

Knowledge regarding Aluminum Phosphide (Rice Tablet) Uses and Hazards among Women at Assiut District Villages

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Abstract

Background: Aluminum phosphide (AIP) or Rice tablet is one of the most lethal poisoning in Egypt, with high mortality rate. Aluminum phosphide hazards are known with no specific antidote exist. Nearly 300,000 people die due to Aluminum phosphide poisoning in the world every year. Aluminum phosphide usage is quite common in the rural areas, causing serious health issues and in some cases fatalities. **Aim of the study:** Assess the women's knowledge regarding Aluminum phosphide uses and hazards at Assiut District Villages. **Methodology:** Cross sectional community-based study was used, that included 425 women. **Sample:** A multistage sampling procedures was applied at Assiut district villages. **Tools:** An interviewer questionnaire was used. It included personal characteristics, medical history and knowledge about Aluminum phosphide uses and hazards. **Results:** the majority of studied women had low knowledge scores (86.8%) while only (13.2%) had moderate knowledge scores regarding Aluminum phosphide uses and hazards. The association between knowledge and personal characteristics data indicates statistically significant differences between knowledge and who having chronic diseases. **Conclusion:** A low level of knowledge regarding Aluminum phosphide uses and hazards was detected among rural women. **Recommendations:** There is a need for continuous Aluminum phosphide educational programs for rural women to increase their awareness regarding Aluminum phosphide uses and hazards.

Keywords: Aluminum phosphide, District, knowledge, Rice tablet, Villages & Women.

Introduction:

Aluminum phosphide (AIP) usage increases in recent years for improving agricultural produce all over the world especially in rural areas (Mohan et al., 2022). It is commonly used in Asian, Middle Eastern, India, Iran, African countries and Egypt (Abdurhman et al., 2022). AIP used extensively in rural areas of Egypt as a cheap rodenticide, insecticide, and fumigant for storing and transport cereal grains such as in silos, ships, and trains. It is also used to kill small verminous mammals such as moles and rodents. Because of it is a deadly insecticide, many cases of accidental poisoning have been reported in the last years (Elshama, 2022 & Ali et al., 2023)

Aluminum phosphide is known in Egyptian market as pest pills or wheat pills besides rice tablet, which marketed as 3-gram dark grey green-yellow tablet and the common brand names are Celphos, AIPhos, Synfume, Phostek, Phostoxin, Phosfume and Quickphos (Bogale et al., 2021).

The major component of AIP is phosphine gas. Pure phosphine is colorless, flammable and toxic with a distinct odor of garlic or decaying fish and chemical formula PH₃ (Arora et al., 2023).

According to numerous studies, AIP toxicities originate from three main routes including: direct oral

consumption, inhalation of air containing phosphine gas, and absorption via skin or eyes (Lorenz, 2022).

The mechanism of AIP toxicity is Non-competitive blockade of cytochrome C oxidase, leads to the inhibition of cellular respiration which negatively affects mitochondria and myocardial proteins and cause dis-hemoglobinemia which can yield high CO₂ findings thus organs such as heart, lung, kidney, and liver with higher oxygen demands, are more sensitive to PH₃-induced damage (Salimi et al., 2022).

Individuals who use AIP in their homes, living near agricultural fields, youth, geriatric individuals and women were at risk for AIP hazards and as a result they become ill, especially if they do not carefully follow the instructions on the AIP label (United state, environmental protection agency, 2023). In particular, if children especially toddlers don't receive proper attention and intervention, they may be accidentally poisoned by AIP. Whereas adolescents are more severely poisoned if attempting self-harm through intentional ingestion (Varghese & Erickson, 2022).

Aluminum phosphide exposure usually induces multiple signs and symptoms include nausea and vomiting, epigastric and retrosternal pain, dyspnea, anxiety, irritability, and garlic or spoiled fish odor

from breath (Garg, 2020). Other manifestations include dizziness, chest tightness, headache, diarrhea, ataxia, numbness, parasthesia, tremor, muscular weakness, and diplopia (Alnasser et al., 2018).

