suicide, Hanging, Trend, Epidemiology, Iran

INTRODUCTION

Suicide is a major health concern worldwide [1], constituting the 15th leading cause of death worldwide and accounting for 1.4% of all deaths [2]. In 2012, approximately 804 000 people globally died due to suicide [3], and, based on the Global Bur-

den of Disease, 703 000 deaths by suicide occurred in 2019 [4]. In addition to completed suicides, suicidal behavior and attempted suicide were taken into consideration. Globally, the prevalence of attempted suicide and suicidal behavior was approximately 2.7% and 9.2%, respectively, in 2008 [5]. Attempted suicide and suicidal behavior are strong predictors of completed suicide and can have negative consequences, such as injury, hospitalization, and loss of liberty, and imposing a heavy economic burden of billions of dollars on society. Overall, attempted suicide and suicidal behavior are the 19th leading cause of the global burden of disease, and the 6th and 9th leading cause, respectively, of the global burden of disease among men and women aged 15-44 years [2]. Although the attempted suicide rate is lower in most Islamic countries, evidence shows

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an increasing trend in these countries [6]. In Iran, the attempted suicide rate is 5.3 per 100 000 people in both men and women [3]. Suicide attempts are more likely in urban than in rural areas due to lifestyle stress [7]. The most common methods of attempted suicide in Iran include drug poisoning, self-immolation, and hanging, in order of most to least common [8]. In Ilam Province, suicide attempts by hanging, self-immolation, and drug poisoning had the highest fatality rates [9].

Hanging is a simple method of attempted suicide because it effectively requires no complex techniques. This method is one of the common types of attempted suicide with high mortality rate [10]. Accordingly, Gunnell et al. [11] estimated the mortality rate of attempted suicide by hanging is about 70%. A study in Fars Province revealed that most attempted suicides were committed by hanging in Fars Province [12].

Due to the rising trend of suicide in Islamic countries and the lack of current, accurate information on the epidemiology of suicide attempts by hanging in Fars Province, the present study was conducted in order to evaluate the epidemiology of attempted and completed suicide by hanging in Fars Province during the years 2011-2019.

METHODS

In this cross-sectional study, all cases of suicide attempts by hanging were investigated in Fars Province (except Jahrom and Fasa). The required data were collected from the Fars Suicide Surveillance System (FSSS) between 2011 and 2019. In the FSSS, information is collected after obtaining informed consent from patients or from their parents or companions, almost 100% of whom agreed to have their information registered in the suicide registration system. After obtaining informed consent from these individuals to use their information for research purposes, the collected information was coded without registering their names.

The FSSS, which belongs to the Statistics Unit of Shiraz University of Medical Sciences, records demographic information, medical history, history of suicides, and data on the cause, methods, and outcome of suicides. The data of the surveillance system were cross-checked with data from psychiatric clinics, hospitals, forensics and death registration centers, urban and rural health centers, private clinics, poison centers, and emergency departments.

All people who attempted suicide by hanging were enrolled in the study, while individuals who had a judicial hanging and

duplicated cases were excluded from the study. Reports from all centers were routinely checked for causes of morbidity and mortality that included suicide attempts and deaths by suicide. After excluding duplicated cases from different sources, 1167 cases of suicide attempts by hanging were included in the study. The researchers reached out directly to 5% of relatives of suicide cases to confirm the accuracy of the data collected by verbal autopsy. The non-response rate was less than 2%. The validity of quantitative and qualitative variables was acceptable, as shown by kappa and Pearson coefficients of 82% and 86%, respectively. The independent variables in this study included demographic characteristics, medical history, history of suicide attempts, and reasons for and method of attempted suicide. The dependent variable included the outcome of suicide. The classification of these variables is shown in Table 1.

