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ORIGINAL ARTICLE

DEMOGRAPHIC AND CLINICAL PROFILES AND MORTALITY OF ALUMINIUM PHOSPHIDE POISONING CASES IN KHYBER PAKHTUNKHWA PROVINCE, PAKISTAN

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ABSTRACT

Background: The prevalence of aluminium phosphide (AlP) poisoning is on the rise in Asian countries. The objectives of our study were to determine the distribution of AlP poisoning by sex, age groups & district and its presentation by blood pressure category and oxygen saturation category and its mortality in Khyber Pakhtunkhwa Province, Pakistan.

Materials & Methods: This cross-sectional study was conducted at Emergency Department of Lady Reading Hospital, Peshawar, Pakistan from June 1, 2020 to September 30, 2020. Fifty eight cases of AlP registered during 2019 were included. The diagnosis was made by history and clinical suspicion. All these cases were managed by standard management protocols. Sex, age groups, district, blood pressure category, oxygen saturation category and presence of mortality were variables; all being categorical were analyzed by count and percentage with 80% confidence interval.

Results: Out of 58 AlP poisoning cases, women 34 (58.62%) were more than men 24 (41.38%), with most cases 30 (51.73%) in 10-19 years age group. Most cases 17 (29.31%) were from district Swabi, followed by district Peshawar 16 (27.58%). Most cases presented in non-recordable blood pressure category 19 (32.76%). Most cases 22 (37.93%) presented in oxygen saturation category of ≥ 90%. Out of 58 cases, mortality was 72.41% (42/58), involving more women 24/58 (41.38%) than men 18/58 (31.03%), with most cases 23 (39.66%) in 10-19 years age group. Mortality was highest in non-recordable blood pressure category 19 (32.76%). Mortality was highest 19 (32.76%) in oxygen saturation category of below 90%.

Conclusion: Aluminium phosphide (AlP) poisoning is an uncommon, but a dreadful public health problem in population of Khyber Pakhtunkhwa Province, Pakistan. It involves women more than men, with most cases in adolescent age group, and in non-recordable blood pressure category. AlP poisoning mortality is very high 72.41% in our population, involving more women than men, with most cases in adolescent age group. Mortality is highest in non-recordable blood pressure category and in oxygen saturation category of below 90%.

KEY WORDS: Aluminium Phosphide; Poisoning; Mortality; Blood Pressure; Hypotension; Ingestion; Sex; Age Groups; Pakistan; Asia.

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1. INTRODUCTION

1.1 Background: Each year, nearly 300,000 people die due to pesticide poisoning around the globe. The most familiar pesticides are organophosphates and phosphides. Among phosphides, aluminium phosphide (AlP), the active substance present in wheat pills, is vastly utilized in agricultural communities as a pesticide that kills rodents.[1] The pill contains around 44% inert elements to avoid disintegration of the tablet, while the rest (about 56%) is

aluminium phosphide. The lethal dose of aluminium phosphide is between 0.15 and 0.5 grams (0.0053 and 0.0176 oz). Aluminium phosphide is available in the form of 3 gm pellets (releasing 1 gm phosphine gas) or 0.6 gm pellets (releasing 0.2 gm phosphine gas).[2]

The mechanism of action consists of the formation of phosphine gas as the end product that results in damage to mitochondria by the action of free radicals. It causes conformational changes in mitochondria and inhibits oxidative respiration up to 70%.[3,4] Phosphine gas induces damage to cell membranes by inhibition of acetyl cholinesterase, inhibition of peroxidase and/ or inhibition of glycerol phosphate dehydrogenase.[5] Multiple researches show that phosphides result in the formation Heinz bodies by denaturing hemoglobin, which causes intravascular hemolysis and methemoglobinemia. This leads to fatal complications such as gastritis, hepatic necrosis, disseminated intravascular coagulation, cardiac arrhythmia, metabolic acidosis, congestive heart failure, hypotensive shock and eventually multi-organ dysfunction syndrome.[3] Hypotension was the commonest presenting complaint of wheat pill poisoning followed by vomiting.[6]

