Acute Pesticide Poisoning amongst adolescent girls and women in Northern Tanzania

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Abstract

Background: Acute pesticide poisoning (APP) is reported to affect community health worldwide but its burden in Tanzania is unknown particularly in women. This study examines APP involving adult females and adolescent girls 10 to 19 years in 3 regions of Tanzania which are famous for coffee and vegetable production. Methods. A one year hospital based surveillance study in 10 Tanzanian healthcare facilities was conducted using methods previous published by the same authors in 2014. Results. The study identified 108 APP cases of whom 31 (28.7%) occurred amongst adolescent girls. Suicide was the leading poisoning circumstances (60.2%) and the most vulnerable women were 20-29 years old who comprised 38.4% of all cases with suicide as circumstance. Organophosphates (OPs), zinc phosphide, paraquat and endosulfan were common amongst known reported poisoning agents. The annual APP incidence, mortality and Case Fatality Rate for women were 5.1/100,000, 0.2/100,000 and 3.7/100, respectively. Conclusion. APP amongst women in Tanzania is common and this call for diverse preventive interventions to reduce poisoning incidents. Key Words: Acute Pesticide Poisoning, adolescent girls & women, Northern Tanzania

Introduction

Acute pesticide poisoning (APP) is documented as a serious public health problem in Tanzania\(^1\)\(^-\)\(^2\) and other parts of the world \(^3\)\^-\(^9\) due to its adverse human health effects. Evidence of APP occurring in women is documented in studies from Tanzania,\(^2\)\(^,\)\(^10\) Uganda,\(^11\) Kenya,\(^12\) South Africa,\(^13\)\^-\(^14\) India,\(^15\) China,\(^16\) Nepal,\(^17\) Sri Lanka,\(^18\) Sri Lanka,\(^18\) Iran\(^19\) and Ethiopia.\(^20\) A 2002 review of APP globally suggested that pesticide-related morbidity and mortality is under-reported amongst women.\(^21\) As a result, the Burden of Disease due to pesticide exposure, particularly amongst women, may be substantially underestimated.
Similarly, amongst children, APP may be an under-reported problem globally. A WHO study reported that over 30% of the global burden of disease amongst children can be attributed to environmental factors, pesticides being a major contributor. Childhood acute pesticide poisoning is documented in several countries including South Korea, South Africa, Canada, Turkey, and India. Apart from accidental and occupational poisoning, adolescent risk-taking behavior can lead to attempted intentional pesticide self-poisoning. Reasons for adolescents’ intentional poisoning include emotional trauma from family stress or failed relationships with the opposite sex. Age and gender are said to affect physiological susceptibility to the effects of exposure to toxic pesticides. Biological factors, notably body size, and differences in physiological, hormonal, and enzyme functions between women and men, and between adults and children influence susceptibility to health hazards from exposure to pesticides. With a generally higher proportion of body fat, women are more likely to store some of the chemicals which are fat-soluble in their tissues, which, if mobilized to become biologically active, can act as a continuous source of internal exposure linked to adverse chronic health outcomes. Moreover, at particular stages of their lives, such as pregnancy, lactation, and menopause, women’s bodies undergo physiological changes that also may change their vulnerability to health effects from toxic chemicals. Studies suggest that women’s exposure to pesticides in pregnancy is associated with miscarriages, premature births, birth defects, and low birth weight, largely because of trans placental exposure, as well as transfer via breast milk during post-partum breastfeeding.