Repeated exposure to AIP may cause:

Anemia, bronchitis, gastrointestinal disorders, speech and motor disturbances, weakness, weight loss, spontaneous fractures, jaw swelling, cardiac failure, acute respiratory distress syndrome (ARDS), dysrhythmia, seizures, coma, liver and kidney damage and death (Deraz et al., 2022).

Because of AIP designed to kill living organisms, it needs to be handled with great care. Thus, non-use or inappropriate personal protective equipment (PPE) such as gloves and mask, non-adherence to manufacturers' safety guides, incorrect application techniques, poorly maintained and improper storage of AIP and smoking, eating, drinking kola and nuts, while wearing PPE or with contaminated hands were specific contributing factors for increased morbidity and mortality among people exposed to AIP hazards (Nwadike et al., 2021).

Aluminum phosphide hazard depends on the length of exposure and the amount that enters the body. So, lack of knowledge about safety dealing with AIP is most important factor contributing to high mortality rate from AIP hazards (Gümüş et al., 2017). Therefore, understanding women's level of knowledge regarding the safe use and handling of AIP is vital for providing sound educational strategies to eliminate the health and environmental hazards caused by AIP (Jallow et al., 2017).

Community health nurse plays an important role in preventing AIP exposure hazards. As trusted source of information, they can positively influence people behavior, and can provide important anticipatory guidance regarding AIP exposure hazards (Sales & Oliveira, 2019).

They should educate women to Store AIP only in their original containers, and keep the original label attached to the container. Store AIP in a locked cabinet and/or on a high shelf to keep out of the reach of children. Never use mouth to clear a spray line or to siphon AIP from a tank or container. After handling or working with AIP, wash hands and face thoroughly with soap and water before eating, drinking, or smoking (Lorenz, 2022).

Also, educating people about use appropriate PPE that in clean and operating condition, wear the PPE correctly and according to the manufacturer's instructions, inspect all PPE before each time of use for leaks, make sure that used mask fits correctly without holes or tears and discard any damaged equipment (United states, 2023).

Significance of the study

Aluminum phosphide poisoning cases in Egypt began to increment, and records of patients started to appear for a sensible extent. Research study in Menoufia poisoning center reflect 116 cases of AIP poisoning in 2019 (El-Farouny & helmy, 2021).

Between January 2021 and June 2022 AIP poisoning cases in Assiut University Hospital were 376 cases from Assiut Governorate, including 157 (41.75%) cases from Assiut District (Assuit UniversityHospitals, 2022).

Aluminum phosphide poisoning has a high mortality rate (90%), and to date, no antidote is available. Majority of the farmers were found to be unaware of the hazards and risks of not handling AIP correctly (Sedaghattalab, 2022). Moreover, no published studies have explored the save uses and hazards of AIP. So, it's important to assess the knowledge of women about AIP uses and hazards.

Aim of the Study:

The current study aiming to assess women knowledge regarding AIP uses and hazards at Assuit District Villages.

Research question:

What is the level of rural women's knowledge regarding AIP uses and hazards?

Subjects and Methods

Research design:

Cross sectional community-based study was used.

Setting:

This study was carried out in some villages at Assuit District because of common use of AIP in this area. Assuit district has 16 Village in west and 12 Village in east.

Sample size:

The sample size was estimated using the EPI info (ver. 7) statistical package Version 7.2.01. To get the maximum representative sample size. The parameters used to estimate the sample size included a margin of error 5% and 95% confidence interval level. Sample size was 384 women and after adding 10% as non-response rate it was raised up to 425.

Sample technique:

A multi stage sampling procedures was applied, which include:

First stage:

Simple random sample was used to choose the Villages. We chose randomly three Villages from west and two from east. (By putting the names of Assiut district villages in papers, then these villages were chosen randomly)

Second stage:

Proportionate sample was applied for choosing the number of studied populations from the selected Villages.

Third stage:

Systematic random sample method was used for selecting the houses in the selected villages. And include one woman from each family.

Village	Number of families	Class Interval	First Random
Elwan	3089	39	9
Masraa	3403	38	19
Refa	5754	39	28
Awlad Ebrahim.	2994	39	22
Bani Hussainvillages	1188	41	8

Exclusion criteria

- Women don't deal with AIP or didn't used it.
- Women below age 18 years old.