The management of aluminium phosphide poisoning mainly consists of supportive measures as there is no specific antidote. The cardinal supportive measures comprise of securing air way, optimizing blood pressure and to prevent hypoxia of the tissues. Severity of the intoxication can be observed by serial blood levels of phosphine (PH3) during the acute intoxication.[7] Gastric lavage with potassium permanganate and mineral oil or coconut oil shows a decrease in mortality.[8] Hypotensive shock as a manifestation of wheat pill poisoning is often recurrent and usually requires aggressive resuscitation via IV fluids guided by central venous pressure (CVP) and a pulmonary capillary wedge pressure (PCWP). As a consequence of fluids resistant hypotension, low dose dopamine (at 4-6 µg/kg/min) should be administered to keep systolic blood pressure above 90 mmHg. IV hydrocortisone (200-400mg q 4- 6 hours) aids in dopamine dose reduction and prevents development of acute respiratory distress syndrome (ARDS) by inhibition of capillary leakage in the lungs. In addition, the renal route can be utilized to increase the excretion of phosphine by giving IV furosemide if the systolic BP is greater than 90 mmHg. IV sodium bicarbonate (50-100mEq q 8 hours) should be used in order to achieve the target bicarbonate level of 18-20 mEq/L. A small number of case studies have shown beneficial effects of digoxin in the management of refractory cardiac shock.[9] In 12-24 hours of initial presentation of acute aluminium phosphide poisoning, cardiovascular issues such as hypotension and/ or arrhythmias have been the most common causes of morbidity. The next 24 hours are associated with liver failure as the usual cause of death.[6] All patients with AlP poisoning require cardiac monitoring and electrolytes, such as potassium and magnesium replacement. Low magnesium might lead to Torsades de Pointes and ventricular fibrillation, which should be managed according to the ACLS guidelines. Although debatable, magnesium replacement is the only intervention linked to decreased mortality in AlP poisoning.[10] Magnesium replacement has also been shown to provide an anti-peroxidant effect. Chugh, et al. illustrated the effect of magnesium to prevent free radicals induced damage which is gradual and autonomous of phosphine elimination.[11] Some case reports indicate development of arrhythmias such as the Brugada syndrome like toxic myocarditis in AlP poisoning.[12] Heart failure is commonly associated with acute pulmonary edema.[13] Hypotensive shock can be treated with ionotropic support, digoxin and trimetazidine. Trim etazidine helps to halt ventricular ectopic beats and bigeminy and conserves oxidative metabolism.[14] A few case reports designate the effects of coconut oil in the acute management of AlP poisoning.[8] Shahdina, et al. reported reduced absorption of phosphine gas as a major effect of coconut oil, which has been shown to be efficacious even after 6 hours of acute aluminum phosphide ingestion. Some animal studies revealed that hyperbaric oxygen therapy might result in an improvement of survival in animals exposed to aluminum phosphide. N-acetylcysteine (NAC), being an antioxidant, reduces mortality in acute AlP poisoning. In a randomized controlled trial conducted in Iran, NAC lowered the period of hospitalization, need for intubation and ventilation.[15] In general, AlP poisoning patients show poor prognosis with mortality nearly 70%. Poor prognostic signs in AlP poisoning include, low Glasgow coma scale, shock, ECG changes, low prothrombin rate, hyperleukocytosis, use of mechanical ventilation, use of vasoactive drugs and high APACHE II (Acute Physiology and Chronic Health Evaluation II).[16]