Statistical Analysis

We reported qualitative variables with frequency and percentage and quantitative variables as the mean and standard deviation. Case-fatality rates (CFRs) and crude and standardized mortality rates were calculated according to age group,

Table 1. Frequency of attempted and completed suicides by hanging in Fars Province, Iran from 2011 to 2019, according to individuals' characteristics

Characteristics	Attempted suicide		Completed suicide	
	n (%)	Valid %	n (%)	Valid %
Total	1167 (100)	100	926 (100)	100
Sex				
Female	227 (19.5)	19.46	173 (18.7)	18.68
Male	940 (80.5)	80.54	753 (81.3)	81.32
Age (y)				
10-14	42 (3.6)	3.67	38 (4.1)	4.15
15-24	344 (29.5)	30.12	259 (28.0)	28.33
25-34	371 (31.8)	32.48	277 (29.9)	30.30
35-44	177 (15.2)	15.49	152 (16.4)	16.63
45-54	112 (9.6)	9.80	94 (10.1)	10.28
55-64	52 (4.4)	4.53	48 (5.2)	5.25
≥ 65	44 (3.8)	3.85	45 (4.8)	4.92
Missing or unknown	25 (2.1)	-	12 (1.3)	-
Marital status				
Married	373 (32.0)	37.41	287 (31.0)	37.27
Single	517 (44.3)	52.27	398 (43.0)	51.68
Divorce and widow	99 (8.5)	10.01	85 (9.2)	11.03
Missing or unknown	178 (15.2)	-	156 (16.8)	-

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Table 1. Continued from the previous page

Characteristics	Attempted suicide		Completed suicide	
	n (%)	Valid %	n (%)	Valid %
Residence				
Urban	496 (42.5)	50.00	361 (39.0)	47.06
Rural	496 (42.5)	50.00	406 (43.8)	52.94
Missing or unknown	175 (15.0)	-	159 (17.2)	-
Education				
Illiterate	65 (5.6)	6.93	63 (6.8)	8.52
Primary school	152 (13.0)	16.22	126 (13.6)	17.05
Middle school	267 (22.9)	28.49	207 (22.3)	28.01
High school	171 (14.6)	18.24	143 (15.4)	19.35
Diploma	196 (16.8)	20.91	125 (13.5)	16.91
Academic/University	86 (7.4)	9.17	75 (8.1)	10.14
Missing or unknown	230 (19.7)	-	187 (20.2)	-
Job				
Housewife	133 (11.4)	13.50	104 (11.2)	13.54
Student: School	120 (10.3)	12.18	98 (10.6)	12.76
Student: University	16 (1.4)	1.62	15 (1.6)	1.95
Governmental	15 (1.3)	1.52	11 (1.2)	1.43
Non-governmental	449 (38.5)	45.58	373 (40.3)	48.56
Soldier and military	6 (0.5)	0.60	4 (0.4)	0.52
Unemployment	166 (14.2)	16.85	109 (11.8)	14.19
Other	80 (6.8)	8.12	54 (5.8)	7.03
Unknown or missing	182 (15.6)	-	158 (17.1)	-
Cause of suicide				
Familial conflicts	151 (12.9)	45.61	81 (8.7)	50.62
Addiction	27 (2.3)	8.15	17 (1.8)	10.62
Economic problems	13 (1.1)	3.92	10 (1.1)	6.25
Falling in love or romance	5 (0.4)	1.51	3 (0.3)	1.87
Mental disorders	73 (6.2)	22.05	25 (2.7)	15.62
Unemployment	3 (0.2)	0.90	3 (0.3)	1.87
Mourning	5 (0.4)	1.51	1 (0.1)	0.62
Others	49 (4.2)	14.80	18 (1.9)	11.25
Rather not say	3 (0.2)	0.90	2 (0.2)	1.25
Unknown or missing	836 (71.6)	-	766 (82.7)	-
History of somatic disorder				
Yes	25 (2.1)	5.07	16 (1.7)	5.81
No	468 (40.1)	94.93	259 (28.0)	94.19
Missing or unknown	674 (57.8)	-	651 (70.3)	-
Suicide outcome				
Recovered	149 (12.8)	13.17	-	-
Hospitalized or under medication	56 (4.8)	4.95	-	-
Death	926 (79.3)	81.87	-	-
Unknown or missing	36 (3.1)	-	-	-

sex, and year of suicide attempts by hanging. To calculate the age standard, we used the 2013 standard population for low-income and middle-income countries [13]. The chi-square and chi-square goodness-of-fit tests were used to examine trends. We used the chi-square test to evaluate differences between qualitative variables and outcome (death or survival). Logistic regression was also used to identify predictors of death in individuals who suicide attempts by hanging. A *p*-value of ≤ 0.05 was considered to indicate statistical significance. Before performing the logistic regression analysis, we first performed univariate analysis and selected the variables that were significant at the 0.2 level. Data were analyzed using SPSS version 19.0 (IBM Corp., Armonk, NY, USA) and Excel 2007 (Microsoft Corp., Redmond, WA, USA).