Tool of the study

A structured interview questionnaire sheet was designed by the researchers based on relevant literature on how to collect data from respondents. It includes one tool:

Part (I): It include personal characteristics of rural women. It included age, sex, residence, marital status, living with any one in house, educational level, housing condition, occupation, attend training program on AIP handling, previous family history of AIP hazards or poisoning and what she did toward this case and history of having chronic disease.

Part (II): It include knowledge about AIP uses and hazards. It includes uses, exposure routes, population at risk, AIP signs and symptoms of toxicity and its hazards. (Farahata et al., 2016 & Obonyo, 2017). Each item had two possible responses yes or no, item responded with yes was scored 1 (correct) and no was scores 0 (incorrect).

Scoring system of AIP uses and hazards knowledge:

A point was given for correct answers and zero was given for incorrect answers. A total score was calculated for each participant. The 37 items were summed, a percent for the summed score was calculated ($\text{score} \div 37 \times 100$). Based on following cut off level women' knowledge were categorized into low level of knowledge for percentage knowledge <60%, moderate level of knowledge for percentage knowledge more than 60% to 80%, and high knowledge for percentage knowledge more than 80%. (Jambari et al., 2020)

Validity of the study tool:

The content validity of the tool was reviewed by (5) experts (3) in Community Health Nursing field, and (2) expert in Forensic Medicine and clinical toxicology field, Assiut University to evaluate the validity of the tools. All comments and suggestions were considered and rewording and sequence of some statements was carried out accordingly.

Reliability of the study tool:

Internal consistency for the used questionnaire were calculated. The values of calculated Cronbach's Alpha reliability were 0.706 for knowledge regarding uses and hazards of AIP.

Methods:**Preparatory phase**

- Before carrying out this study statistics, was obtained from the Directorate of Health Affairs in Assiut district about the number of villages in Assiut district, including the number of women, men, households and families.
- Oral approval from influential leaders and health authorities in these villages to support our study.
- An official permission letter was taken from the Dean of Faculty of Nursing, Assiut University. The letter includes a permission to carry out the study.

Pilot study

Pilot study was carried out before starting data collection on 10% of total calculated sample (43 women). The aim of this study was to test the clarity of tools and estimate the required time to fill the questionnaire. Based on the result of a pilot study, no modification in the tool was done, so that it included in the study.

Data collection phase (field work).

Data collection started from the first of June, 2023 to the end of September, 2023. Data was collected in three days/ week from 9 A.M to 3P.M, and nine questionnaires were collected daily. Filling of the questionnaire was taken from 25-30 minutes. After collecting data, a brochure was given for all studied women included all information about uses and hazards of AIP.

Ethical considerations:

Research proposal was approved from the Ethical Committee in the Faculty of Nursing-Assiut University; there is no risk for the studied rural women during the application of the research. The study followed the common ethical principles in clinical research. Written informed consent was taken from all studied women before the study enrollment with explanation of the nature and purpose of the study. They have the right to refuse to participate or withdraw from the study without any rationale at any time. Privacy and confidentiality of participant were ensured.

Statistical analysis

The collected data were computerized and statistically analyzed using Statistical Package for Social Science program (SPSS) version 27. Quantitative data were expressed as mean \pm SE (standard error), while

qualitative data were expressed as frequencies and relative percentages. Testing data normality was performed and appropriate statistical tests were used, e.g., Mann-Whitney U Test was used to assess the statistical significance difference of a non-parametric variable between two study groups and Kruskal-

Wallis Test were used to assess the statistical significance of a non-parametric variable between more than two study groups in not normally distributed data. Correlation analysis was used to assess the strength of association between two quantitative variables. P value: <0.05

Results:

Table (1): Frequency of women's personal characteristics data at Assuit District Villages, 2023 (n=425)

