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Exploration of the Prevalence and Profile of Suicide Cases in the Population of Northern Morocco (2017-2022)

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Abstract:

Background:

Suicide, a complex phenomenon that constitutes a major public health issue, has been increasingly prevalent in the Moroccan context. Against this backdrop, this study examines the prevalence and profile characteristics of suicide cases in the northern region of Morocco.

Methods:

Employing a retrospective research design, we analyzed data from the forensic unit service in three provinces over six years, yielding a sample of 480 suicide cases. Data were subjected to statistical analysis using the SPSS software version 23, involving the bilateral Pearson Chi-square and independent t-tests.

Results:

Our findings reveal that suicide predominantly affects men (75%), who are typically unmarried (56%), residing in rural areas (75%), and having low levels of formal education (84%), with a majority being unemployed (57%). Hanging was the predominant method used to commit suicide (93%). Additionally, while psychiatric disorders had been diagnosed in 42% of cases, only 29% were receiving psychiatric care. Notably, suicide rates displayed an unexpected seasonal variation, peaking during the spring season and reaching their maximum in June.

Conclusion:

In conclusion, our study underscores the relevance of young and adult males from rural areas who are single, lacking education, unemployed, and not receiving medical care as the most vulnerable population segment regarding suicide. Further multidimensional research encompassing psychological, social, cultural, and economic factors could advance the formulation and implementation of effective suicide prevention policies.

Keywords: Suicide, Prevalence, Characterization, Morocco, Public health, Risk factors.

1. INTRODUCTION

Suicide is the leading cause of violent death [1], as defined by the World Health Organization (WHO). It is considered a public health priority due to the alarming increase in suicide cases and suicide attempts, which have risen by 60% over the past 45 years [2]. Suicide accounts for 1.4% of all deaths worldwide, representing more than 700,000 deaths yearly (equivalent to one suicide every four seconds), surpassing the annual number of deaths resulting from wars and homicides combined, and ranking as the fifteenth leading cause of mortality globally. It is among the top three leading causes of death among individuals aged 15 to 44 years and the second leading cause among young people aged 10 to 24 years in some countries. The WHO estimates that deaths by suicide could

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reach 1,007,000 per year by 2030 [3]. The idea that the suicide rate is higher in high-income countries than in low- and middle-income countries (LMICs) has been refuted, especially given that LMICs account for 75% of suicide cases [3]. The standardized suicide rate projected by the WHO for 2019 was 11.2 per 100,000 in African regions, 10.5 per 100,000 in Europe, and 10.2 per 100,000 in Southeast Asia, all of which exceed the global average of 9.0 per 100,000 [4]. However, the rate was recorded at 6.4 per 100,000 in the Eastern Mediterranean region. These alarming figures demonstrate the urgent need to address this escalating behavior according to the recommendations of the WHO and UN *via* the Global Mental Health Action Plan and the third Sustainable Development Goal [5].

The situation in Morocco is similarly grave, with a rate of 7.2 per 100,000 inhabitants recorded in 2019, exceeding that of other Maghreb countries, including Algeria, Tunisia, Egypt, Mauritania, and Libya, with rates ranging between 2.5 and 4.5 per 100,000 inhabitants [4]. The northern Moroccan region of Tangier Tetouan Al Hoceima is among the most affected by this phenomenon. In fact, Morocco does not possess a centralized national register of suicide [6] apart from the archives of the regional Medico-legal Units. Attempts and cases of suicide are declared through different media outlets. Therefore, the minister in charge of health and social protection refers in this matter to the figures published by the WHO [6]. Studies shedding light on suicide attempt trends are abundant [7 - 12]compared to those dedicated to completed suicide cases. The study by Mahir *et al.* showed that 1130 cases of suicide by self-poisoning were reported between 1981 and 2007 [13], which tragically and enduringly affects the economic, emotional, and social well-being of the bereaved population [14], regardless of their age, religion, ethnicity, gender, income levels, and regions. Despite the complexity of suicide, studies suggest it may be preventable [15, 16]. Thus, this study aims to determine the prevalence of suicide cases in Northern Morocco and investigate the demographic profile, encompassing age, gender, and socioeconomic status of individuals who die by suicide, in an attempt to enhance academic comprehension of suicide epidemiology in the region, and raise awareness of the problem's magnitude.

2. METHODS

2.1. Aims

This study aims to determine the prevalence of suicide cases and investigate the demographic profile, including age, gender, and socioeconomic status, of individuals who die by suicide. By achieving these objectives, the study intends to contribute to the academic understanding of suicide epidemiology in Northern Morocco. The study also seeks to shed light on the magnitude of the issue and generate knowledge that can inform targeted interventions and strategies to effectively address the growing concern of suicide in the region.

2.2. Data Collection and Management

Data collection was conducted in three provinces: Chefchaouen, Tetouan, and Ouezzane, after obtaining authorization from the competent authority represented by the director of the region concerned by the study and the favorable opinion of the biomedical research ethics committee seated at the Faculty of Medicine and Pharmacy of Rabat (N: 13/23). At the level of the forensic medical units, all files of non-natural deaths that specifically involved cases of suicide were exhaustively consulted (n=480, with 10 files referred to Tangier; 6 referred to Rabat and 4 incomplete files), of which 460 were complete and met the inclusion criteria of the current study: a) a file concerning a completed suicide; b) the suicide occurred in the region of Tangier-Tetouan-El Hoceima; c) the file contained all necessary and useful data for the study.

The extracted data were divided into three categories according to the consulted documentation: registers of information related to deaths (name, age, address, gender, and date of suicide), autopsy reports written by a forensic physician (suicide method), and reports edited by the judicial police (circumstances of suicide). Data collection covered the period from January 1, 2017, until December 30, 2022, approximately six years (Fig. **1**).

