

## ORIGINAL ARTICLE

**Incidence, Distribution, and Determinants of Suicide by Self-Poisoning in two Egyptian Provinces**ZEINAB A. KASEMY<sup>1</sup>, SAFAA A. AMIN<sup>2</sup>, ASMAA F. SHARIF<sup>3,4</sup>, MANAR M. FAYED<sup>3</sup>, DALIA E. DESOUKY<sup>1</sup>, AMAL A. SALAMA<sup>5</sup>, HANAA M. ABO SHEREDA<sup>6</sup>, NEHAD B. ABDEL-AATY<sup>1</sup><sup>1</sup>Department of Public Health and Community Medicine, Faculty of Medicine, Menoufia University, Egypt.<sup>2</sup>Department of Forensic medicine and clinical toxicology, Faculty of Medicine, Menoufia University, Egypt.<sup>3</sup>Department of Forensic medicine and clinical toxicology, Faculty of Medicine, Tanta University, Egypt.<sup>4</sup>Department of Clinical Medical Sciences, College of Medicine, Dar Al-Uloom University, Riyadh, Saudi Arabia.<sup>5</sup>Department of Family medicine, Faculty of Medicine, Menoufia University, Egypt. Email<sup>6</sup>Department of Psychiatric and Mental Health Nursing, Faculty of Nursing, Menoufia University, Egypt.Corresponding author: Asmaa F. Sharif, Email: [asma.s@dau.edu.sa](mailto:asma.s@dau.edu.sa) ORCID ID: <https://orcid.org/0000-0002-6104-562X>, Cell: 0096581639317**ABSTRACT****Objectives:** Suicide by self-poisoning is a serious public health problem that accounts for global morbidities and mortalities. This work aims to study the incidence, trend, and determinants of suicide by self-poisoning in two Egyptian provinces.**Methods:** The current study is a bi-designed two-phases observational study carried out in two Egyptian poison control centers including Menoufia Poison Control Center (MPCC) and Tanta Poison Control Center (TPCC). A total of 7,802 patients were enrolled. The first phase of the current study was conducted retrospectively to show the trend of suicide attempts over 2016, 2017, and 2018 when the cases diagnosed as suicide by self-poisoning were extracted from medical record. The second part was conducted prospectively (January 2019-Januaray 2020) among cases of suicide by self-poisoning and accidental poisoning.**Results:** The current study revealed that incidence of poisoning exposure no matter what its type represented 34.99/100,000 (CI95%: 33.84–36.20) distributed as 28.18/100,000 (CI95%: 27.14–29.26) for suicide by self-poisoning and 6.82/100,000 (6.32–7.36) for accidental poisoning. The suicide by self-poisoning death rate represented 2.08/100,000 (1.90–2.49). The suicide by self-poisoning was significantly associated with young age <25years, low socioeconomic status, being a student or not working.**Conclusion:** Suicide by self-poisoning shows a continuous increase across time raising a serious concern. Collaborative Efforts are required by to conduct health education and enforce legislation to overcome this serious condition.**Keywords:** Aluminum phosphide; Egypt; pesticides; self-poisoning; suicide**INTRODUCTION**

Suicide is a serious public health problem that mostly affects children and adolescents<sup>1</sup>. Global suicide rates showed a steady increase over the last 50 years<sup>2</sup>. About 79% of suicides happened in low- and middle-income countries<sup>3</sup>. Unfortunately, the suicide rate in the Middle East region doubled between 1990 and 2015<sup>4</sup>.

Reports published in the US considered suicide by self-poisoning the most common method of suicide attempts among adolescents (66.5%)<sup>5</sup>. In the UK, suicidal self-poisoning accounts for about a quarter of all suicides<sup>6</sup>. The situation in the developing world is worsened with a dramatic increase in mortality due to suicide by self-poisoning<sup>7</sup>. A recent study published in Egypt showed an obvious increase in pesticide self-poisoning suicide in recent months<sup>8</sup>.