Personal characteristics	No.425 (%)
Age: (years)	
>40 years old	278 (65.4)
More than 40 years old	147 (34.6)
Residence	
Refa	149 (35.1)
Masara	90 (21.2)
Elwan	80 (18.8)
Awlad Ebrahim	77 (18.1)
Bani Hussain Villages	29 (6.8)
Marital status	
Single	32 (7.5)
Married	374 (88.0)
Divorced	5 (1.2)
Widow	14 (3.3)
Who do you live with	
With my husband	338 (79.5)
With my husband family (other than my mother-in-law)	21 (4.9)
With my mother in law	11 (2.6)
with my mother	38 (8.9)
others (Children)	17 (4.0)
Education	
Illiterate	118 (27.8)
Basic education	75 (17.6)
Secondary (high school)	118 (27.8)
Intermediate education	53 (12.5)
University education	61 (14.4)
Housing condition	
Good ventilated	350 (82.4)
Poor ventilated	75 (17.6)
Occupation	
House wife	288 (67.8)
Employee	119 (28.0)
Skilled worker	18 (4.2)
Attend training program on AIP handling	
No	425(100.0)
Positive family history of AIP poisoning or its hazards	
Yes	90 (21.2)
No	335 (78.8)
Action when poisoning or hazards occurs	
Transfer to hospital	40 (9.4)
Give water with salt	33 (7.8)
Give coconut oil	-
Others (Give old cheese, lemon juice and hot sauce)	17 (4.0)
I didn't do anything	335 (78.8)

Table (2): Distribution of women by their medical history at Assuit District Villages, 2023 (n=425).

Medical history [#]	No.425 (%)
Do you have any chronic disease	
Yes	157 (36.9)
No	268 (63.1)
If, yes (No = 157)	
Renal disease	12 (7.6)
Heart disease	29 (18.5)
Hypertension	80 (51.0)
Diabetes	45 (28.7)
Reproductive problems	5 (3.2)
Others (chest allergy, Arthritis, Hypotension, Cancers, Epilepsy, Hypothyroidism)	62 (39.5)
Duration of chronic disease	
Less than 3 months	7 (4.5)
From 3 to 6 months	43 (27.4)
More than 6 months	107 (68.1)
Are you receiving your medication	
Yes	135 (85.9)
No	22 (14.1)

Multiple response answers allowed[#]

Table (3): Distribution of women's knowledge regarding uses of Aluminum phosphide (Rice tablet) at Assuit District Villages, 2023 (n=425)

Uses of Aluminum phosphide [#]	Correct		Incorrect		Mean	Mean knowledge rank
	No.	%	No.	%		
Preserving grains against rodents and insects	408	(96.0)	17	(4.0)	0.96	1
Preserving legumes against rodents and insects	123	(28.9)	302	(71.1)	0.29	2
Saving grain during transporting	104	(24.5)	321	(75.5)	0.24	3
Killing rats	77	(18.1)	348	(81.9)	0.18	4
Keep raw rice from being destroyed by termites	62	(14.6)	363	(85.5)	0.15	5
Killing bedbugs	36	(8.5)	389	(91.5)	0.08	6

Answers are not mutually exclusive[#]

Table (4): Distribution of women knowledge regarding exposure routes of Aluminum phosphide (Rice tablet) at Assuit District Villages, 2023(n=425)

Exposure routes [#]	Correct		Incorrect		Mean	Mean knowledge rank
	No.	%	No.	%		
Do you know exposure routes to AIP	396	93.2	29	6.8		
Ingestion	416	97.9	9	2.1	0.97	1
Inhalation	74	17.4	351	82.6	0.17	2
Dermal	33	7.8	392	92.2	0.08	3
AIP in dry form be absorbed through skin	101	23.8	324	76.2	0.24	
AIP in liquid form be absorbed through the Skin	118	27.8	307	72.2	0.28	

Answers are not mutually exclusive[#]

Table (5): Distribution of women knowledge regarding population at risk to Aluminum phosphide (Rice tablet) hazards at Assuit District Villages, 2023(n=425)

Population at risk [#]	Correct		Incorrect		Mean	Mean knowledge rank
	No.	%	No.	%		
Rural residents	307	72.2	118	27.8	0.72	1
Agriculture workers	286	67.3	139	32.7	0.67	2
The women at higher risk for AIP hazards than other family members	200	47.1	225	52.9	0.47	3
Residents near the agriculture places	99	23.3	326	76.7	0.23	4
All family members	83	19.5	342	80.5	0.20	5
Others (children, elderly, chest allergy patients, youth)	57	13.4	368	86.6	0.13	6