From January 1997 to June 2003, 93 cases of aluminum phosphide exposures were reported to the National Poisons Information Service, London; 8 aluminium phosphide ingestions, 57 inhalational cases of phosphine gas, 3 topical exposures, 11 oral/ inhalational or oral/ topical and 14 with unknown exposure route. Among these cases, 17 were asymptomatic, 33 had respiratory symptoms, and 27 had gastrointestinal symptoms. Only one death of an 80 year old male was reported. However, majority of the cases were caused by accidental, comparatively restricted exposure in agricultural environments to phosphine gas. The incidences of self-induced AlP poisoning cases do not seem to be growing.[17] A North Indian study reported it to be the most common way of committing suicide in

the region.[18,19] Among 559 cases of acute poisoning in India, 68% were as a result of AlP exposure, with 60% mortality.[19] Gupta and Ahlawat have also validated this suicidal AlP poisoning epidemic.[20] In the period between 1977 and 1987, barbiturates (33.3%), organophosphates (23.8%), and copper sulphate (14.3%) were the most common suicidal agents and from 1987 to 1997, they were substituted by organophosphates (45 %) and AlP (26.5%). Since 1992, AlP has taken lead with as much as 80% of the total cases. The incidence of suicidal deaths grew from 10.9% (1987 to 1992) to 15.7% (1997 and 2002), with the highest occurrence of 18.2% (1992 to 1997), as AlP became available on the free market. Of all deadly toxins, both suicidal and accidental between 1987 and 1997, AlP attributed to 26.5%. AlP proved to be the most common poison to commit suicide, accounting for 68.4% of total fatalities due to poisoning in 10 years (1992 to 2002). Another study carried out in Tehran, Iran concluded that there was a noteworthy rise ($p < 0.05$) in mortality due to phosphine poisoning in an 8-year period.[21] The rate of AlP poisonings in Iran has also been shown to be high; among 471 cases reported from 2000 to 2007, 146 (31 %) were lethal,[22] which is increasingly worrying considering the fact that AlP marketing is illegal in Iran. A study conducted in Saudi Arabia reported death rate in AlP poisonings was highest among children and a majority of them occurred during fumigation of households. In developed states such as the UK, however, AlP is available in the form of pills, but supply is regulated under the 1998 Pesticides Act to certified customers.[17] AlP tablets are only rarely used in European countries to commit suicides and a small number of cases have been reported in the UK, Denmark, Germany and France. Demographic data for Pakistani population, however, is not available.[6]

1.2 Research Objectives (ROs): The objectives of our study were;

RO 1-3: To determine the distribution of aluminium phosphide poisoning by sex, age groups & district in Khyber Pakhtunkhwa Province, Pakistan.

RO 4-5: To determine the presentation of aluminium phosphide poisoning by blood pressure and oxygen saturation in Khyber Pakhtunkhwa Province, Pakistan.

RO 6-8: To determine the prevalence of aluminium phosphide poisoning mortality and its distribution by sex and age groups in Khyber Pakhtunkhwa Province, Pakistan.

RO 9-10: To determine the presentation of aluminium phosphide poisoning mortality by blood pressure and oxygen saturation in Khyber Pakhtunkhwa Province, Pakistan.

1.3 Significance: Having in hand the local data on demographic profile, clinical profile and mortality of aluminium phosphide poisoning cases in Khyber Pakhtunkhwa Province, Pakistan, we can formulate indigenous guidelines for diagnosis and treatment of such cases. This data base will help other researcher working on this title, and other titles on its association to socio-demographic factors.

2. MATERIALS AND METHODS

2.1 Design, Setting & Duration: This cross-sectional study was conducted at the Emergency Department of Lady Reading Hospital, Peshawar, Pakistan from June 1, 2020 to September 30, 2020. This hospital is the oldest and largest teaching hospital of the Khyber Pakhtunkhwa province and has largest inflow of casualty patients. The data for the year 2019 was retrospectively observed for AlP cases after permission was sought from relevant authorities.

2.2 Sample Selection & Conduct of Procedure: Fifty eight (58) cases of AlP registered during the year 2019 were included. There were no exclusion criteria. The diagnosis was made by history and clinical suspicion. All these AlP poisoning cases were managed by standard management protocols. Air way was secured. IV line was secured. Vitals and oxygen saturation were monitored. Where appropriate, gastric lavage, IV fluids, inotropic support, dopamine, calcium sulphate, calcium gluconate and magnesium sulphate were given.