Suicide by self-poisoning has been noticed to replace traditional methods in many countries due to the easy availability of poisons<sup>9</sup>. Drugs used in suicide by self-poisoning vary according to many considerations. In most of the developed countries, acetaminophen and psychotropic drugs are the commonest<sup>10</sup>. Over-the-counter medications like analgesics and antihistamines constitute more than one-third of suicide by self-poisoning substances in the US<sup>5</sup>. The situation in developing countries is a little bit different where pesticides such as organophosphorus compounds and aluminum phosphides are the most common poisons utilized in suicide<sup>7,11</sup>. More locally, in Egypt, phosphides and organophosphate are reported as the main agent in suicide by self-poisoning.

Due to the growing nature of suicide by self-poisoning and as previous statistics on its incidence in Egypt are grossly inadequate, and hence, comparison based on past figures may be inaccurate and misleading<sup>12</sup>, this work aimed to study the incidence, distribution, trends, and determinants of suicide by self-poisoning among patients presenting at Menoufia Poison Control Center (MPCC) and Tanta Poison Control Center (TPCC) serving two large Egyptian provinces.

**MATERIAL AND METHODS**

**Study design and setting:** The current study is a bi-designed observational study carried out during the period January 2016–January 2020 in two Egyptian poison control centers (MPCC and TPCC) serving two Egyptian provinces inhabited by more than 10,000,000 individuals.

The study was carried out over two phases:

i. A retrospective phase including the data extracted from the medical records belonging to patients admitted to both centers and diagnosed as self-poisoning suicide during the years 2016, 2017, and 2018. These data were utilized to show the trends of suicide by self-poisoning.

ii. A prospective phase including all patients admitted to both centers and suffering from toxic exposure including accidental poisoning and suicide by self-poisoning conducted during the period from January 2019– to January 2020 as shown in Figure 1.

**Subjects and sampling:** Convenience sampling was adopted to recruit the largest number of cases. A total number of 7,802 patients were enrolled in the current study. Of them, 4,419 were involved in the first phase for trend analysis and extraction of themes. During the second phase, 3,383 cases were included which represent the previous year's accidental poisoning and self-poisoning suicide admissions in both centers.

**Inclusion criteria:** In addition to the medical records of patients presented to MPCC and TPCC during 2016, 2017, 2018 and diagnosed with suicidal self-poisoning, all patients admitted to both centers during the period (January 2019– to January 2020) and diagnosed as accidental or suicide by self-poisoning were included. Diagnosis of drug poisoning was carried out according to the International Classification of Diseases. The poisoning manner was judged based on the history given by patients aged 18 years and above, or history given by guardians in the case of minors or mentally incapacitated cases. Besides the history, some cases of suicide by self-poisoning were previously documented in the centers' database for previous suicide attempts. Less often, some cases carry signs of previous attempts by other means. e.g., cut wrists.

**Exclusion criteria:** Suspected cases of iatrogenic poisoning and poisoning due to chronic drug overdose, and those discharged

upon request or who spent less than one day with unclear outcomes were excluded from the study.

**Data collection tools:** For all patients presented during the year 2019–2020, upon admission, clinical and toxicological evaluations were carried out for all patients. The type of the drug or poison was determined from the history conveyed by the patients or their relatives or less often, the patients brought the container of the poison used. Confirmation by clinical examination for specific toxidromes and toxicological screening followed.

After the patient's stabilization and management, a special case report form was completed by the investigators. A team composed of a senior toxicologist, a psychiatrist and a nurse were assigned to meet the patients individually or in the presence of one guardian in cases of minors. The patients' demographic data including age, sex, residence, and occupation were reported. Other information including the causative agent used, the presence and the type of trigger events, such as psychological problems or family conflicts, and the outcome were reported. The socioeconomic status of the included patients was evaluated as high, moderate, or low based on the scale developed by Fahmy et al.<sup>13</sup>. The patients were subjected to psychiatric evaluation by psychiatrists based on the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th ed.<sup>14</sup>. Psychological consultation was requested for those diagnosed with psychological problems. Patients not diagnosed with mental disorders were requested to select one of four items as the main cause pushing them to commit suicide: family conflicts, financial problems, emotional issues, or bullying. The patients who failed to select one of the previous causes or those with other or unexplained causes such as street children were reported as unknown causes.