Ethics Statement

In the FSSS, information is collected after obtaining informed consent from patients or from their parents or companions, almost 100% of whom agreed to have their information registered in the suicide registration system. After obtaining informed consent from these individuals to use their information for research purposes, the collected information was coded without registering their names. This study is in agreement with the Declaration of Helsinki and Iranian national guidelines for ethics in research. This study was approved by the Research Ethics Committee of Fars University of Medical Sciences (ethics code: IR.SUMS.REC 1395. S950).

RESULTS

During the study period, 1167 cases of suicide attempts by hanging occurred in Fars Province. The mean age of female and male cases was 32.75 ± 18 years and 33.29 ± 16.52 years, respectively. The mean age of both sexes combined was 33.21 ± 16.82 years. The majority of those who attempted suicide were male (80.5%), 44.3% were single, and 38.5% had non-governmental jobs. The highest rates of completed suicide by hanging were seen in the age groups of 25-34 years and 15-24 years (31.8% and 29.5%, respectively). According to the medical histories of the subjects, 2.1% of the cases ($n=25$) had somatic disorders, 12.9% ($n=151$) had a history of suicide, 1.5% ($n=17$) had a family history of suicide attempts, and 14.1% ($n=164$) had a psychological disorder (Table 1).

An analysis of the number of cases of attempted and completed suicide by hanging according to the months of the year

showed that most cases of attempted and completed suicide by hanging took place in June and September, respectively (Figure 1). The average age at the time of attempted and completed suicide by hanging during the study period was around 30 years, but in 2017, it was over 40 years.

The CFR was calculated at 79.66%, and the highest CFRs

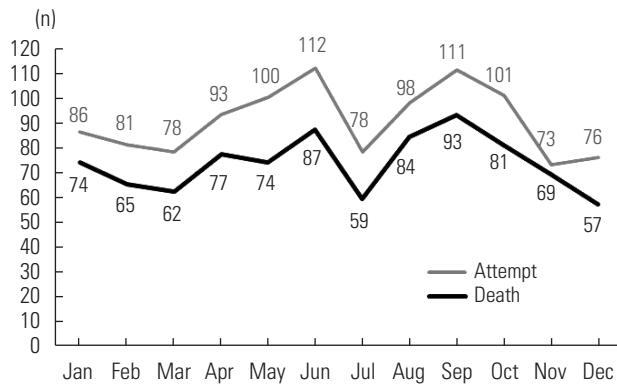


Figure 1. Number of attempted and completed suicides by hanging according to month in Fars Province, Iran during 2011-2019.

were observed in the age groups of less than 65 years and 55-64 years (95.34% and 94.11%, respectively).

The age-standardized incidence rates of suicide attempts by hanging from 2011 to 2019 were 0.72, 2.67, 3.46, 3.62, 3.86, 3.29, 2.68, 5.98, and 2.98 per 100 000 population, respectively. The adjusted rates of completed suicide by hanging were 0.30%, 2.50%, 2.99%, 3.09%, 3.24%, 3.76%, 1.89%, 4.82%, and 1.66% per 100 000 population, respectively. Table 2 presents the crude and standardized incidence rates of attempted and completed suicides and CFRs.

The results of the chi-square analysis showed statistically significant relationships between the outcome of attempted suicide and age group ($p=0.001$), male ($p=0.023$), place of residence ($p=0.020$), history of suicide attempts ($p<0.001$), psychological disorders ($p=0.001$), education level ($p<0.001$), and occupation ($p=0.001$) (Table 3).

