

FATAL ALUMINIUM PHOSPHIDE POISONING IN FAYOUM GOVERNORATE, EGYPT (2012-2019)

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ABSTRACT

Background: Aluminium phosphide (AIP) is an insecticide and rodenticide used to shield put away grains from rodents and other household bugs. **Aim of work:** Surveying the death pace of Aluminium Phosphide hurt cases guaranteed to the Forensic Medical Authority (FMA) at Fayoum Governorate. **Method:** A cross-sectional research assessed deaths from ALP poisoning in Fayoum Governorate between June 2012 and June 2019 were evaluated reflectively and included into the present study (n=96). The cases were assessed according to: age, gender, residence, single or married, cause of suicide and autopsy findings. **Results:** Majority of studied cases were females (71.9%), and the mean age of the decedents 29 ± 9.9 ranged (from 20 to 60 years old) whereas 71 (74%) of the dead were aged between (20 and 30 years old). Nearly, half of the deaths were from Fayoum district (46.9%), followed by Sinnoris district (21.9%). The distribution of deaths indicated an increase in number of deaths especially in recent years. The study showed that 24/96 (25%) of the cases were registered in 2017. On 2018, number of deaths increased to 35/96 (36.5%). Judging from the case history, all deaths in the study were (100%) suicidal attempts. The majority of deaths mentioned in the study 69/96 (71.9%) were with unknown causes. **Conclusion:** Mortality because of AIP harming was the most elevated reason of death in youthful females and the most common self-destructive element. Local authorities must to put restrictions on purchases ALP in open sales.

Keywords: Aluminium phosphide, poisoning, mortality

INTRODUCTION

poisoning is a mutual medicosocial problem that represents a major health challenge all over the world, and depletes valuable health service resources with considerable high morbidity and mortality. Aluminium phosphide (AIP) is a well-known, efficacious insecticide and rodenticide, (Mehrpour et al., 2012) and is one of the most ordinarily used pesticides readily available in local

stores though its sale is illegal (Bogle, 2006 and Shadnia et al., 2009). It does not alter seed viability and leaves no residue on protected grains, yet evokes outrageous lethal impacts to people for which no convenient antidote is available. Mortality from AIP poisoning ranges from 37% to 100%. Exposition is either accidental, occupational or by suicidal intention (Bumbrahet al., 2014 and Bhalla A and Singh, 2015).

Premeditated and incidental oral ingestion of the metal phosphides isn't uncommon in certain parts of the world and many cases of acute premeditated poisoning have been documented by a mortality rate of higher than 50 % (Singh et al., 1985 and Shadniaet al., 2008). Ingestion of phosphides may instigate serious gastrointestinal irritation, cardiovascular collapse, acute neuropsychiatric troubles, respiratory and renal failure, and late hepatic harm may lead to death within 4 days, but most of cases died within 24 hours or less. Diagnosis of phosphine/phosphide poisoning is normally based on the history and clinical side effect. Blood and urine samples cannot be used for phosphine detection, because the exact mechanism of toxicity of phosphine/phosphide poisoning is not clear in human beings yet, and no particular treatment or antitoxin is accessible so far (Fatma et al., 2019).

This first research of Aluminium phosphide poisonings reported to the Medicolegal Department of Ministry of justice at Fayoum governorate .We expect the data and analysis to contribute significantly in reinforcement preventive measures against Aluminium phosphide poisoning-induced mortality and morbidity. The study aimed to record numbers of issues during the approximate period of 2012 to 2019 by demographic and geographic variables and also gain some ideas of trends and some perspectives on the complex issues of this serious problem (e.g., expanded controls from policymakers, open mindfulness and instruction).