2.3. Statistical Methods

Data collection was performed using a pre-established, tested, and validated grid encompassing all variables studied in this paper. Data analysis was performed through SPSS version 23 software, using the Pearson chi-square statistical test and the independent bilateral t-test, and a p-value < 0.05 was considered significant.

3. RESULTS

Table **1** demonstrates that individuals under 20 years of age account for 15%, while those aged between 21 and 30 and between 41 and 60 account for a quarter of the sample each. Suicide affects men more than women, with three-quarters (3/4) in our sample being male. and half of the suicide cases were single (56%). The cases that resided in rural areas were the most affected by suicide. Accounting for three quarters (75%). The distribution of suicide cases does not differ significantly across the three provinces where the data was collected. Most people who committed suicide in these provinces had never received any formal education, with a percentage of 84%. Joblessness significantly contributes to the increase in the suicide rate. With over half of the cases (57%) being unemployed. The preferred method of suicide is hanging. Accounting for 93% of the cases (Table **1**).

Moreover, with regard to the mental health status of the individuals who committed suicide, only one-third (29%) were receiving psychiatric care at the time of their death. Those with confirmed diagnoses of psychiatric disorders accounted for 42% of the population (Table **1**). Fig. (**2**) explains the distribution of the number of suicide cases according to:

The data is depicted in Fig. (**2A**) indicates an inverse relationship between the number of suicide cases and the number of children. In other words, the incidence of suicide tends to decrease as the number of children in a family increases. Fig. (**2B**) shows that the suicide rate is higher during the spring season compared to other seasons. The curve displayed in Fig. (**2C**) reflects that the cumulative number of suicide cases reached its peak in June.
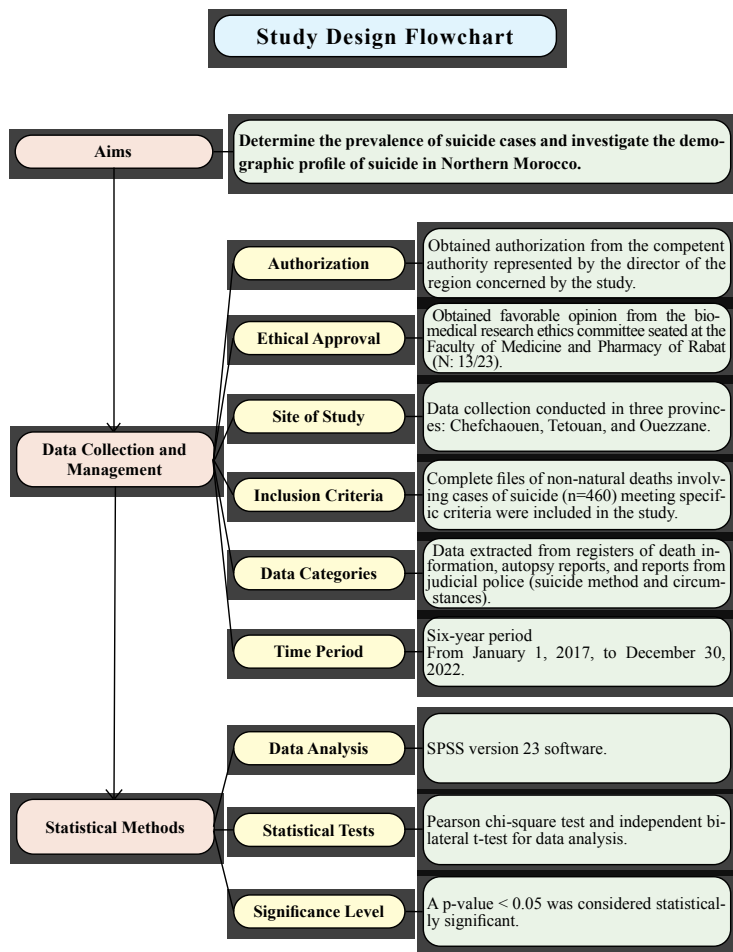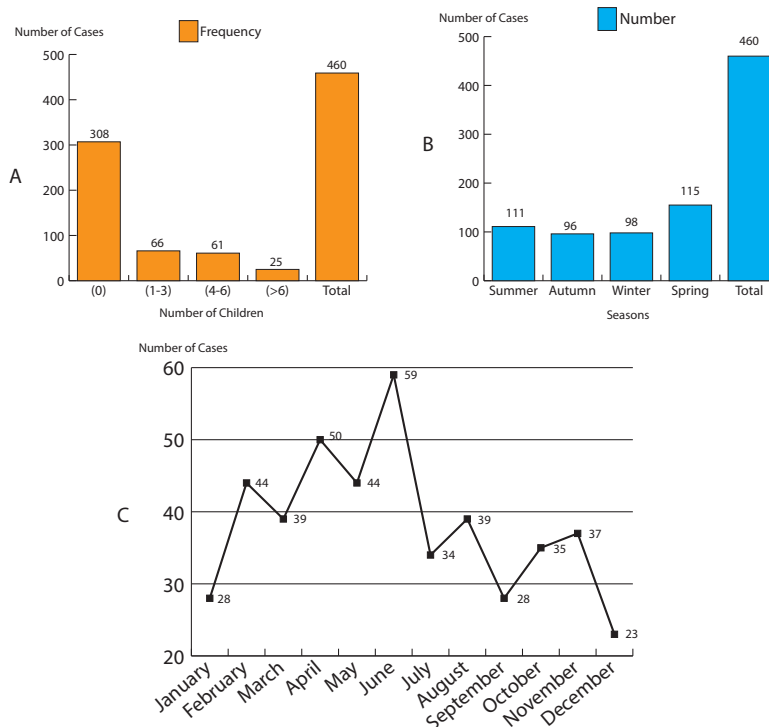
Fig. (1). Study design flow chart.

Fig. (2). The prevalence of suicide cases as per (**A**), the number of children; (**B**), the seasons; and (**C**), the months. Sample size N=460.