The results of multiple logistic regression analysis showed that the likelihood of death in individuals who had a history of suicide attempts was 2.25 times higher than in individuals who did not have a history of suicide attempts (odds ratio [OR],

Table 2. Crude and age-standardized rates of attempted and completed suicide by hanging (per 100 000 people) and CFRs (%) in males and females in Fars Province, Iran from 2011 to 2019, according to age group and year

Variables	Hanging attempts rate			Hanging mortality rate ¹			CFR		
	Male	Female	All	Male	Female	All	Male	Female	All
Age (y)									
10-14	2.22	0.82	1.53	2.00	0.74	1.39	90.32	90.90	90.47
15-24	8.33	2.71	5.58	6.46	1.85	4.20	77.48	68.29	75.29
25-34	7.21	1.32	4.29	5.51	0.83	3.19	76.50	63.15	74.46
35-44	4.90	0.93	2.93	4.17	0.83	2.51	85.23	89.28	85.87
45-54	4.35	0.91	2.65	3.69	0.71	2.22	84.94	78.94	83.92
55-64	2.43	1.10	1.76	2.22	1.10	1.66	91.42	100.00	94.11
≥65	2.83	0.84	1.83	2.66	0.84	1.74	93.93	100.00	95.34
Total	5.50	1.36	3.50	4.42	1.02	2.79	80.71	75.33	79.34
Year	Crude	Age-standardized (95% CI)		Crude	Age-standardized (95% CI)		Crude	From standardized rates	
2011	0.81	0.72 (0.43, 1.02)		0.33	0.30 (0.12, 0.48)		41.37	41.23	
2012	2.79	2.67 (2.12, 3.22)		2.59	2.50 (1.98, 3.02)		93.00	93.64	
2013	3.65	3.46 (2.84, 4.09)		3.18	2.99 (2.43, 3.56)		87.12	86.41	
2014	3.81	3.62 (2.99, 4.25)		3.18	3.09 (2.51, 3.66)		83.45	85.36	
2015	4.05	3.86 (3.22, 4.51)		3.46	3.24 (2.65, 3.83)		82.55	83.94	
2016	4.39	3.29 (3.55, 4.89)		3.93	3.76 (3.13, 4.40)		89.57	87.65	
2017	3.10	2.68 (2.15, 3.20)		2.08	1.89 (1.44, 2.35)		68.10	70.52	
2018	5.81	5.98 (5.22, 6.75)		4.69	4.82 (4.07, 5.56)		80.82	80.60	
2019	3.13	2.98 (2.42, 3.53)		1.72	1.66 (1.23, 2.09)		55.08	55.70	
Average (9-y period)	3.50	3.25 (2.67, 3.83)		2.79	2.69 (2.06, 3.32)		79.34	76.11	
p-value	<0.001	0.257		<0.001	0.314		0.141	<0.001	

CFR, case-fatality rate; CI, confidence interval.

¹Direct standardization method and using the 2013 standard populations of low- and middle-income countries.

Table 3. The relationship between individuals' characteristics and hanging outcomes in Fars Province, Iran from 2011 to 2019

Variables	Class	Outcome		p-value
		Death	Survived	
Age (y)	10-14	38 (86.4)	6 (13.6)	0.001
	15-24	259 (78.7)	70 (21.3)	
	25-34	278 (77.0)	83 (23.0)	
	35-44	152 (86.4)	24 (13.6)	
	45-54	94 (85.5)	16 (14.5)	
	55-64	48 (94.1)	3 (5.9)	
	≥65	41 (97.6)	1 (2.4)	
Sex	Male	753 (82.9)	155 (17.1)	0.023
	Female	173 (77.9)	49 (22.1)	
Marital status	Single	398 (78.8)	107 (21.2)	0.607
	All statuses	372 (81.0)	87 (19.0)	
Residence	Rural	406 (83.4)	81 (16.6)	0.020
	Urban	361 (76.3)	112 (23.7)	
History of suicide attempts	No	639 (81.9)	141 (18.1)	<0.001
	Yes	94 (62.7)	56 (37.3)	
Psychological disorder	No	211 (64.1)	118 (35.9)	0.001
	Yes	75 (48.7)	79 (51.3)	
Education	Illiterate	63 (98.4)	1 (1.6)	<0.001
	No diploma	476 (82.6)	100 (17.4)	
	Diploma and higher	200 (73.0)	74 (27.0)	
Season	Spring	238 (78.0)	67 (22.0)	0.446
	Summer	236 (82.2)	51 (17.8)	
	Fall	207 (82.8)	43 (17.2)	
	Winter	201 (82.0)	44 (18.0)	
Occupation	Housewife	104 (80.0)	26 (20.0)	0.001
	Student	113 (85.0)	20 (15.0)	
	Governmental	11 (78.6)	3 (21.4)	
	Non-governmental	373 (85.0)	66 (15.0)	
	Unemployment	109 (68.6)	50 (31.4)	
	Other	55 (70.5)	23 (29.5)	