MATERIAL AND METHODS

Study Design and setting

A cross-sectional study evaluated deaths from ALP poisoning in Fayoum Governorate. All cases of Aluminium Phosphide poisoning claims referred to the Forensic Medical Authority (FMA) at Fayoum Governorate, between June 2012 and June 2019 were reviewed retrospectively and included into the present study (n=96), which shows deaths reported due to suicidal attempts (n=96), while other causes were excluded. It was implemented in Fayoum Governorate, which lying in Middle Egypt, about 100 kilometers (62 miles) southwest of Cairo. The total population of Fayoum Governorate is 3.170.150 inhabitants in January, 2015 with 22.5 % urban and 77.5 % rural population, according to the Central Agency for Public Mobilization and Statistics (CAPMAS). Fayoum Governorate was divided into 6 districts: (Fayoum, Etsa, Tamiya, Sinnoris, Youssef Sadiak, Abshoay). Each district is composed of groups of villages representing Fayoum rural area. The main capital of the governorate is Fayoum city which is considered the urban area (CAPMAS, 2015)

Information was gained from documents of Forensic Medical Authority at Fayoum Governorate (FMA). The cases were evaluated according to the following factors: age, gender, residence, single or married, cause of suicide and autopsy findings. All deaths were with suicidal endeavor (100%) with froth around the mouths, and garlic odor as reported. Presence of phosphine gas in stomach in some cases by toxicological examination.

Statistical Analysis

•Data were collected, coded and analyzed using Statistical Package for Social Science (SPSS version 16. Chicago IL, USA). Simple descriptive analysis in the form of means and standard deviations for numerical data, Frequencies and percent for qualitative

data. Non-parametric tests (chi-square) were used to find its association with other factors. $P \leq 0.05$ was considered statistically significant.

RESULTS

The demographic characteristics of 96 deaths of Aluminum phosphate poisoning over the period from 2012 to 2019 were collected from reports of the Forensic Medicine Authority, most of the deaths 74/96 (77.1%) occurred in the period from 2016 to 2019, and majority of them were females (71.9%), while the mean age of the decedents 29 ± 9.9 ranged from (20 to 60 years) whereas 71 (74%) of the dead persons were aged between 20 to 30 years old. Nearly half of deaths from Fayoum district (46.9%) followed by Sinnoris district (21.9%). About two third of the deaths were singles (62.5%) as in **table (1)**.

The distribution of deaths indicates an increase in number of deaths in recent years from 2016 to 2019 especially in the year 2017; the deaths were 24/96 (25%). In the year 2018 there were 35/96(36.5%) deaths as in **fig (1)**. Majority of deaths 69/96 (71.9%) were with unknown causes. Autopsy examination showed that 6.2% of the victims were not virgin and 4.2% of them were pregnant without marriage and presence of phosphine gas in stomach by 4.2% **table (2) and fig (2)**. There were more deaths among the youth in the age from 20 to 30 years old. The studied cases were all among single people, people with social troubles, among females and rural population with significant difference ($p < 0.05$) **table (3)**. This study also recorded that the

most of the victims (92.7%) had cardiovascular collapse and 84.4% had abdominal pain. Nearly half (45.8%) of them had vomiting 32.3% of them were with dyspnea, 20.8% were with coma and only (8.3%) of them showed cyanosis in **table (4)**. Death from aluminium phosphide poisoning 64/96(66.67%) of the victims died after 2 hours of admission and 32/96 (33.33%) died immediately as illustrated in **fig (3)**.

In **fig (4)** recorded the distribution of first aid treatment (gastric lavage) to the patients in hospitals by residence 41/96 (42,7%) of the victims had done gastric lavage more than half of the procedure had been applied at Fayoum district hospital by 53.66% followed by snoris district hospital by 19.51%.

Table (1): Demographic characteristics and distribution of deaths related to Aluminum phosphate poisoning in Fayoum governorate from 2012 to 2019

Characters	N (96)	%
Sex		
Male	27	28.1
Female	69	71.9
Age		
20-30 years old	71	74
≥40 years	25	26
Residence		
Fayoum	45	46.9
Abshoway	10	10.4
Etsa	16	16.7
Tamia	4	4.2
Snoris	21	21.9
marital status		
Single	60	62.5
Married	36	37.5
Year interval		
2012-2015	22	22.9
2016-2019	74	77.1

Table (2): Case History Distribution and Autopsy of Aluminum Phosphide Poisoning-Related Deaths 2012 to 2019 (total number 96)