Table 1. Characteristics of the study population.

Variables	Classes				
Gender	**Female**		**Male**		
	130 (28%)		**330 (71.7%)**		
Age (years)	0 – 20	21 – 30	31 – 40	41 – 60	> 60
	69 (15%)	130 (28.2%)	69 (17.6%)	124 (27%)	56 (12.2%)
Family situation	Single	Divorce	Married		Without
	258 (56.1%)	17 (3.7%)	172 (37.4%)		13 (2.8%)
Environment	Rural		Urban		
	347 (75.4%)		113 (24.6%)		
Study level	Illiterate	Primary	Secondary		University
	388 (84.3%)	24 (5.2%)	39 (8.5%)		9 (2%)
Profession	Farmer	Student	Daily	Without	Other
	54 (12%)	44 (9.6%)	59 (12.8%)	262 (57%)	41 (8.9%)
Province	Chefchaouen		Ouezzane		Tetouan
	172 (37.4%)		118 (25.7%)		170 (37%)
Method of suicide	Intoxication		Hanging		Other
	26 (5.7%)		429 (93.3%)		5 (1%)
Psychiatric disorder	No		Yes		
	269 (58.5%)		191 (41.5%)		
Follow up	No		Yes		
	327 (71.1%)		133 (28.9%)		

Table 2. Effect of environment on the studied variables.

-		Environment		Total	*p*-value
		Rural	**Urban**		
		N(%)	**N(%)**		
Marital status	Single	186 (53.6%)	72 (63.7%)	258	0.212
	Divorced	12 (3.5%)	5 (4.4%)	17	
	Married	138 (39.8%)	34 (30.1%)	172	
	Widowed	11 (3.2%)	2 (1.8%)	13	
Gender	Feminine	107 (30.8%)	22 (19.5%)	129	0.019
	Masculine	240 (69.2%)	91 (8.5%)	331	
Follow-up	No	258 (74.4%)	69 (61.1%)	327	0.007
	Yes	89 (25.6%)	44 (38.9%)	133	
Psychiatric disorder	No	216 (62.2%)	53 (46.9%)	269	0.004
	Yes	131 (37.8%)	60 (53.1%)	191	
Provinces	Chefchaouen	166 (47.8%)	6 (5.3%)	172	0
	Ouezzane	105 (30.3%)	13 (11.5%)	118	
	Tetouan	76 (21.9%)	94 (83.2%)	170	
Number of children	1 (0)	225 (65.0%)	82 (72.6%)	307	0.132
	2 (1-3)	48 (13.9%)	18 (15.9%)	66	
	3 (4-6)	53 (15.3%)	8 (7.1%)	61	
	4 (>=7)	20 (5.8%)	5 (4.4%)	25	
Age (years)	0-20	62 (17.9%)	7 (6.2%)	69	0.043
	21-30	95 (27.4%)	35 (31.0%)	130	
	31-40	57 (16.4%)	24 (21.2%)	81	
	41-60	90 (25.9%)	34 (30.1%)	124	
	>60	43 (12.4%)	13 (11.5%)	56	
Occupation	Farmer	54 (15.6%)	0 (0%)	54	0
	Without	193 (55.6%)	69 (61.1%)	262	
	Student	41 (11.8%)	3 (2.7%)	44	
	Other	18 (5.2%)	23 (20.4%)	41	

(Table 2) contd.....

-		Environment		Total	*p*-value
		Rural	**Urban**		
		N(%)	**N(%)**		
Method of suicide	Hanging	324 (93.4%)	105 (92.9%)	429	0.98
	Intoxication	17 (4.9%)	6 (5.3%)	23	
	Other	6 (1.7%)	2 (1.8%)	8	

Table 3. Effect of gender on the studied variables.

-		Gender		Total	*p*-value
		Feminine N (%)	**Masculine N (%)**		
Marital status	Single	64 (49.6%)	194 (58.6%)	258	0.00003
	Divorced	3 (2.3%)	14 (4.2%)	17	
	Married	51 (39.5%)	121 (36.6%)	172	
	Widowed	11 (8.5%)	2 (0.6%)	13	
Study level	Illiterate	105 (81.4%)	283 (85.5%)	388	0.442
	Primary	6 (4.7%)	18 (5.4%)	24	
	Secondary	14 (10.9%)	25 (7.6%)	39	
	University	4 (3.1%)	5 (1.5%)	9	
Environment	Rural	107 (82.9%)	240 (72.5%)	347	0.0194
	Urban	22 (17.1%)	91 (27.5%)	113	
Psychiatric disorder detected	No	88 (68.2%)	181 (54.7%)	269	0.0081
	Yes	41 (31.8%)	150 (45.3%)	191	
Age	0-20	32 (24.8%)	37 (11.2%)	69	0.0069
	21-30	30 (23.3%)	100 (30.2%)	130	
	31-40	19 (14.7%)	62 (18.7%)	81	
	41-60	33 (25.6%)	91 (27.5%)	124	
	>60	15 (11.6%)	41 (12.4%)	56	
Province	Chefchaouen	57 (44.2%)	115 (34.7%)	172	0.023
	Ouezzane	37 (28.7%)	81 (24.5%)	118	
	Tetouan	35 (27.1%)	135 (40.8%)	170	
Number of children	1 (0)	78 (60.5%)	229 (69.4%)	307	0.047
	2 (1-3)	25 (19.4%)	41 (12.4%)	66	
	3 (4-6)	22 (17.1%)	39 (11.8%)	61	
	4 (>7)	4 (3.1%)	21 (6.4%)	25	
Follow-up	No	98 (76.0%)	229 (69.2%)	327	0.149
	Yes	31 (24.0%)	102 (30.8%)	133	
Number of yearly cases	2017	24 (18.6%)	54 (16.3%)	78	0.503
	2018	25 (19.4%)	49 (14.8%)	74	
	2019	24 (18.6%)	50 (15.1%)	74	
	2020	18 (14.0%)	65 (19.6%)	83	
	2021	23 (17.8%)	60 (18.1%)	83	
	2022	15 (11.6%)	52 (15.7%)	67	

In this study, we investigated the effect of the residential environment of individuals who died by suicide on other studied variables. Significant associations were found between the residential environment and gender (p=0.01), age (p=0.04), province (p=0.00), presence of psychiatric disorder (p=0.004), psychiatric follow-up (p=0.007), and employment status (p=0.00). However, marital status, number of children, and method of suicide were not found to relate to the residential environment of those who died by suicide (Table **2**).