2.3 Data Collection & Analysis Plan: Sex (men/women), age groups (six), district (nine), blood pressure category and oxygen saturation category were demographic/ grouping variables (factors), while presence of mortality was a research variable. All these variables were measured on categorical scale and were analyzed by count and percentage. Estimation of parameters for the population was described by confidence interval at 80% confidence level, using an online statistical calculator "Statistics Kingdom" by normal approximation method.

3. RESULTS

3.1 Distribution of AlP poisoning by sex and age groups (RO 1-2): Out of a sample of 58 AlP poisoning cases and based on their confidence intervals, the frequency of AlP poisoning was higher in women 34 (58.62%) than men 24 (41.38%). The frequency was highest 30 (51.73%) in 10-19 years (adolescence) age group, which was steadily lower in higher age groups, and was zero in 60+ years age group (elderly). (Table 3.1)

3.2 Distribution of AlP poisoning by district (RO 3): Most of the AlP poisoning cases were from district Swabi 17 (29.31%), followed by district Peshawar 16 (27.58%) cases. (Table 3.2)

3.3 Presentation of AlP poisoning by blood pressure category (RO 4): Most AlP poisoning cases 19 (32.76%) presented in non-recordable blood pressure category. (Table 3.3)

Table 3.1: Distribution of aluminium phosphide poisoning by sex and age groups in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variables	Attributes	Sample statistics		80% CI for proportion	
		Count	Percentage	Lower	Upper
Sex	Men	24	41.38	33.44	49.79
	Women	34	58.62	50.20	66.55
Age groups	10-19 years	30	51.73	43.31	60.13
	20-29 years	18	31.04	23.24	38.81
	30-39 years	06	10.34	06.26	16.60
	40-49 years	03	05.17	02.52	10.28
	50-59 years	01	01.72	00.51	05.58
	60+ years	00	0	-	-
Total		58	100%	Population parameters	

Table 3.2: Distribution of aluminium phosphide poisoning by district in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variable	Attributes	Sample statistics		80% CI for proportion	
		Count	Percentage	Lower	Upper
District	Swabi	17	29.31	22.30	37.45
	Peshawar	16	27.58	20.76	35.64
	Mardan	07	12.07	07.60	18.61
	Charsadda	05	08.62	04.96	14.55
	Buner	04	06.90	03.71	12.45
	Malakand	03	05.17	02.52	10.28
	Nowshehra	02	03.45	01.44	08.01
	Kohat	02	03.45	01.44	08.01
	Timergara	02	03.45	01.44	08.01
Total		58	100%	Population parameters	

Table 3.3: Presentation of aluminium phosphide poisoning by blood pressure category in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variables	Attributes	Sample statistics		80% CI for proportion	
		Count	Percentage	Lower	Upper
Blood Pressure category (mmHg)	Non-recordable	19	32.76	25.43	41.03
	Below 62/42	06	10.34	06.26	16.60
	62/42-91/61	13	22.42	16.21	30.13
	92/62-131/91	14	24.14	17.71	31.98
	Above 131/91	06	10.34	06.26	16.60
Total		58	100%	Population parameters	

3.4 Presentation of AIP poisoning by oxygen saturation category (RO 5): Most AIP poisoning cases 22 (37.93%) presented in oxygen saturation category of ≥ 90%. (Table 3.4)

3.5 Prevalence of AIP poisoning mortality & its distribution by sex and age groups (RO 6-8): Out of 58 AIP poisoning cases, 42 died, so mortality was 72.41% (80%CI, 64.35-79.23). The frequency of mortality was higher in women 24/58 (41.38%) than men 18/58 (31.03%). The frequency of mortality was highest 23 (39.66%) in 10-19 years (adolescence) age group, which was steadily lower in higher age groups. (Table 3.5)