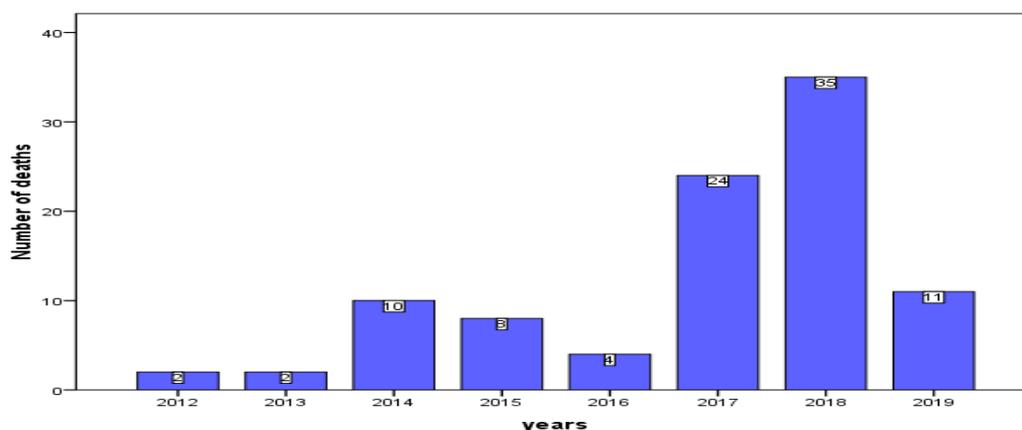
Number (96)	%
Case History	
Psychotic disorders	5 (5.2)
Social troubles (with family or divorce)	22 (22.9)
Unknown causes	69 (71.9)
Autopsy	
Abrasion and bruises	10(10.4)
Not virgin (single females)	6(6.2)
Pregnant (single females)	4(4.2)
Phosphine gas in stomach	6 (6.2)
No finding	70(73)

Table (3): Factors related to mortality from ALP poisoning

Characters	2012 to 2015 (N=22)/%	2016 to 2019 (N=74)	X ²	Odds ratio CI (95%)	P value
Sex Males (27) Females (69)	10 (37) 12 (17.4)	27 (63) 69 (82.6)	4.420	2.794(1.029-7.586)	0.039*
Age 20 to 30 years (71) >=40 years old (25)	14(19.7) 8(32)	57(80.3) 17(68)	1.579	0.522(0.188-1,453)	0.209
Residence urban 45 rural 51	15(33.3) 7(13.7)	30(66.7) 44(86.3)	5.203	3.143 (1.143-8.630)	0.023*
Marriage Single (60) Married (36)	14(23.3) 8 (22.2)	46 (76.7) 28 (77.8)	.016	1.065 (0.397-2.860)	0.900
social troubles Yes 22 No 74	4(18.2) 18 (24.3)	18(81.9) 56(75.7)	0.362	1.446(0.433-4.834)	0.547

Table (4): clinical findings of the patients after arrival to the hospital (96 fatalities)

Clinical findings	NO of patients	Percentage (%)
Cardiovascular collapse	89	92.7
Abdominal pain	81	84.4
Vomiting	44	45.8
dyspnea	31	32.3
coma	20	20.8
cyanosis	8	8.3

**Figure (1):** Distribution of deaths related to Aluminum phosphate poisoning in Fayoum governorate over the years from 2012 to 2019