**Compliance with ethical standards:** The current study was commenced after obtaining approval from both contexts: the Research Ethical committee of Menoufia Faculty of Medicine, Menoufia University (ID: 2/2021COM) and the Research Ethical Committee of the Faculty of Medicine, Tanta University (ID: 34244/11/20). Following Declaration of Helsinki, the confidentiality of patients was maintained. The medical records and the case report forms were fully anonymized before being accessed. The Research Ethical Committees waived the requirement for informed consent whether for the retrospective or prospective elements.

**Statistical analysis:** Data were collected, statistically analyzed, and tabulated using Statistical Package of Social sciences (SPSS) software statistical computer package version 27 (SPSS Inc., Chicago, Illinois, USA). For nominal data, the number and percentage were used. A Chi-square test ( $X^2$ ) was used to compare groups for nominal variables. Binary logistic regression analysis was done, which analyzes independent predictors with odds ratios for a binary outcome. A p-value of less than 0.05 and a 95% confidence interval were adopted as levels of significance. The incidence rate per 1,000 and 100,000 population was calculated; each calculated by dividing the number of acts/thoughts identified through our search by the number of patients admitted or population in the region derived from official population data, respectively.

**RESULTS**

The current study showed that number of suicides by self-poisoning cases increased over the four studied years starting from 969 in 2016 to 1,192 in 2017 to reach 2,258 in 2018 and 2,724 in 2019–2020, January as shown in Figure 2.

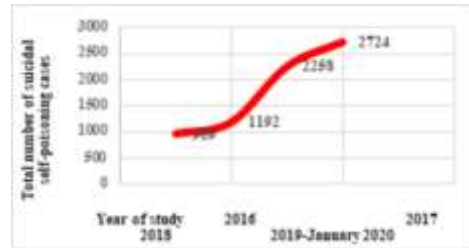


Figure 2: Trend of self-poisoning suicide over four-year registry data  
 In the current study and during the year 2019–2020 January, 3,383 patients presented to MPCC and TPCC were diagnosed with poisoning exposure. Suicide by self-poisoning represented 80.5% of all cases (n=2,724) while accidental poisoning was reported in 659 patients. The incidence of exposure to poisoning no matter what its type in relation to all admitted patients was 35.72/1,000 (CI95%: 34.56–36.91) distributed as 28.76/1,000 (CI95%: 27.72–29.79) for and 6.96/1,000 (6.4–7.5) for accidental poisoning. Incidence rate of poisoning exposure no matter what its type in relation to the regional population represented 34.99/100,000 (CI95%: 33.84–36.20) distributed as 28.18/100,000 (CI95%: 27.14–29.26) for suicide by self-poisoning and 6.82/100,000 (6.32–7.36) for accidental poisoning. The suicide by self-poisoning death rate represented 2.08/100,000 (1.90–2.49). Case fatality rate for poisoning in relation to all poisoned cases, including suicide by self-poisoning, and accidental poisoning was 6.12% (CI95%: 5.36–6.98), 7.38% (CI95%: 6.45–8.42), and 0.91% (CI95%: 0.41–2.01), respectively. The proportionate suicide mortality rate was 14.11% (CI95%: 12.43–16.0) as shown in Table 1.



Figure 1: Flow chart of patients enrolled in the current study

The most common method for committing suicide by self-poisoning was pesticides (29.0%) followed by aluminum phosphide (26.6%) and drugs (18.3%), which were distributed as central nervous system (CNS) depressants (39.5%), cardiovascular and xanthine derivatives (28.7%), antipsychotics (22.0%), and antidepressants (20.0%). The reported reasons behind committing suicide by self-poisoning were mainly family conflicts (32.8%) and psychological problems (22.6%) as depicted in Table 2.

Table 1: Incidence of suicide by self-poisoning and associated rates of deaths during January 2019– January 2020

	Number	(CI95%)
Poisoning type		
Suicide by Self-poisoning	2724	80.5% (80.4-80.6)
Accidental Poisoning	659	19.5 % (19.4-19.5)
	Incidence rate	CI95%
Incidence rate of poisoning in relation to all admitted patients	28.76/1000	27.72-29.84
- Self-poisoning suicide	06.96/1000	6.4-7.5
- Accidental Poisoning	35.72/1000	34.56-36.91
Incidence rate of suicide in relation to all regional population	28.18/100000	27.14-29.26
- Suicide by Self-poisoning	6.82/100000	6.32-7.36
- Accidental Poisoning	34.99/100000	33.84-36.20