Based on the results presented in Table **3**, it appears that gender may be significantly associated with the marital status of individuals who have committed suicide (p=0.00), as well as their place of residence and province (p<0.05), age (p=0.006), and the presence of diagnosed psychiatric disorders (p=0.008). However, no significant associations were found between gender, level of education, and psychiatric follow-up (p>0.05).

In this study, we examined the impact of the presence of psychiatric disorders among individuals who died by suicide on the studied variables. Significant associations were found between age (p=0.00), gender (p=0.009), province (p=0.00),

level of education (p=0.001), rural environment (p=0.004), and occupation (p=0.00). However, no significant relationships were found between the presence of psychiatric disorders and marital status, number of children or method of suicide (Table 4).

Table 4. The cross-tabulation of the psychiatric disorder variable with other variables.

-	-	Psychiatric Disorder			
-	Variables	Yes	No	Total	*p*-value
Gender	Feminine	41 (8.9%)	88 (19.1%)	129 (28.0%)	0.09
	masculine	150 (32.6%)	181 (39.3%)	331 (72.0%)	
Marital status	Single	109 (23.7%)	149 (32.4%)	258 (56.1%)	0.445
	Divorced	10 (2.2%)	7 (1.5%)	17 (3.7%)	
	Married	67 (14.6%)	105 (22.8%)	172 (37.4%)	
	Widowed	5 (1.1%)	8 (1.7%)	13 (2.8%)	
Province	Chefchaouen	47 (10.2%)	125 (27.2%)	172 (37.4%)	0
	Ouezzane	67 (14.6%)	51 (11.1%)	118 (25.7%)	
	Tetouan	77 (16.7%)	93 (20.2%)	170 (37.0%)	
Number of children	0	133 (29.0%)	174 (37.9%)	307 (66.9%)	0.511
	1-3	24 (5.2%)	42 (9.2%)	66 (14.4%)	
	4-6	22 (4.8%)	39 (8.5%)	61 (13.3%)	
	≥7	12 (2.6%)	13 (2.8%)	25 (5.4%)	
Age (years)	0-20	9 (2.0%)	60 (13.0%)	69 (15.0%)	0
	21-30	65 (14.1%)	65 (14.1%)	130 (28.3%)	
	31-40	35 (7.6%)	46 (10.0%)	81 (17.6%)	
	41-60	54 (11.7%)	70 (15.2%)	124 (27.0%)	
	>60	28 (6.1%)	28 (6.1%)	56 (12.2%)	
Occupation	Farmer	20 (4.3%)	34 (7.4%)	54 (11.7%)	0
	Student	3 (0.7%)	41 (8.9%)	44 (9.6%)	
	Worker	30 (6.5%)	29 (6.3%)	59 (12.8%)	
	Without	123 (26.7%)	139 (30.2%)	262 (57.0%)	
	Other	15 (3.3%)	26 (5.7%)	41 (8.9%)	
Method of suicide	Intoxication	5 (1.1%)	18 (3.9%)	23 (5.0%)	0.073
	Hanging	181 (39.3%)	248 (53.9%)	429 (93.3%)	
	Other	5 (1.1%)	3 (0.7%)	8 (1.7%)	
Environment	Rural	131 (28.5%)	216 (47.0%)	347 (75.4%)	0.004
	Urban	60 (13.0%)	53 (11.5%)	113 (24.6%)	
Season	Autumn	39 (8.5%)	57 (12.4%)	96 (20.9%)	0.474
	Summer	43 (9.3%)	68 (14.8)	111 (24.1%)	
	Winter	37 (8.0%)	61 (13.3%)	98 (21.3%)	
	Spring	72 (15.7%)	83 (18.0%)	155 (33.7%)	
Study level	Illiterate	175 (38.0%)	213 (46.3%)	388 (84.3%)	0.001
	Primary	7 (1.5%)	17 (3.7%)	24 (5.2%)	
	Secondary	5 (1.1%)	34 (7.4%)	39 (8.5%)	
	University	4 (0.9%)	5 (1.1%)	9 (2.0%)	

Table 5. The cross-tabulation of the "follow-up" variable with the other variables.

-	Variables	Follow-up		-	-
-		Yes	No	Total	*p*-value
Gender	Feminine	31 (6.7%)	98 (21.3%)	129 (28.0%)	0.149
	Masculine	102 (22.2%)	229 (49.8%)	331 (72.0%)	
Marital status	Single	76 (16.5%)	182 (39.6%)	258 (56.1%)	0.719
	Divorced	6 (1.3%)	11 (2.4%)	17 (3.7%)	
	Married	46 (10.0%)	126 (27.4%)	172 (37.4%)	
	Widowed	5 (1.1%)	8 (1.7%)	13 (2.8%)	

(Table 5) contd.....