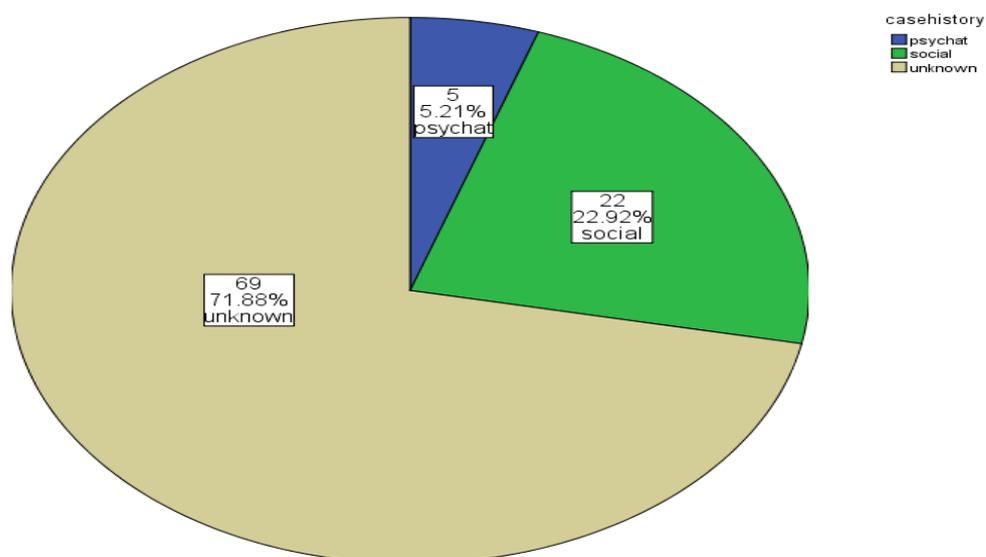


Figure (2): Distribution of causes of suicidal attempts as reported from the case history

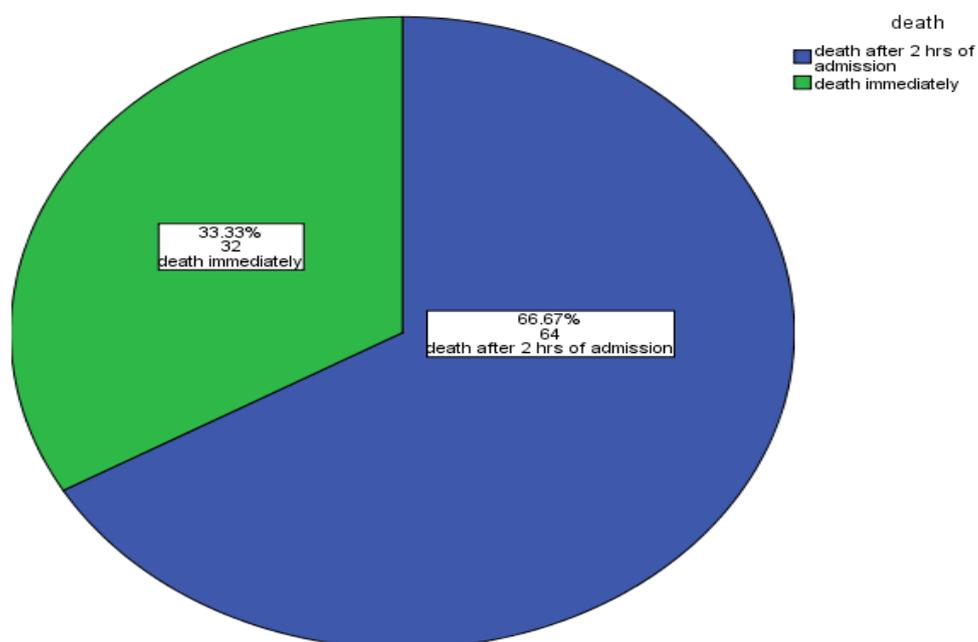


Figure (3): Distribution time interval between onset of overdose, admission to hospital and immediately death.

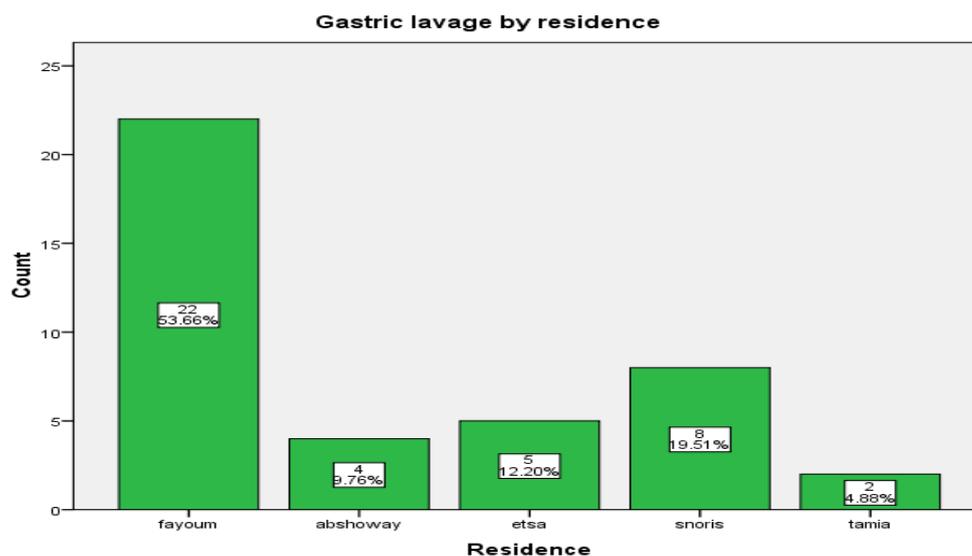


Figure (4): Distribution of first aid treatment (gastric lavage) of patients in hospital related to residence.