- Total poisoning		
Self-Poisoning suicide death rate	2.08/100000	1.90-2.49
Case fatality rate		
- Suicide by Self-poisoning	7.38%	6.45-8.42
- Accidental Poisoning	0.91%	0.41-2.01
- Total (Suicide by Self-poisoning + accidental poisoning)	6.12%	5.36-6.98
Proportionate mortality rate	14.11%	12.43-16.0

- Psychological problems	598	22.0
- Financial problems	347	12.7
- Emotional issues	156	5.7
- Bullying	114	4.2
- Unknown		

Table 2: Distribution of the studied participants regarding suicide by self-poisoning causative agent exposure and reported reasons behind committing suicide by self-poisoning during January 2019– January 2020

Suicide by Self-poisoning	No out of 3383	
	number	%
Causative Agent Exposure		
- Pesticide	980	36.0
- Aluminum phosphide	900	33.3
- Zinc phosphide	260	9.4
- Hydrocarbons	83	3.0
- Drugs→	501	18.3
CNS depressants	198	39.5
Cardiovascular and xanthine derivatives	144	28.7
Antipsychotics	110	22.0
Antidepressants	100	20.0
Reported causes of committing suicide by self-poisoning	(n=2724)	
- Family conflicts	893	32.8
	616	22.6

Regarding suicide by self-poisoning associated risk factors, the current study revealed that individual risk factors were the age group <25 years old, which was more at risk of committing suicide by self-poisoning than other age groups [p<0.001, OR=8.22, 95% CI: 6.24–10.83]. Being a female patient showed a higher risk of suicidal ideation than being a male [p<0.001, OR=2.09, 95% CI: 1.76–2.48]. Patients who were students or not working showed a significantly higher percentage than working patients [OR= 5.49, 95%CI: [4.26–7.08] and OR= 1.59, 95%CI: [1.31–1.93], respectively]. Low socioeconomic status patients were at a significantly higher risk than other socioeconomic status categories for committing suicide by self-poisoning [OR= 12.67, 95%CI: [8.40–19.11] as Table 3. illustrates.

Table 3: Distribution of poisoning (as a suicidal method and accidental) according to demographic data and outcome

	Poisoning				Total		P value	OR CI95%
	Suicidal (n=2724)		Accidental (n=659)		Total (n=3383)			
	no	%	no	%	no	%		
Age (years)								
• ≤25	1381	50.7	90	13.7	1578	46.6	<0.001*	8.22 [6.24-10.83]
• >25-40	981	36.0	375	56.9	1249	36.9	0.001*	1.40 [1.14-1.73]
• >40	362	13.3	194	29.4	556	16.4	-	1.0
Sex								
• Male	899	33.0	334	50.7	1233	36.4	<0.001*	1.0
• Female	1825	67.0	325	49.3	2150	63.6		2.09 [1.76- 2.48]
Residence								
• Rural	1608	59.0	248	37.6	1364	40.3	<0.001*	1.15 [0.97- 1.37]
• Urban	1116	41.0	411	62.4	2019	59.7		1.0
Occupation								
• Working	676	24.8	303	46.0	979	28.9	-	1.0
• Not working	945	34.7	266	40.4	1131	33.4	<0.001*	1.59 [1.31- 1.93]
• A student	1103	40.5	90	13.7	1273	37.6	<0.001*	5.49 [4.26-7.08]
SES								
• Low	1821	66.9	198	30.0	1893	56.0	<0.001*	12.67 [8.40-19.11]
• Moderate	858	31.5	399	60.5	1375	40.6	<0.001*	2.96 [1.98-4.43]
• High	45	1.7	62	9.4	115	3.4	-	1.0
Outcome								
Died	201	7.4	6	0.9	207	6.1	<0.001*	8.67 [3.83-19.62]
Alive	2523	92.6	653	99.1	3176	93.9		1.0

\*: significant, SES: Socioeconomic standard

A logistic regression was performed to ascertain the effects of age, sex, occupation, residence, and socioeconomic status on the likelihood that participants may commit suicide by self-poisoning as Table 4. shows.