| - | Variables | Follow-up | | - | - |
		Yes	No	Total	*p*-value
Province	Chefchaouen	37 (8.0%)	135 (29.3%)	172 (37.4%)	0.023
	Ouezzane	41 (8.9%)	77 (16.7%)	118 (25.7%)	
	Tetouan	55 (12.0%)	115 (25.0%)	170 (37.0%)	
Number of children	0	90 (19.6%)	217 (47.3%)	307 (66.9%)	0.950
	1-3	19 (4.1%)	47 (10.2%)	66 (14.4%)	
	4-6	16 (3.5%)	45 (9.8%)	61 (13.3%)	
	>=7	8 (1.7%)	17 (3.7%)	25 (5.4%)	
Age (years)	0-20	4 (0.9%)	65 (14.1%)	69 (15.0%)	0.000
	21-30	43 (9.3%)	87 (18.9%)	130 (28.3%)	
	31-40	29 (6.3%)	52 (11.3%)	81 (17.6%)	
	41-60	41 (8.9%)	83 (18.0%)	124 (27.0%)	
	>60	16 (3.5%)	40 (8.7%)	56 (12.2%)	
Occupation	Farmer	10 (2.2%)	44 (9.6%)	54 (11.7%)	0.000
	Other	11 (2.4%)	30 (6.5%)	41 (8.9%)	
	Student	2 (0.4%)	42 (9.1%)	44 (9.6%)	
	Worker	15 (3.3%)	44 (9.6%)	59 (12.8%)	
	Without	95 (20.7%)	167 (36.3%)	262 (57.0%)	
Method of suicide	Other	4 (0.9%)	4 (0.9%)	8 (1.7%)	0.101
	Intoxication	3 (0.7%)	20 (4.3%)	23 (5.0%)	
	Hanging	126 (27.4%)	303 (65.9%)	429 (93.3%)	
Environment	Rural	89 (19.3%)	258 (56.1%)	347 (75.4%)	0.007
	Urban	44 (9.6%)	69 (15.0%)	113 (24.6%)	
Seasons	Autumn	33 (7.2%)	63 (13.7%)	96 (20.9%)	0.085
	Summer	25 (5.4%)	86 (18.7%)	111 (24.1%)	
	Winter	23 (5.0%)	75 (16.3%)	98 (21.3%)	
	Spring	52 (11.3%)	103 (22.4%)	155 (33.7%)	
Study level	Illiterate	123 (26.7%)	265 (57.6%)	388 (84.3%)	0.010
	Primary	3 (0.7%)	21 (4.6%)	24 (5.2%)	
	Secondary	4 (0.9%)	35 (7.6%)	39 (8.5%)	
	University	3 (0.7%)	6 (1.3%)	9 (2.0%)	

The results presented in Table **5** show that psychiatric follow-up may be significantly related to the occupation of individuals who have committed suicide (p=0.00), as well as to the region and province of their residence (p<0.05), their age (p=0.00), and study level (p=0.01). However, no significant association was found between gender, marital status, and method of suicide.

4. DISCUSSION

Globally, suicide affects all age groups, with nearly 75% of suicides occurring in third-world countries or developing countries. The rates of suicide are higher among individuals aged 70 years or older; however, some countries reported that youngsters are more affected [17].

Improved identification of risk factors and protective measures is essential to prevent suicide and suicidal behavior [18].

Thus, the issue of suicide attracts the attention of both government authorities, non-governmental organizations, and the public due to its severity and magnitude on individuals and society, consequently, a significant influence on sustainable development, which one of its objectives is to quickly reduce the global suicide rate [19].

Furthermore, several studies have attempted to describe the epidemiological profile and determine the factors involved in suicide attempts [7 - 12], but few have invested in understanding suicide itself [13].

Therefore, suicide, which cannot be exclusively attributed to mental health problems, is undoubtedly influenced by a series of biological, psychological, and social factors [20]. The results of this study show that the age group between 21-30 and the age group between 41-60 represent each quarter (28%; 27% respectively), and that the suicide rate in the age group up to 40 years is 61% which remains high. This is consistent with the results of Barrimi *et al*. who found a percentage of 75% for the same age group [21]. In their study, Na *et al*. refuted the hypothesis that older individuals develop attitudes towards suicide. Our sample supports this finding, revealing a rate of only 12% among suicide victims over 60 years old [22].

Regarding gender, suicide affects men (75%) more than women (25%), which is consistent with the findings of the 5th report of the National Suicide Observatory where the number of suicides is higher among men (n=6.278) than among women (n=2.088) with a ratio of 3/1. The age-adjusted death rate is 3.5 times higher among men, which promotes the idea that age differences between these two subpopulations do not explain

this gap between the two genders [23]. Similarly, according to Freeman, this behavior tends to lean towards the male side in the European Union [11]. Another Ecuadorian study calculated standardized global suicide rates by age from 2001 to 2014 for all age groups and found that it was 7.1 per 100,000 and that men were three times more likely to die by suicide than women, an idea supported by several studies [15, 24 - 27].

In relation to the marital status of the cases studied in this research, 56% were single and 37% were married. A study found that most suicide deaths were single (64.2%), followed by married (18.6%) and divorced individuals (14.2%) [28]. Our results are almost identical to those published in the study conducted by Agoub *et al.* (2006) on 400 men and 400 women, where they found that singles accounted for 58% of the population, while 35.3% of them were married [29], as well as those of Ortiz-Prado, Besnier *et al.* [16, 18].

Furthermore, three-quarters of the suicides (75%) reported in this study resided in rural areas. This evidence contradicts the findings of Troya *et al.* who found higher suicide rates in urban regions, for both men and women [30]. However, according to Li and Cao, these rates have been increasing in rural areas, particularly where there is a low level of education in China, before 2000 [31]. Additionally, Hu found a rate of 23.6% in the same regions among elderly individuals living alone [32]. Our results suggest that suicide is a behavior that remains predominantly rural in the Moroccan context.