DISCUSSION

In recent years, frequency of intense aluminium phosphide harming (ALP) an amazingly dangerous substance has a high mortality. Phosphine, the dynamic part, hinders the mitochondrial cytochrome oxidase and the cell oxygen usage, disrupting at the end the normal mitochondrial Activity (**Valmas et al., 2008 and Karami et al., 2013**).

The occurrence of AIP harming in Egypt began to increment, and records of patients started to appear for a sensible extent (**Hasabo, 2015**). The present study was completed to assess aluminium phosphide harming related passing in Fayoum Governorate over the 7 earlier years, this research indicated expanded number of (ALP) related passing because of self-destructive endeavors by 74/96 (77.1 %) in 2016 to 2019 versus 22/96 (22.9%) in 2012 to 2015 particularly in 2017 and 2018 separately . This was reliable with numerous examinations led in Egypt, Iran and India (**Hawton and Van, 2009 and Singh et al.,**

2014), which might be explained by the wide abuse and the easy accessibility to aluminium phosphate tablets in the developing countries (**Mann, 2005**).

The suicidal causes for the unfortunate casualties archived in this research were for the most part obscure 69/96 (71.9%). According to the study, 22.9% of causes credited to social inconveniences in the family, divorce and fornication especially if it led to pregnancy. We also discovered that 5.21% of the deaths were due to psychiatric disorders. This might be due to increasing numbers of unreported causes of suicide cases because of social embarrassment. Anyway there are numerous examinations which portrayed solid relationship between suicide mortality and mental or physical disorder (**Hegerl et al., 2009, Dias et al., 2014 and El Hangouche et al., 2017**).

Post-mortem examination demonstrated that 6.2% of not married victims were not virgins and 4.2% of

them were pregnant without marriage. Over the period from 2012 to 2019, numbers of studied deaths identified with phosphine harming expanded particularly in the period from 2016 to 2019. There was more passing among the adolescents aging from 20 to 30 years old, this concurs with other announced study that most of passing was 32%, and 62% of the patients were more youthful than 20 years old. In a comparative research, 28 cases with mean (SD) age of 24 years old (11) long periods of AIP harming conceded in Morocco between January 1992 and December 2002 (**Hajouji et al., 2006**). Another documented study in Iran revealed a general mortality of 31%, with half being males with a mean time of 27.1 years (**Afshar et al., 2015**). Most of the patients were somewhere in the range of 20 and 40 years of age. Another Iranian research revealed that 93% of cases were self-harming with a self-destructive expectation which concurs with this study that the most common reason for harming is suicidal (**Soltaninejad et al., 2012**).

Autopsy reports can make significant data about the utilization of lethal substances for various purposes. Phosphine gas in stomach, foam around the mouths, and garlic scent in AIP harming cases were accounted for by Forensic Medical Authority in the present seeking. The outcomes are in concurrence with those of revealed wicked exudate leaving the (**Jain et al., 2005** and **Bumrah et al., 2012**), mouth and nose of youngsters harmed with AIP. Some vital organs were observed to be congested in the present investigation; this finding had likewise been seen in previous studies (**Sinha et al., 2005** and **Abder-Rahman, 2009**).

In trial studies, phosphine can initiate oxidative harm in liver, lungs, and brain of rats (**Arora et al., 1995**) Histopathological examination of vital

organs demonstrated congestion, edema, and leukocyte invasion particularly in lungs, kidneys and adrenal, which recommend cell hypoxia in the research of discoveries affirm presence of congestion in the liver and lungs of rodents exposed to AIP. Previous studies recommend that a combination of vitality deficiency and oxidative pressure could legitimize dialogue about the pathophysiologic impacts of phosphine poisonous toxicity (**Anand et al., 2012**).