Table 4: Binary Logistic regression analysis for factors associated with suicide by self-poisoning

	P value	Odds Ratio	95% CI	
			Lower	Upper
Age (<25)	<0.001*	21.67	14.60	32.16
Sex (Female)	0.066	1.22	0.98	1.51
Occupation (A student +not working)	<0.013*	1.32	1.06	1.65
SES (Low)	<0.001*	11.39	9.11	14.25

The logistic regression model was statistically significant, p < 0.001. The model explained 37.4% (NagelkerkeR<sup>2</sup>) of the variance in suicide and correctly classified 85.3% of cases. Suicide by self-poisoning was associated with age <25years old (OR=21.67, CI95%: 14.60–32.16), low socioeconomic status (OR=11.39, CI95%: 9.11–14.25), being a student or not working (OR=1.32, CI95%: 1.06–1.65), and of rural residency.

## DISCUSSION

The current study showed that suicide by self-poisoning was reported in (80.5%) of the patients admitted, while accidental poisoning was reported in (19.5%). This rate is higher than that reported by El-Mahdy et al. in 2010, when a suicide rate of 62.6% among patients admitted over a year was reported<sup>15</sup>.

Incidence of suicide by self-poisoning/1,000 population increased over four years starting from 16.71 in 2016–2017 to 17.15 in 2017–2018 and 20.23 in 2018–2019 to reach 28.76 in 2019–2020. This means that the condition is serious and progressing. Finkelstein et al., in 2015, revealed a 16% increase in the suicide rate over the last decade in the US<sup>16</sup>. Another study carried out in Australia showed an increase of 8.39%/year with an overall increase of 98% during the period from 2006 to 2016<sup>17</sup>. Also, several studies conducted in the UK, Brazil and Italy reported an increasing trend, raising a global concern<sup>18–20</sup>.

The current study reported a suicide by self-poisoning death rate of 2.08/100,000 over one year. Gad El Hak et al. reported a range of 1.66–2.41/100,000 for the period 1998–2004b<sup>21</sup>, Taha et al. reported a range of 0.47–0.74/100,000 for the period 2003–2007<sup>22</sup>, and Aboul-Hagag et al. reported a range of 0.55–0.81/1,000,000 during the period 2005 to 2009<sup>23</sup>. In the US, the suicide death rate is approximately 20/100,000 persons, while in India, it is 10.5/100,000.

The fact that the rate varied from one study to another and over time between different countries and even within the same country can be explained by the difference in methodological handling of the term “suicidal” or “self-harming or self-poisoning” behaviors, the kind of population investigated, the geographical area size analyzed, the criteria of the healthcare setting, the wide variability in socio-demographic variables in addition to the different political and living conditions. Also, inadequate surveillance and misclassification may occur, which, in turn, may underestimate the number of suicides from one region to another<sup>24–28</sup>.

The most common method used for committing suicide by self-poisoning in this study was pesticides (29.0%), followed by aluminum phosphide (26.6%) and drugs (18.3%), which were distributed as CNS depressants (39.5%), cardiovascular and xanthine derivatives (28.7%), antipsychotics (22.0%) and antidepressants (20.0%). In Sri Lanka, 41% of self-inflicted poisoning was attributed to pesticides including organophosphorus compounds, carbamates, and other unspecified types<sup>29</sup>. These findings agree with other studies in different settings<sup>21,30–32</sup>. This finding may be explained by the widespread use of easily available and low-cost household product pesticides in both rural and urban homes. Also, aluminum phosphide is a poison of choice for suicide as it demonstrates no effective antidote, and it is cheap and freely available. In the US, the percentage of suicidal opioid self-poisoning changed from 2.2% to 4.4% during the period 1999–2010<sup>33</sup>. Among the developed countries, CNS-acting drugs (psychoactive drugs, neuroleptics, and antidepressants) are the most common methods of intentional self-poisoning<sup>34</sup>. The proportion of suicidal drug exposure in other countries was higher than the proportion encountered in the current study, as reported in Pakistan (62%)<sup>35</sup>, Iran (90.2%)<sup>36</sup>, and in Italy (68%) where psycho-pharmaceutical drugs represented 45% of drugs used<sup>37</sup>.