Similarly, we investigated the possible effect of rural dwelling and its association with other factors. In fact, a significant association was found with gender, age, province, presence of psychiatric disorders, psychiatric follow-up, and employment status. The latter contributed significantly and predominantly (57%) to the increase in suicide cases in our study. This unemployment rate exceeds twice the rate calculated in a previous study conducted in a Moroccan metropolitan area (24.1%) [29, 32]. In another study conducted at Hassan II University Hospital Center in Fez, 65% of patients were unemployed [21]. Additionally, a 2.5% increase in suicide mortality rate is observed for every 10% increase in the unemployment rate [33 - 36]. The forestry and agricultural sectors are also associated with an increased risk of suicide mortality in men [37].

It is evident from our results that illiteracy is an undeniable determinant in the use of suicidal behaviors (84%). Attachment to school protects against suicidal thoughts and attempts, but prevention efforts in schools appear to have no manifest effect on suicide rates [38]. In the same vein, men, and those with a low level of education are more susceptible to suicide [30, 39].

Also, among the entire study population (n=460), only 42% were diagnosed with a psychiatric disorder, and two-thirds (71%) of suicide cases did not receive any psychiatric support. Current evidence shows that mental illnesses, such as depression, constitute a significant risk factor for suicide. A study asserted that over 80% of individuals who died by suicide suffered from a mental illness or psychiatric disorder, with more than 90% of young people experiencing addiction-related disorders [38]. In another study conducted in South Korea, authors estimated that 87% of suicidal individuals had a mental health problem prior to their death, but only 15.2% received treatment or counseling [14]. Suicide is frequently used as an indicator of a population's mental health [20]. Similarly, studies support that suicide rates are closely linked to the presence of mental disorders, regardless of their nature, with a significant percentage related to substance use problems, personality, affective and depressive disorders. and especially geographical factors [32, 40 - 43].

Additionally, our results indicate that hanging is the most common suicide method (93%). This corroborates with other studies on the same topic [16, 24, 30], but different from other contexts where jumping from height remains the most common method [44].

During the analysis of the results of the present study, we were struck by the fact that the number of suicide cases increases during spring, particularly in June, and that there is a correlation between the increase in the number of children and the reduction in the suicide rate. Conversely, in another study conducted by Soumah *et al*, it is noteworthy that the frequency of suicide cases focuses on peri-urban areas where suicides are committed during the cold season, particularly during the first three months of each year [24].This goes in line with the study carried out by Zakharof *et al.* [45].

However, the current study has some limitations: First, the availability of data from only the forensic unit service in three provinces. It may not represent the broader population or consider cases that did not come under forensic investigation. Second, other variables such as the socio-economic situation, need to be explored to better describe the epidemiology of suicide in the studied provinces. Third, the lack of financial support to conduct an exploratory epidemiological investigation among the families of suicide victims was also a hurdle. Fourth, due to the transfer of some suicide cases from the northern region to Rabat for further judicial investigation, some case records were not explored. Fifth, the unavailability of a psychological autopsy limits a deeper understanding of the underlying psychological factors behind suicide. Lastly, there is likely an underestimation of suicidal behavior due to the taboo still surrounding it in many cultures, including Morocco. It is quite common for some suicides to be classified as domestic accidents or other types of mishaps.

CONCLUSION

This study represents a pioneering effort in the investigation of suicide in the northern region of Morocco and potentially the entire country. It sheds light on the prevalence and demographic profile characterization of individuals dying by suicide, encompassing a wide array of variables. Our findings indicate that the incidence of suicide is primarily concentrated among young and adult males who are unmarried, living in rural areas, lacking education, employment, and medical care, with hanging being the most common method employed. Nonetheless, our results also suggest that marriage and parenthood may have a mitigating effect on suicidal behaviors.

Although Morocco has a high rate of suicide cases, no official interventions have been undertaken yet. Recently, Morocco intends to adopt a national suicide prevention strategy

for the 2023-2030 period, but details are still undisclosed. Indeed, the results of the current study may provide useful insights for future interventions.

Further multidimensional investigations, incorporating additional variables and larger sample sizes, are highly warranted.

AUTHORS' CONTRIBUTIONS

All authors contributed significantly to the conception, study design, execution, acquisition of data, analysis, and interpretation of this work or in all these areas. AE and HK contributed to conceptualization. AE contributed to data collection. AE and HG contributed to data analysis and drafted the initial manuscript. ME. YE and HK contributed to the revision of the manuscript. HK supervised the study. All authors edited and approved the final version of the manuscript.

LIST OF ABBREVIATIONS

LMICs	=	Low- and middle-income countries
SPSS	=	Statistical Package for the Social Sciences
WHO	=	World Health Organization

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was conducted in accordance with ethical principles and regulatory requirements. Prior to data collection, appropriate ethical clearance was obtained, including authorization from the relevant officials in the study regional directory of health (authorization number 2920/21) and a favourable opinion from the ethics committee for biomedical research at the Faculty of Medicine and Pharmacy, Mohammed V University of Rabat (approval number N: 13/23).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Consent for publication was obtained from all participants' next of kin, and identities have been protected in accordance with ethical guidelines.

AVAILABILITY OF DATA AND MATERIALS

The data collection procedure was initiated by the authors themselves who, in the medical forensic unit, classified death cases and focused on suicide deaths. Data and materials used in this study are available upon request from the corresponding author. The dataset analyzed during the current study is not publicly available due to privacy and ethical restrictions, but de-identified data may be made available from the corresponding author upon reasonable request and with appropriate institutional approvals.

STANDARDS OF REPORTING

STROBE guidelines were followed.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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REFERENCES

[1] Kuehn B. Suicide: The Leading Cause of Violent Death. JAMA 2018; 319(10): 973.
[http://dx.doi.org/10.1001/jama.2018.1699] [PMID: 29536105]

[2] Pridmore S, Auchincloss S. Book reviews: Preventing suicide: a global imperative. Australas Psychiatry 2015; 23(1): 81-2.
[http://dx.doi.org/10.1177/1039856214562079]

[3] World Health Organization. Global Health Observatory Data Repository Suicide mortality rate (per 100,000 population) 2019. Available from: https://donnees.banquemondiale.org/indicator/SH.STA.SUIC.P5?locations=MA (Accessed on: 19 Nov 2022).