3.6 Presentation of AIP poisoning mortality by blood pressure category (RO 9): The frequency of AIP poisoning mortality was highest as 19 (32.76%) in non-recordable blood pressure category and was lowest as one (1.72%) in highest blood pressure category of above 131/91. (Table 3.6)

Table 3.4: Presentation of aluminium phosphide poisoning by oxygen saturation category in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variables	Attributes	Sample statistics		80% CI for proportion	
		Count	Percentage	Lower	Upper
Oxygen saturation category (%)	Below 90	19	32.76	25.43	41.03
	≥ 90	22	37.93	30.20	46.32
	Unknown	17	29.31	22.30	37.45
Total		58	100%	Population parameters	

Table 3.5: Distribution of AIP poisoning mortality by sex and age groups in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variables	Attributes	Sample size	Sample statistics		80% CI for proportion	
			Count	Percentage	Lower	Upper
Sex	Men	24	18	31.03	23.86	39.25
	Women	34	24	41.38	33.44	49.79
Age groups	10-19 years	30	23	39.66	31.81	48.06
	20-29 years	18	10	17.24	11.81	24.47
	30-39 years	06	05	08.62	04.96	14.55
	40-49 years	03	03	05.17	02.52	10.28
	50-59 years	01	01	01.72	00.51	05.58
Total deaths		58	42	72.41%	64.35	79.23
No deaths		58	16	27.58%	20.76	35.64
Total (n)		58	58	100%	Population parameters	

Table 3.6: Presentation of aluminium phosphide poisoning mortality by blood pressure category in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variables	Attributes	Sample size	Sample statistics		80% CI for proportion	
			Count	Percentage	Lower	Upper
Blood Pressure category (mmHg)	Nonrecordable	19	19	32.76	25.43	41.03
	Below 61/41	06	06	10.34	06.26	16.60
	62/42-91/61	13	11	18.97	13.25	26.38
	92/62-131/91	14	05	08.62	04.96	14.55
	Above 131/91	06	01	01.72	00.51	05.58
Total deaths		58	42	72.41%	64.35	79.23
No deaths		58	16	27.58%	20.76	35.64
Total (n)		58	58	100%	Population parameters	

Table 3.7: Presentation of aluminium phosphide poisoning mortality by oxygen saturation in Khyber Pakhtunkhwa Province, Pakistan (n=58)

Variables	Attributes	Sample size	Sample statistics		80% CI for proportion	
			Count	Percentage	Lower	Upper
Oxygen saturation category (%)	Below 90	19	19	32.76	25.43	41.03
	≥ 90	22	09	15.51	10.38	22.54
	Unknown	17	14	24.14	17.71	31.98
Total deaths		58	42	72.41%	64.35	79.23
No deaths		58	16	27.58%	20.76	35.64
Total (n)		58	58	100%	Population parameters	

3.7 Presentation of AIP poisoning mortality by oxygen saturation category (RO 10): The frequency of AIP poisoning mortality was highest 19 (32.76%) in oxygen saturation category of below 90% and lowest 9 (15.51%) in oxygen saturation category of ≥ 90%. (Table 3.7)

4. DISCUSSION

4.1 Distribution of AIP poisoning by sex and age groups (RO 1-2)

Our study showed higher frequency of AIP poisoning in women 34/58 (58.62%, 80%CI, 50.20-65.55) than men 24/58 (41.38%, 80% CI, 33.44-49.79). (Table 3.1)

Similar to our study, higher frequency for women 59.1% (65/110) than men 49.9% (45/110) was reported by Qureshi, et al.[23] from Sahiwal, Pakistan for year 2017, by Soltaninejad, et al.[24] from Tehran, Iran, from 2007 to 2010 as 54.71% (95%CI, 51.55-57.83) (523/956) women and 45.29% (95%CI, 42.13-48.46) (433/956) men, by Alnaseer, et al.[1] from a nationwide study from Saudi Arabia for the period from 2006-2017, with 56% (38/68) women and 44% (30/68) men, and by Louriz, et al.[16] from Rabat, Morocco from January 1992-December 2007, reporting 63.27% (31/49) women and 36.73% (18/49) men.