In this research also documented, most of the victims (92.7%) had cardiovascular collapse and 84.4% had abdominal pain. Nearly half (45.8%) of them had vomiting 32.3% of them were with dyspnea, 20.8% were with coma and only (8.3%) of them showed cyanosis which was agreement with other research in Tahrán showed In our study, 28.13% of patients showed loss of consciousness on admission time. About 78% of patients had cardiovascular manifestation on admission time with 96% (**Ola et al., 2017**).

The shortage of a specific antidote is a major concern when treating AIP poisoning. Of course, several other (mainly supportive) therapeutic choices might be tried, including gastric lavage which showed that 41/96 (42,7%) of the victims had done gastric lavage more than half of the procedure had been applied at Fayoum district hospital by 53.66% followed by snoris district hospital by 19.51%, that coincide with other research recorded that is only treatment is supportive like including gastric washing with sodium bicarbonate (alternatively the potassium permanganate), hydration, oral administration of charcoal, hyperbaric oxygen, Intravenous magnesium sulphates, treatment of acidosis, fluid resuscitation, vasopresors, digoxin and trimetazidine have been tried as well,

particularly when cardiogenic shock overwhelms the clinical picture (Mofrih et al., 2019).

CONCLUSION

Information obtained from this recorded study demonstrated that the pattern of AIP casualty is continuously expanding in Fayoum Governorate. The mortality because of AIP harming influences youthful females more than males. The issue winds up influencing both rural and urban individuals, single or married.

LIMITATIONS

It is a retrospective data collection and the general little example estimate with deficiency of data on the proven amount of AIP and its route of exposure. Also, there is absence of data on the exact time tardiness between admission of the patients and inception of treatment. The scarcity of a specific antidote adds further difficulties to every one of these exposures. The requirement for general wellbeing plans going for counteractive action, awareness, and conceivably the substitution of phostoxin or other aluminium phosphide pesticides with less risky is detailed.

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الملخص العربي

فوسفيد الألومنيوم هو مبيد حشري ومبيد للقوارض يستخدم لحماية الحبوب من القوارض والحشرات المنزلية الأخرى. هدف البحث هو دراسة عدد الوفيات لحالات اصابات فوسفيد الالمنيوم التي سجلت في مصلحة الطب الشرعي الشرعي بمحافظة الفيوم.

وفي هذا البحث قمنا بدراسة احصائية للوفيات الناجمة عن التسمم فوسفيد الومنيوم في محافظة الفيوم بين يونيو 2012 ويونيو 2019 (عدد الحالات التي تم تسجيلها 96 حالة). تم تقييم الحالات حسب: العمر ، الجنس ، الإقامة ، أعزب أو متزوج ، سبب الانتحار وتشريح الجثة.

أظهرت نتائج هذه الدراسة أن أغلبية الحالات كانت من الإناث (71.9%) ، ومتوسط عمر المتوفين 29 ± 9.9 تراوحت (من 20 إلى 60 سنة) ، 71 (74%) من المتوفين تتراوح أعمارهم بين (20 و 30 سنة) . ما يقرب من نصف الوفيات من محافظة الفيوم (46.9%) ، تليها منطقة سنوريس (21.9%). وأشار توزيع الوفيات إلى زيادة في عدد الوفيات خاصة في السنوات الأخيرة. وأظهرت الدراسة أن 96/24 (25%) من الحالات تم تسجيلها عام 2017. وفي عام 2018 ، ارتفع عدد الوفيات إلى 96/35 (36.5%). انطلاقاً من تاريخ القضية ، كانت جميع الوفيات في الدراسة (100%) محاولات انتحارية. غالبية الوفيات المذكورة في الدراسة 96/69 (71.9%) كانت لها أسباب مجهولة.

كان معدل الوفيات بسبب تسمم من فوسفيد الومنيوم هو السبب الأكثر ارتفاعاً للوفاة في الإناث الشباب والعنصر الأكثر تدميراً ذاتياً. يجب على السلطات المحلية وضع قيود على استخدام فوسفيد الومنيوم في جميع منافذ البيع.