Answers are not mutually exclusive[#]

Table (6): Distribution of women knowledge regarding signs, symptoms and complications of Aluminum phosphide toxicity and their hazards at Assuit District Villages, 2023 (n=425)

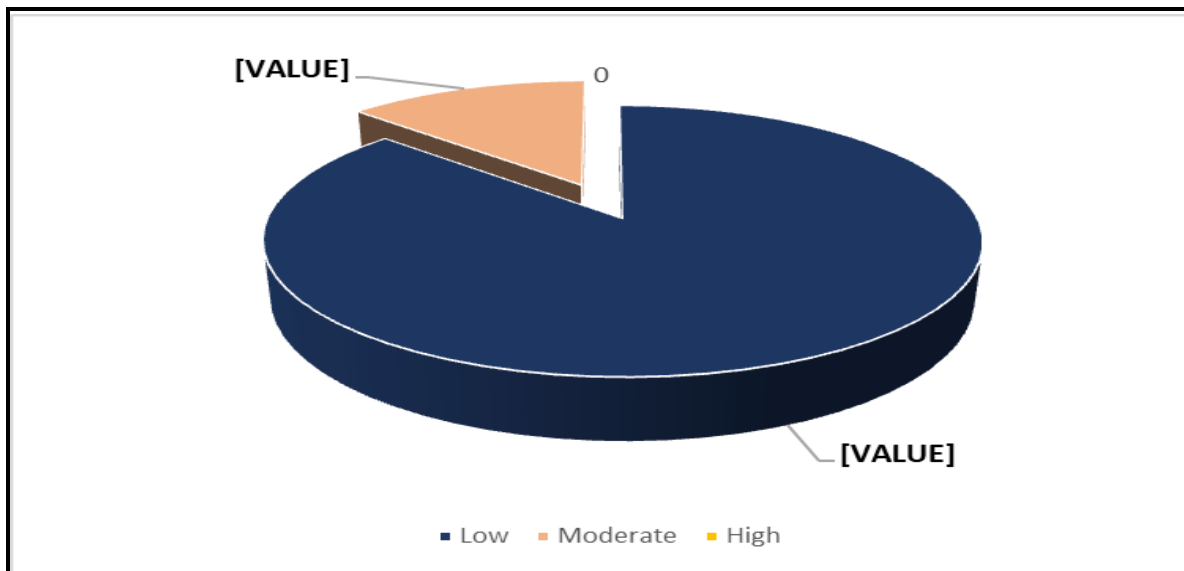
Variables [#]	Correct		Incorrect		Mean	Rank
	No.	%	No.	%		
Headache	343	80.7	82	19.3	0.81	1
Excessive sweating	288	67.8	137	32.2	0.68	2
Redness in the eye	256	60.2	169	39.8	0.60	3
Itching eyes	243	57.2	182	42.8	0.57	4
Epigastric pain	242	56.9	183	43.1	0.57	4
Chest tightness and pain	229	53.9	196	46.1	0.54	5
Drowsy	229	53.9	196	46.1	0.54	5
Dyspnea	215	50.6	210	49.4	0.51	6
Hypotension	208	48.9	217	51.1	0.49	7
Skin itching	203	47.8	222	52.2	0.48	8
Blurred vision	198	46.6	227	53.4	0.47	9
Sore throat	168	39.5	257	60.5	0.40	10
Cough	166	39.1	259	60.9	0.39	11
Sudden loss of appetite	160	37.6	265	62.4	0.38	12
Nausea and Vomiting	131	30.8	294	69.2	0.31	13
Runny nose	129	30.4	296	69.6	0.30	14
Diarrhea	126	29.6	299	70.4	0.30	14
Death	119	28.0	306	72.0	0.28	
Chronic diseases	105	24.7	320	75.3	0.25	

Answers are not mutually exclusive [#]

Table (7): Relation of women knowledges about Aluminum phosphide (Rice tablet) hazards and their personal characteristics at Assuit District Villages, 2023 (n=425)