Contrary to our study, similar frequency of AIP poisoning in men and women was reported by Iftikhar, et al.[6] from Kharian, Pakistan, from July 1, 2009 to December 30, 2010, showing 25/52 (48.1%, 80%CI 39.39-56.87) men and 27/52 (51.9%, 80%CI 43.12-60.60) women, and Shadnia, et al.[22] from Tehran, Iran from January 2000 to January 2007, reporting 246/471 (52.23%, 95% CI, 47.71-56.70) men and 225/471 (47.77%, 95% CI, 43.29-52.28) women, and Etemadi-Aleagha, et al.[21] from Tehran, Iran for the period from 2006-2013 in a toxicological/ autopsy study, reporting 967 (48.18%) men and 1,040 (52.82%) women. There is overlap between the two confidence intervals, hence similar.

Opposite to our study, higher frequency of AIP poisoning was shown in men 48/77 (62.34%) than women 29/77 (37.66%) by Navabi, et al.[25] from Kermanshah province, Iran, from 2014 to 2015.

In our study, the frequency AIP poisoning was highest 30 (51.73%) in 10-19 years (adolescence) age group, followed by steady decrease as 18 (31.04%) in 20-29, six (10.34%) in 30-39, three (05.17%) in 40-49, one (01.72%) in 50-59 years and zero cases in 60+ years age group (elderly). (Table 3.1)

Qureshi, et al.[23] from Sahiwal, Pakistan for year 2017, reported highest frequency 48/110 (43.64%) for age group 21-30 years, followed by 46/110 (41.82%) in age group 12-20, 12/110 (10.90%) in 31-40 and 4/110 (3.64%) in age group >40 years.

Shadnia, et al.[22] from Tehran, Iran reported highest frequency 311/471 (66.02%) for age group 21-40 years, followed by 104/471 (22.08%) in age group 12-20, 42/471 (8.92%) in 41-60 and 14/471 (2.98%) in age group >60 years.

Soltaninejad, et al.[24] from Tehran, Iran reported highest frequency 563/956 (59%) for age group 21-40 years, followed by 249/956 (26%) for age group 12-20, 115/965 (12%) for 41-60 and 29/965 (3%) for age group >60 years.

Alnaseer, et al.[1] from Saudi Arabia reported highest frequency 42/68 (61.77%) for age group 0-20 years, followed by 19/68 (27.94%) for age group 21-40 and 7/68 (10.29%) for 41-60 years age group.

It is evident from all the studies describing frequencies by age groups that as the age groups go higher, the number of cases is decreased. This might be due to the fact that youngsters are emotionally and mentally less stable as compared to adults and therefore, contribute to a higher number of self-poisonings in general.

4.2 Distribution of AIP poisoning by district (RO 3): In our study, most of the AIP poisoning cases were from district Swabi 17 (29.31%), followed by district Peshawar 16 (27.58%) cases. (Table 3.2)

These two areas are rich in agricultural land and thus, preservation requires the vast use of wheat pills.

Thus, easy access of people to wheat pills in Swabi and Peshawar might contribute to the observed high number of cases. No relevant studies were available for comparison.

4.3 Presentation of AIP poisoning by blood pressure category (RO 4): In our study, most of the AIP poisoning cases 19 (32.76%) were in non-recordable BP category, followed by 14 in 92/62-131/91, 13 in 62/42-91/61 and six each in <62/42 & >131/91 categories. (Table 3.3)

No relevant studies were available for comparison.

4.4 Presentation of AIP poisoning by oxygen saturation category (RO 5): In our study, most of the AIP poisoning cases 22 (37.93%) were in oxygen saturation category of ≥90%, followed by 19 (32.76%) in below 90% and 17 (29.31%) in unknown category. (Table 3.4)

No relevant studies were available for comparison.