[4] World Health Organization. Suicide worldwide in 2019 2019. Available from: https://www.who.int/publications-detail-redirect/9789240026643 (Accessed on: 4 May 2023).

[5] World Health Organization. One in 100 deaths is by suicide 2021. Available from: https://www.who.int/news/item/17-06-2021-one-in-100-deaths-is-by-suicide (Accessed on: 4 May 2023).

[6] Bessa A, Chouaib J, Sebti N, Bendella A. Mental health and the causes of suicide in Morocco. The Economic, Social and Environmental Council 2023.

[7] Otheman Y, Satté A, Mounach J, Kadiri M, Bichra MZ. [Sleep related dissociative disorder: A case complicated by a suicide attempt]. Encephale 2019; 45(3): 271-3.
[http://dx.doi.org/10.1016/j.encep.2018.06.003] [PMID: 29983174]

[8] Abderrahmane A, Kharbach A, Azzine H, *et al.* Suicide attempts in Morocco: A systematic review. Rev Epidemiol Sante Publique 2022; 70(5): 243-51.
[http://dx.doi.org/10.1016/j.respe.2022.05.006] [PMID: 35927118]

[9] Barrimi M, Maazouzi M, Malakt S, Lazaar S, Khaoulani H. Ideas and suicide attempts among medical students in Morocco: Results of a multicenter study. Med Psychol Ann Psychiatr J 2019; 178(5): 481-6.

[10] Otheman Y, Satté A, Mounach J, Kadiri M, Bichra MZ. Trouble dissociatif lié au sommeil : à propos d'un cas clinique compliqué d'une tentative de suicide. Encephale 2019; 45(3): 271-3.
[http://dx.doi.org/10.1016/j.encep.2018.06.003] [PMID: 29983174]

[11] Aarab C, Elghazouani F, Aalouane R, Rammouz I. Suivi prospectif sur 5 ans des tentatives de suicide en population clinique dans la région de Fès, Maroc. Pan Afr Med J 2014; 18: 18.
[http://dx.doi.org/10.11604/pamj.2014.18.321.3726]

[12] Mekaoui N, Karboubi L, Ouadghiri FZ, Benjelloun BS. Epidemiological aspects of suicide attempts among Moroccan children. Pan Afr Med J 2016; 24: 112.
[http://dx.doi.org/10.11604/pamj.2016.24.112.7805] [PMID: 27642451]

[13] Mahir S, Soulaymani A, Hami H, *et al.* [Suicide by poisoning in the Souss-Massa-Drâa region of Morocco]. Sante Publique 2013; 25(3): 343-50.
[http://dx.doi.org/10.3917/spub.253.0343] [PMID: 24007910]

[14] Bae MN, Cho SE, Ryu JH, *et al.* Psychiatric and Psychosocial Factors of Suicide Decedents and Survivor of Suicide Loss: Psychological

Autopsy Study of Incheon City in South Korea. Int J Environ Res Public Health 2022; 19(13): 7895.
[http://dx.doi.org/10.3390/ijerph19137895] [PMID: 35805554]

[15] Canada A of Public Health The Federal Framework for Suicide Prevention - 2018 Progress Report 2020. Available from: https://www.canada.ca/fr/sante-publique/services/publications/vie-saine/cadre-federal-prevention-suicide-rapport-2018.html (Accessed on: 29 Nov 2022).

[16] Ortiz-Prado E, Simbaña K, Gómez L, *et al*. The disease burden of suicide in Ecuador, a 15 years' geodemographic cross-sectional study (2001–2015). BMC Psychiatry 2017; 17(1): 342.
[http://dx.doi.org/10.1186/s12888-017-1502-0] [PMID: 29017474]

[17] Suicide prevention: the global state of emergency. Geneva: World Health Organization 2014.

[18] Besnier N, Gavaudan G, Navez A, *et al*. Approche clinique du suicide au cours de la schizophrénie (I). Identification des facteurs de risque. Encephale 2009; 35(2): 176-81.
[http://dx.doi.org/10.1016/j.encep.2008.02.009] [PMID: 19393388]

[19] Utyasheva L, Robertson G, Sharma JR. Perception of the criminality of attempted suicide in Nepal and its impact on suicide reporting. Int J Law Psychiatry 2022; 83: 101796.
[http://dx.doi.org/10.1016/j.ijlp.2022.101796] [PMID: 35594745]

[20] Hsu CY, Chang SS, Yip PSF. Subjective wellbeing, suicide and socioeconomic factors: an ecological analysis in Hong Kong. Epidemiol Psychiatr Sci 2019; 28(1): 112-30.
[http://dx.doi.org/10.1017/S2045796018000124] [PMID: 29633681]

[21] Barrimi M, Elghazouani F, Aarab C, *et al*. [Experience of liaison psychiatry in Morocco: transversal study over 24 months]. Encephale 2014; 40(5): 373-9.
[http://dx.doi.org/10.1016/j.encep.2013.03.010] [PMID: 24095294]

[22] Na KS, Oh KS, Lim SW, *et al*. Association between age and attitudes toward suicide. Eur J Psychiatry 2018; 32(1): 44-51.
[http://dx.doi.org/10.1016/j.ejpsy.2017.08.007]

[23] Grégoire R. Epidemiological data on deaths by suicide in France in 2017. In: Observatoire National Du Suicide – 5e Rapport. 2017.

[24] Soumah MM, Eboué BA, Ndiaye M, Sow ML. Aspects épidémiologiques du suicide à Dakar. Pan Afr Med J 2013; 15.