Values are presented as number (%).

2.28; 95% confidence interval [CI], 1.21 to 4.27). The likelihood of death in individuals with a psychological disorder was 1.85 times higher than those without a psychological disorder (OR, 1.85; 95% CI, 1.09 to 3.12) (Table 4).

DISCUSSION

The present study was conducted on 1167 subjects who attempted suicide by hanging to evaluate the trends in attempted suicide and related factors in Fars Province, southern Iran,

Table 4. Significant predictors of death in suicide attempts by hanging cases using multiple logistic regression

Predictor	OR (95% CI)	p-value
Age	1.00 (0.98, 1.03)	0.515
Sex		
Female	1.00 (reference)	
Male	2.28 (0.95, 5.46)	0.062
Residence		
Rural	1.00 (reference)	
Urban	1.15 (0.55, 1.44)	0.654
History of suicide attempts		
No	1.00 (reference)	
Yes ¹	2.28 (1.21, 4.27)	0.010
Psychological disorder		
No	1.00 (reference)	
Yes	1.85 (1.09, 3.12)	0.021
Education		
Illiterate	1.00 (reference)	
No diploma	0.99 (0.96, 1.05)	0.998
Diploma and higher	0.97 (0.95, 1.03)	0.980
Occupation		
Unemployment	1.00 (reference)	
Housewife	0.37 (0.10, 1.03)	0.058
Student	0.35 (0.14, 0.85)	0.021
Governmental	0.54 (0.10, 2.80)	0.474
Non-governmental	0.99 (0.98, 1.02)	0.980
Other	0.51 (0.27, 0.93)	0.030

OR, odds ratio; CI, confidence interval.

¹Attempt to suicide by any of the suicide methods such as overdose or self-immolation or suicide with a cold weapon or other suicide methods.

between 2011 and 2019. Suicide is a major public health problem influenced by several factors, such as economic status of the individuals and cultural and religious issues, which are in constant interaction with one another. One of the most common methods of attempted suicide worldwide is by hanging. As such, Akhlaghi et al. [14] reported that 22.1% of the attempted suicides were done by hanging. Also, 75.4% of all attempted suicides were done by hanging in Ilam city [15]. The likelihood of death and simplicity (the lack of need for special equipment and easy access to the necessary equipment), as well as the avoidance of a disturbing death scene are some of the factors associated with the increased favorability for suicide attempts by hanging [16,17].

The results of our study showed that the standardized incidence rate of this type of attempted suicide has increased from 0.72% per 100 000 people in 2011 to 2.98% per 100 000 peo-

ple in 2019, indicating an increasing trend in suicide attempts by hanging. The rate of suicide attempts by hanging was shown to be increasing in several previous studies conducted in various parts of the world [18-25]. This elevated rate of suicide attempts by hanging can be attributed to various factors, including economic crises, financial problems, increased stress levels, high prevalence of psychological disorders, increased use of psychotropic substances, unemployment, and lifestyle changes.

We estimated the fatality rate of hanging at 80%, and the standardized mortality rate due to suicide attempts by hanging was shown to increase from 0.30% in 2011 to 1.66% in 2019, which was consistent with the increased incidence rate for this type of attempted suicide [26]. It should be noted that in our study, though the rates of attempted and completed suicide by hanging were significantly higher in 2019 than in 2011, it was remarkably lower than the years preceding 2011, which could be due to inaccurate registration of attempted suicide cases. Thus, these statistics should be investigated more precisely to investigate this decrease.