4.5 Prevalence of AIP poisoning mortality & its distribution by sex and age groups (RO 6-8): In our study, frequency of AIP poisoning mortality was 42/58 (72.41%, 80%CI, 64.35-79.23). Similar mortality to our study was reported in 1995 by Siwach, et al.[18] from Haryana, India as 67.6%. Lower mortality than our study was reported by Qureshi, et al.[23] from Sahiwal, Pakistan 56.36% (62/110), Shadnia, et al.[22] from Tehran, Iran 31% (146/471), Navabi, et al.[25] from Kermanshah province, Iran 53.25% (41/77), Soltaninejad, et al.[24] from Tehran, Iran, from 2007 to 2010 as 24.06% (230/956), Alnaseer, et al.[1] from Saudi Arabia 32.35% (22/68) and Louriz, et al.[16] from Rabat, Morocco 49% (24/46). Higher mortality than our study was reported by Iftikhar, et al.[6] from Kharian, Pakistan 85.54% (45/52).

In our study, AIP poisoning mortality was higher in women 24/58 (41.38%, 80%CI, 33.44-49.79) than men 18/58 (31.03%, 80%CI, 23.86-39.25). (Table 3.5) Contrary to our findings, similar mortality in men 117/956 (12.24%) and women 113/956 (11.82%) was reported by Soltaninejad, et al.[24] from Tehran, Iran, and by Alnaseer, et al.[1] from Saudi Arabia as 10/68 (14.70%, 80%CI, 09.20-20.21) in men and 12/68 (17.65%, 80%CI, 11.72-23.57) in women. Opposite to our study, Shadnia, et al.[22] from Tehran, Iran reported higher mortality in men 107/471 (22.72%) than women 39/471 (8.28%).

In our study, AIP poisoning mortality was highest 23 (39.66%) in 10-19 years (adolescence) age group, followed by steady decrease as 10 (17.24%) in 20-29, five (08.62%) in 30-39, three (05.17%) in 40-49 and one (01.72%) in 50-59 years age group. (Table 3.5) Alnaseer, et al.[1] from Saudi Arabia reported highest AIP poisoning mortality 42/68 (61.77%) in age group 0-20 years, followed by 19/68 (27.94%) for age group 21-40 and 7/68 (10.29%) for age group 41-60 years.

Soltaninejad, et al.[24] from Tehran, Iran reported highest AIP poisoning mortality 126/956 (13.18%) for age group 21-40 years, followed by 74/956 (7.74%) for age group 12-20, 25/965 (2.62%) for 41-60 and 5/965 (0.52%) for age group >60 years.

4.6 Presentation of AIP poisoning mortality by blood pressure category (RO 9): In our study, AIP poisoning mortality was highest 19 (32.76%) in non-recordable BP category, followed by 11 (18.97%) in 62/42-91/61, six (10.34%) in below 61/41, five in 92/62-131/91 and one in above 131/91 category. (Table 3.6) No relevant studies were available for comparison.

4.7 Presentation of AIP poisoning mortality by oxygen saturation category (RO 10): In our study, AIP poisoning mortality was highest 19 (32.76%) in oxygen saturation category of below 90%, followed by 14 (24.14%) in unknown category and lowest as nine (15.51%) in oxygen saturation category of ≥ 90%. (Table 3.7) No relevant studies were available for comparison.

5. CONCLUSIONS

Aluminium phosphide (AlP) poisoning is an uncommon, but a dreadful public health problem in population of Khyber Pakhtunkhwa Province, Pakistan. It involves women more than men, with most cases in adolescent age group, which steadily decreases in higher age groups, with no case in 60+ years. Most cases present with non-recordable blood pressure.

AIP poisoning mortality is very high 72.41% in our population, involving more women than men, with most cases in adolescent age group, which steadily decreases in higher age groups. Mortality is highest in non-recordable blood pressure category, which steadily decreases with high blood pressure categories. Mortality is highest in oxygen saturation category of below 90%.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.