Socio-demographics characteristics	Knowledge score	P value
	Mean + SE	
Marital status		
Single	23.46 + 0.41	0.30
Married	22.77 + 0.12	
Divorced	24.40 + 0.91	
Widow	24.21 + 0.59	
Education		
Illiterate	22.88 + 0.22	0.15
Basic	21.81 + 0.27	
Secondary (high school)	22.46 + 0.22	
Above average education	24.24 + 0.32	
University education	23.88 + 0.30	
Occupation		
House wife	22.42 + 0.14	0.26
Employee	23.88 + 0.22	
Skilled worker	23.83 + 0.53	
have any chronic diseases	23.85 + 0.19	0.002*
Previous history of having family members poisoned with rice tablet	22.54 + 0.25	0.88

**Independent sample Mann-Whitney U Test & and Kruskal-Wallis Test*



Figures (1): Total knowledge score of the studied women regarding Aluminum phosphide (Rice tablet) hazards at Assuit District Villages, 2023(n=425)

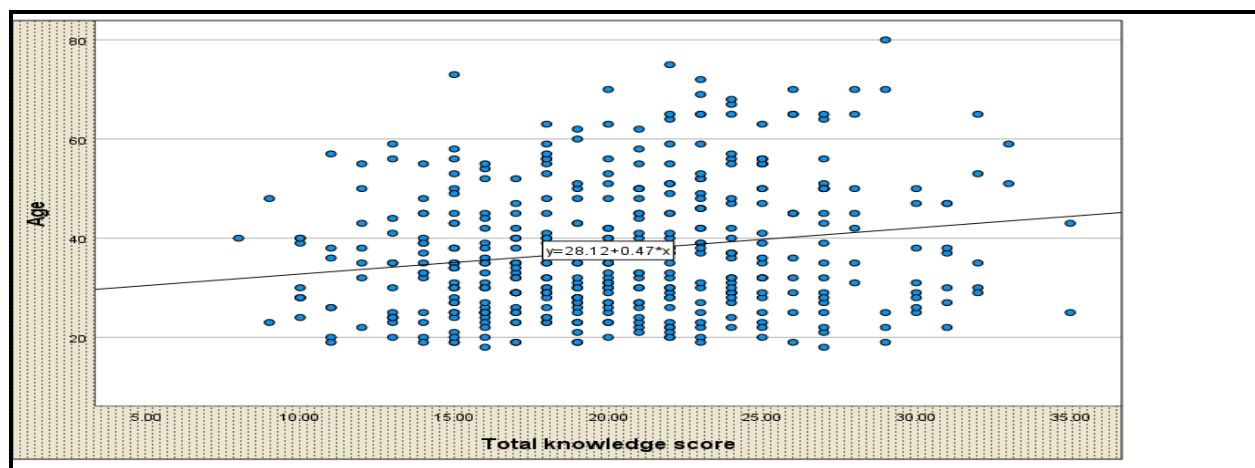


Figure (2): Correlation between Age and total knowledge score among women regarding Aluminum phosphide (Rice tablet) hazards at Assuit District Villages, 2023(n=425)

Table (1): Shows the most frequent age group (65.4%) were < 40 years old. 27.8% and 67.8% of participant were illiterate, and house wives respectively. 82.4% having good ventilated homes. Also, this table represent that 100% of studied women didn't attend any training program about AIP. 21.2% of them have a positive history of AIP poisoning or its hazards.

Table (2): States that 36.9% of studied women have chronic diseases, included hypertension, diabetes, heart disease, renal disease, reproductive problems and other diseases (chest allergy, Arthritis, Hypotension, Cancers, Epilepsy, and Hypothyroidism) with percentage of (7.6%, 18.5%, 51.0%, 28.7%, 3.2% and 39.5%) respectively. Also, the present finding illustrated that 68.1% of studied

women have chronic diseases for a period more than six months and 85.9% of them receiving their medications.

Table (3): Reports women's knowledge regarding uses of AIP. 96.0% of studied women answered that AIP used for preserving grains against rodents and insects.

Table (4): Observe women's knowledge regarding exposure routes to AIP. women know that people exposed to AIP hazards by ingestion followed by inhalation and dermal 97.9%, 10.8 and 7.8% respectively, while fewer of them 6.8% of them didn't know exposure routes to AIP hazards.