The variations between the countries can be explained by the difference in socioeconomic standards and the availability of drugs. Increasing depression among people, which may be aggravated due to social problems such as unemployment or spinsterhood and its associated societal view especially in Egypt, may lead to more drug abuse, and explaining whether the depression leads to use of these drugs or the drug abuse increases depression is difficult<sup>38</sup>.

The current study demonstrated reasons for committing suicide by self-poisoning, such as family conflicts (32.8%) and psychological problems (22.6%), while unknown reasons were reported in 4.2% of the results. These results agree with the literature suggesting that self-harm may be associated with recent family disputes or psychological disturbances, in which emotional dysregulation or maladaptive coping strategy can occur<sup>11,22,32,37,39–43</sup>. The association between psychological problems and suicide by self-poisoning agrees with other studies in different settings<sup>44,45</sup>. Psychological illness like schizophrenia, are characterized by disturbance in brain neurotransmitters<sup>46</sup>. Severe physical

consequences are the only reason for affected individuals committing suicide by self-poisoning to seek medical attention. Sometimes the acts could be misdiagnosed as unintentional accidents<sup>47,48</sup>.

As a heavy stigma surrounding suicide exists, that may result in underreporting of the act; in our study, in 4.2% of the cases the reason was unknown, which may be explained by the tendency by the patients' relatives to deny and refuse to admit it, or they have no family at all in addition to the difficulties faced by clinicians in the assessment and management of such cases in the emergency room<sup>49,50</sup>.

The current study reported that individuals less than 25 years old were more at risk of committing suicide than other age groups. This may be attributed to emotional instability and unemployment faced by young people in addition to, unfortunately and unsurprisingly, over dosage in psychotropics which are commonly taken by this age category in contrast to the increased responsibility of older people toward their families which may hinder suicidal ideation<sup>21,30,51–53</sup>. Also, the availability of internet services, social media (the monster), and smart phone usage among this age group could exhibit an adverse impact on mental health and the capability to respond to stressors. Egypt is in the sixth rank of internet usage worldwide and exhibits high smart phone usage among young people (94%). Similar findings were reported in Australia, the US, and the UK<sup>17</sup>.

The present study showed that female patients were at a significantly higher risk than males regarding suicide by self-poisoning. A similar picture is seen globally, where self-harm ranks second among females and third among males. In an Australian study, females outnumbered males by three to one<sup>37,40,54</sup>. Females tend to ingest already available substances at home, while males tend to ingest a substance kept in a garden or a field or purchase it. The ease of availability of the substance, which is mainly pesticide or aluminum phosphide, in addition to menstrual issues and the usual tendency of females to exhibit conflicts with parents are the main reasons for suicide by self-poisoning and not the distribution of males and females in the population<sup>55–58</sup>.

Patients who were students or not working showed a significantly high percentage of suicide by self-poisoning. This finding is supported by El-Mahdy et al. and Halim et al.<sup>15,59</sup>. Others reported that even working but for low wages exhibits a direct causal link with suicide rates, and raising that low wage would drop the suicide rate quickly<sup>60</sup>. Patients with low socioeconomic status were at significantly high risk for committing suicide. This result is supported by Liu et al. and could be explained by a decrease in income, which is associated with a higher risk for anxiety, substance use, and mood disorders<sup>61</sup>. However, Finkelstein et al. conveyed opposite findings and mentioned that admissions due to suicidal drug poisoning are more common among patients with higher socioeconomic status<sup>16</sup>.

Rural residency served as a significant predictor to committing suicide, and this agrees with Sun et al. who found the rural/urban difference to be 2.5:1, suggesting that the difference may be explained by the differences in age, educational level, occupation, and method preference between rural and urban residents<sup>62</sup>. Conversely, a study conducted in rural Sri Lanka reported a low incidence of self-poisoning as they depend on land farming for living without the need for extra resources<sup>63</sup>.

## CONCLUSION

Suicide by self-poisoning shows a continuous increase across time not only in Egypt, indicating a global phenomenon. The availability of pesticides and aluminum phosphide in addition to drugs, especially psychoactive drugs, needs immediate action. Family conflicts and psychological problems were the main causes of attempted suicide.

**Acknowledgements:** The authors extend their appreciation to TPCC and MPCC for facilitating data collection

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