In the present study, the mean age of individuals was 33 years, which was consistent with the results of other studies (e.g., 31.4 years [16], 37 years [25], and 33.4 years [27]). The highest rates of attempted and completed suicide by hanging were observed in individuals aged 15-24 years and 25-34 years, respectively. These results were consistent with the results of studies conducted in Mexico [20] and Poland [28]. Additionally, the highest rates of attempted and completed suicide by hanging were found among individuals aged 15-19 years in India [29] and 20-29 years in Saudi Arabia [17], South Africa [25], and Ghana [19]. As a consequence, the highest rate of suicide attempts by hanging is seen in young adults, which might be because these individuals often face a wide range of family, economic, and social problems. It has been shown that young adults with low economic and social status, limited educational progress, and low income have higher rates of attempted suicide. Marital disputes, history of sexual abuse in childhood, and psychological disorders are additional factors that influence the suicide rate among these individuals [30].

Consumption of substances and communication with inappropriate friends usually lead to family problems and strict supervision by parents, which may eventually lead to suicide attempts in these individuals. Young adults are also likely to experience financial problems, failure to achieve their goals, marital problems, lack of family support, and unemployment, which can lead to psychological problems in these individuals and

even suicide attempts.

Although we observed the highest attempted suicide rate in people aged 15-24 years, the highest rate of mortality was observed in individuals aged 65 years or more, which might have been due to the presence of chronic diseases and weaker physical strength of these individuals.

According to the results of this study, the rate of suicide attempts by hanging was significantly higher in males than in females, which was in line with the results of many studies [19,28,31,32]. Compared to females, males are in more dangerous situations in society and are pressured by family issues, and the inability to provide for the needs of the family due to financial problems increases the risk of psychedelics and illicit drug use in males, which can lead to a higher rate of attempted suicide in these individuals.

In 70% of cases, the main cause of the suicide attempt was unknown due to the high rate of death of these individuals and the family's unawareness of the cause of the suicide attempt; however, in another 30% of cases, family conflicts were the leading cause of suicide. Our result was in accordance with the results of studies conducted in Saudi Arabia and India [16,27]. Various factors, such as substance abuse, economic and employment issues, and moral problems can cause family problems. Thus, further research should be done to find the underlying causes of these problems in order to reduce them.

The results of this study showed that individuals with a previous history of suicide attempts had a 2.2 times greater mortality rate than the average. Monsef Kasmaee et al. [16] also showed that 11.9% of those who attempted suicide by hanging had a previous history of committing suicide.

In our study, the mortality rate of suicide by hanging was 1.85 times higher among individuals with psychological disorders. Accordingly, 14.1% of the subjects had psychological disorders. Värnik et al. [33] reported that 20% of their subjects had psychological disorders while Santos et al. [34] found that 80-100% of attempted suicide cases had psychological disorders. Given the prevalence of psychological disorders was reported as 16.1% in Iran and the higher frequency among males and unemployed persons [35], individuals with psychological disorders must be effectively identified and provided with appropriate treatment and counseling.

Some of the strengths of the present study include its large sample size, the relatively long study period, and the evaluation of trends in suicide attempts by hanging. This was also the first study on suicide by hanging in Iran. One of the limita-

tions of our study was the presence of missing data for some study variables.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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AUTHOR CONTRIBUTIONS

Conceptualization: Mirahmadizadeh A, Azarbaksh H. Data curation: Azarbaksh H, Moftakhar L. Formal analysis: Azarbaksh H, Rezaei F, Moftakhar L. Funding acquisition: None. Methodology: Mirahmadizadeh A, Azarbaksh H. Project administration: Azarbaksh H, Amiri S. Visualization: Rezaei F. Writing – original draft: Moftakhar L, Amiri S. Writing – review & editing: Moftakhar L, Mirahmadizadeh A, Amiri S, Rezaei F, Azarbaksh H.

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