Table (5): Shows that studied women know that rural residents and agriculture workers are at risk to AIP hazards 72.2% and 67.3% respectively. Also, the

present data shows that 47.1% reported that woman at higher risk for AIP hazards than other family members.

Table (6): Reveals that the most common symptoms known to studied women regarding signs and symptoms of AIP hazards were headache, excessive sweating, redness and itching in eyes (80.7%, 67.8%, 60.2% and 57.2%) respectively, while nausea and vomiting, runny nose and diarrhea were the least known signs and symptoms (30.8%, 30.4% and 29.6%) respectively. Moreover, 28.0% of studied women mentioned that exposure to AIP hazards can lead to death while, 24.7% of them reported that AIP hazards can lead to chronic diseases.

Table (7): Represents there was a highly statistically significant differences between knowledge score who having chronic disease. P value (0.002).

Figure (1): Illustrates that 86.8% of studied women had low knowledge scores regarding AIP uses and hazards.

Figure (2): Present that there was weak positive correlation between age and total knowledge score of AIP hazards among women at Assuit District Villages with significant $r = 0.120$ **p value** = 0.014

Discussion

Aluminum phosphide is a pesticide registered in many countries for the indoor fumigation of agricultural commodities. With no effective antidote is freely available in the market. AIP is highly toxic that decomposes to generate a toxic phosphine gas in water or humid air, during storage, transportation, and with use thus people will be exposed to AIP hazards during these activities (Shafahi et al., 2019). So, this study aiming to assess rural women knowledge regarding AIP uses and hazards at Assuit District Villages.

The present study revealed that two thirds of studied women aged < 40 years old this result is supported by Ghalavand et al., (2023) who conducted a study under the title: Prevalence and Life-Threatening Electrocardiographic Changes in Aluminum Phosphide Poisoned Patients and Deraz et al., (2022) who conducted a study in Zagazig General Hospital Poison Center under the title: Acute Aluminum Phosphide Poisoning in East Delta, Egypt: a Growing Public Health Problem Over the Last Five Years. Who mentioned that the most prevalent age group were from 20 to 40 years. This indicates that the use of AIP is widespread among young people and highlights the importance of monitoring the trade of this poisons and educating women to resolve problems leading to AIP hazards in that age.

The current study showed that women occupation varies among house wives, employed or skilled workers with two thirds of them were house wives.

This results similar to Farahata et al., (2016) who conducted a study under the title: Knowledge, attitudes, and practices of organophosphorus, pesticide exposure among women affiliated to the Manshat Sultan Family Health Center (rural area) in Menoufia governorate: an intervention study, they mention that two thirds of women who affiliated to the center were house wives. This mean that housewives who spent longer time in their houses were at higher risk for AIP exposure hazards Deraz et al., (2022).

Also, the present study showed that majority of studied women were married, this might be explained by married women were responsible for AIP application at homes which put them at a higher risk for its hazards, this result in agreement with Somboon et al., (2022) who conducted a study on Thailand about Acute Pesticide Poisoning among Mixed-crop Agricultural Workers and mentioned that more than two thirds of studied women were married. Considering the level of education, the present study showed that one third of studied women were illiterate. This result in the same line with Farahata et al., (2016) who reported that one third of studied women were illiterate. Illiterate people use pesticides more than educated people, this is due to women who received school education had more knowledge about the AIP negative effects on health and routes of exposure. They also able to read labels of AIP containers and taking precautions after coming in contact with it.

From this study, it was shown that no one of studied women attend any training program on AIP safety handling. This contradictory with a study conducted by Jambari et al., (2020) in Kota Bharu, Kelantan to assess Knowledge, Attitude and Practice (KAP) on Pesticide Exposure Among Farmers and they mention that one half of participant attend. previous training program on insecticides safety handling. This contradiction due to illiteracy and lack of awareness among women who used AIP.

The current study showed that vast majority of studied women know that AIP used for Preserving grains and legumes against rodents and insects. This result is supported by Deraz et al., (2022). They mention that the most commonly reason for using AIP is preserving grains against rodents and insects.