[25] Ceverino A, Lopez CJ, Baca-García E. Evolution of suicide risk during the woman's lifetime. In: Suicides and attempted suicides. Cachan: Lavoisier 2010; pp. 163-9.
[http://dx.doi.org/10.3917/lav.court.2010.01.0163]

[26] Teti GL, Rebok F, Rojas SM, Grendas L, Daray FM. Systematic review of risk factors for suicide and suicide attempt among psychiatric patients in Latin America and Caribbean. Rev Panam Salud Publica 2014; 36(2): 124-33.
[PMID: 25345534]

[27] Roman-Lazarte V, Moncada-Mapelli E, Huarcaya-Victoria J. Evolution and differences of suicide rates in peru by gender and department, 2017-2019. Rev Colomb Psiquiatr 2021; S0034-7450(21)00074-3. Online ahead of print

[28] Bouhlel S, M'solly M, Benhawala S, Jones Y, El-Hechmi Z. Les facteurs liés aux tentatives de suicide dans une population tunisienne de patients atteints de schizophrénie. Encephale 2013; 39(1): 6-12.
[http://dx.doi.org/10.1016/j.encep.2012.06.003] [PMID: 23095582]

[29] Agoub M, Moussaoui D, Kadri N. Assessment of suicidality in a Moroccan metropolitan area. J Affect Disord 2006; 90(2-3): 223-6.
[http://dx.doi.org/10.1016/j.jad.2005.09.014] [PMID: 16352345]

[30] Troya MI, Gerstner RM, Narvaez F, Arensman E. Sociodemographic Analysis of Suicide Rates Among Older Adults Living in Ecuador: 1997–2019. Front Public Health 2021; 9: 726424.

[http://dx.doi.org/10.3389/fpubh.2021.726424] [PMID: 34692624]

[31] Li Y, Li Y, Cao J. Factors associated with suicidal behaviors in mainland China: a meta-analysis. BMC Public Health 2012; 12(1): 524.
[http://dx.doi.org/10.1186/1471-2458-12-524] [PMID: 22800121]

[32] Hu C, Zhao D, Gong F, Zhao Y, Li J, Sun Y. Risk factors for suicidal ideation among the older people living alone in rural region of China. Medicine (Baltimore) 2020; 99(29): e21330.
[http://dx.doi.org/10.1097/MD.0000000000021330] [PMID: 32702929]

[33] Relation entre chômage et suicide Available from: http://www.bichat-larib.com/revue.presse/revue.presse.resume.affichage.php?numero_etudiant=&numero_resume=667

[34] Desprat D, Baudelot C, Debout M, Waters S, Lerouge L. Work-related and unemployment-related suicides 2020.

[35] Chen VCH, Chou JY, Lai TJ, Lee CTC. Suicide and unemployment rate in Taiwan, a population-based study, 1978–2006. Soc Psychiatry Psychiatr Epidemiol 2010; 45(4): 447-52.
[http://dx.doi.org/10.1007/s00127-009-0083-8] [PMID: 19536446]

[36] Frasquilho D, Matos MG, Salonna F, *et al*. Mental health outcomes in times of economic recession: a systematic literature review. BMC Public Health 2015; 16(1): 115.
[http://dx.doi.org/10.1186/s12889-016-2720-y] [PMID: 26847554]

[37] Klingelschmidt J, Chastang JF, Khireddine-Medouni I, Chérié-Challine L, Niedhammer I. Facteurs professionnels en lien avec le suicide au sein des salariés affiliés à la Mutualité sociale agricole (MSA) et en activité entre 2007 et 2013. Rev Epidemiol Sante Publique 2020; 68(1): 1-8.
[http://dx.doi.org/10.1016/j.respe.2019.09.008] [PMID: 31843361]

[38] SUICIDE AND SUICIDE PREVENTION RESEARCH: What the Evidence Says and Topics for Future Research. Public Health Agency of Canada. 2018.

[39] Fiske A, Wetherell JL, Gatz M. Depression in older adults. Annu Rev Clin Psychol 2009; 5(1): 363-89.
[http://dx.doi.org/10.1146/annurev.clinpsy.032408.153621] [PMID: 19327033]

[40] Arsenault-Lapierre G, Kim C, Turecki G. Psychiatric diagnoses in 3275 suicides: a meta-analysis. BMC Psychiatry 2004; 4(1): 37.
[http://dx.doi.org/10.1186/1471-244X-4-37] [PMID: 15527502]

[41] Bachmann S. Epidemiology of Suicide and the Psychiatric Perspective. Int J Environ Res Public Health 2018; 15(7): 1425.
[http://dx.doi.org/10.3390/ijerph15071425] [PMID: 29986446]

[42] Vismara M, Grancini B, Cremaschi L, *et al*. Suicide attempts and clinical correlates in patients with bipolar I *vs*. II disorder. Eur Psychiatry 2018; 52: 113-5.
[http://dx.doi.org/10.1016/j.eurpsy.2018.04.009] [PMID: 29778833]

[43] Pompili M, Gonda X, Serafini G, *et al*. Epidemiology of suicide in bipolar disorders: a systematic review of the literature. Bipolar Disord 2013; 15(5): 457-90.
[http://dx.doi.org/10.1111/bdi.12087] [PMID: 23755739]

[44] Song J, Hong SH, Kim J, Chang S, Yook KH, Hong HJ. Comparison of Suicide Attempts and Suicide Deaths by Jumping from a High Place in Korean Children and Adolescents. Int J Environ Res Public Health 2021; 18(18): 9513.
[http://dx.doi.org/10.3390/ijerph18189513] [PMID: 34574436]

[45] Zakharov S, Navratil T, Pelclova D. Suicide attempts by deliberate self-poisoning in children and adolescents. Psychiatry Res 2013; 210(1): 302-7.
[http://dx.doi.org/10.1016/j.psychres.2013.03.037] [PMID: 23810383]