Most of studied women had knowledge about exposure routes to AIP hazards with vast majority reported ingestion, less than one fifth reported inhalation and fewer of them reported dermal. This result is opposed to Jallow et al., (2017) who conducted a study under the title: Pesticide Knowledge and Safety Practices among Farm Workers in Kuwait: Results of a Survey and who observed that studied population knowledge

regarding exposure route were dermal followed by inhalation and oral.

The lack of knowledge about AIP routes of entry into the body among studied women could lead to increase these exposure to AIP risks **Obonyo, (2017)** this may be due to lack of educational services, absence of training program in rural area and illiteracy among rural women.

The current study revealed that two thirds of women didn't know whether AIP in liquid or dry form can penetrate skin. This result is agreed with **Obonyo, (2017)** who conducted a study under the title: Assessment of Pesticides Handlers' Knowledge, Practices and Self- Reported Toxicity Symptoms: A Survey of Kisumu County, Kenya Adams. They mention that two thirds of studied population didn't know if AIP in wet or dry form can penetrate the skin. Lack of clear knowledge on which pesticide formulation penetrates the skin contribute to farmers not using the right personal protective equipment and handlers may be exposed to AIP hazards **Kalyabina et al., (2021)**.

In terms of population at risk to AIP hazards, our result demonstrated that two thirds of respondents were aware that Agriculture workers and rural residents are at higher risk to AIP hazards. Moreover, one third of them were aware that other people like (children, elderly, chest allergy patients, youth) were at risk to AIP hazards. This result agreed with **Farahata et al., (2016)**, they mention that two thirds of respondents were aware that workers in the agriculture sector, farm residents as well as, subpopulations such as children and pregnant women, are at a higher risk than the general population for AIP hazards.

The current finding showed that the most common symptoms known to the participants were headache, excessive sweating, and ocular manifestation (Itching & Redness) while gastrointestinal manifestation (nausea, vomiting and diarrhea) were the least known manifestation. The present study agreed with **Eizadi-mood et al., (2023)** who conducted a study under the title: Acute pesticide poisoning in the central part of Iran : A 4-year cross-sectional study **Sai et al., (2019)** who mention that most clinical finding of AIP intoxication were headache and ocular signs while the least signs was diarrhea.

Our result is also supported by **Jambari et al., (2020)** who reported that most manifestation experienced by subjects were excessive sweating and blurred vision and only small percentage had symptoms such as nausea and stomach pain.

On other hand results disagreed with **Farahata et al., (2016)** who mention that The most common symptoms known to the participants were

gastrointestinal symptoms (nausea & vomiting). Period of using AIP, different routes of exposure, and toxicity severity may be the reason for these differences.

In the present study two thirds of participant didn't know that AIP hazards have a negative effect on health. This may be due to a considerable number of the respondents in this study were illiterate or had limited formal education, and did not receive any training or technical support in AIP safety handling. This result in opposite to **Obonyo, (2017)** who mention that majority of the participants knew pesticides had a negative effects on human health.

The present study showed that the most of study participant weren't aware that AIP can lead to chronic disease, these result disagreed with **Sai et al., (2019)** who reported that majority of the participant knew the ill effects of pesticides completely.

Regarding total knowledge scores we found that vast majority of women having low knowledge scores regarding AIP hazards. This supported by **Mubushar et al., (2019)** who conducted a study under the title: Assessment of farmers on their knowledge regarding pesticide usage and biosafety and reported that the majority of the respondents have a low level of information on safe pesticide usage. This might be due to their low level of education, as educational level is known to play an important role in increasing knowledge.

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The present study revealed significant weak positive correlations between total knowledge score and total reported practice score among women about AIP hazards, this result in agreement with **Jambari et al., (2020)** who reported that there was no significant correlation between knowledge and practice score. Some factors may contribute to the result of this current study were different in education level and studied population.

Conclusions

The findings of the present study indicates that vast majority of participant had low knowledge level about safe use and handling of AIP, no one of participant attend training program on AIP safety handling and majority of them know that agriculture workers and rural resident at higher risk for AIP hazards.

Recommendations

- Health education programs should be developed and implemented for rural women and farmers to increase their awareness about safe use and handling of AIP.
- Dissemination of health awareness about AIP hazards through the media (radio and television) that invades all homes in the rural and urban areas.

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