Other health effects linked with pesticide exposure in women include pregnancy
complications as reported in Tanzanian horticulture, \(^2\) depressed cholinesterase levels due to Organophosphate (OP) exposure as reported amongst South African female farm workers, \(^3^2\) and respiratory problems, including asthma, as reported in Brazil \(^3^3\) and South Africa. \(^3^2\) Hormonally-related cancers in females, including breast, thyroid, and ovary, were reported amongst women in North Carolina USA. \(^3^4\) Adolescent females are also at risk to the impacts of endocrine disrupting chemicals, and many pesticides have been linked to adverse impacts on sexual development amongst both boys and girls. \(^3^5\)

Exposure pathways for women are diverse. Women can be exposed to pesticides directly through poor pesticide handling in agriculture, ingestion involving deliberate swallowing of pesticides or their concentrates, inappropriate handling in pesticides retail shops and consumption of pesticide-contaminated food. Dermal absorption can occur with exposure to contaminated clothing, dust or residues on floors and other surfaces or objects. Other possible sources for exposure include pesticide drift and unattended empty pesticide containers. \(^5\) While many pathways for women’s exposure may be similar to men’s, some pathways may be gender-specific. For example, women may also be exposed to pesticides through washing their husbands’ contaminated work clothes, or re-entering fields to conduct work earmarked for women following spray application. \(^3^6\)

Research on APP amongst women in Tanzania suggests that, firstly, agents reported to be responsible for poisoning include hazardous pesticides, particularly OPs used on food crops. \(^2\) Secondly, although reports of occupational pesticide poisoning are uncommon in health facility records, \(^1\) studies have suggested that women may be at high risk for APP, given that women comprise of 80% of the agricultural labour force in Sub-Saharan Africa where pesticides are applied regularly. \(^3^7\)
Despite the prevailing reliance on pesticides for pest control, Tanzania currently has no surveillance system for APP. Poisoning is reported in the health management information system within Tanzanian hospitals with non-standardised information on the causative agent. Previous studies have reported the lack of specificity of reporting of pesticide poisoning in hospital information systems. Because the magnitude of APP in adolescent and adult females in Tanzania is unknown, this study was undertaken with the aim of estimating the burden from APP and characterizing the patterns of APP amongst adolescent and adult females in Tanzania. Because Tanzania currently lacks a comprehensive surveillance system for acute pesticide poisoning, this study also could potentially generate recommendations to address this surveillance gap.

Methods

2.1 Data collection

This study was a cross-sectional study that involved reviewing of APP cases from 10 hospitals in three regions of Tanzania namely Mwanza, Kilimanjaro and Arusha where intensive vegetable and/or coffee production was associated with intensive pesticide use. The population included all hospital admissions in the 3 regions and sample size was 10 hospitals. The hospitals visited included regional hospitals, district hospitals, health centers and dispensaries. This paper focuses on the findings involving adolescent and adult females in the hospital based surveillance study conducted in 2006. A case of APP in this study was defined as a diagnosis of APP made by the clinician and recorded in either the register or patient folder or both. In general, clinician diagnosis was based on a history of exposure (from the patient, relative, or accompanying person) to
one or more pesticides and clinical manifestations of poisoning or specific laboratory test results compatible with APP, within 14 days of exposure. Cases were included in this study if they were females aged 10 years or older.

2.2 Data analysis

APP cases captured were categorized by age using 10-year intervals (10 – 19, 20-29, 30-39 and 40+). Analysis of age further dichotomized age into two categories as (a) Adolescent girls (10 – 19 years, as per WHO guidance on defining adolescence) and (b) Mature Women (20 years or more). The variable age was used to evaluate the distribution of APP poisoning cases across various ages and age groups. Poisoning circumstances were categorised as (a) suicide, (b) accidental, (c) occupational, (d) homicide, or (e) unknown. A second analysis of circumstances further dichotomized circumstances into two categories as (a) Suicide versus (b) Non-suicide. The variable circumstances of poisoning was used to evaluate actual reasons resulting into poisoning events.

The outcomes of APP were classified as (a) recovery, (b) absconded, (c) referred, (d) residual disability after discharge, (f) death, or (g) unknown and then dichotomized into (a) Known versus (b) Unknown. The variable outcome of poisoning was used to evaluate the end result of the poisoning in human health.

Pesticides responsible for APP were classified as (a) specific (active ingredient was identified), (b) nonspecific (active ingredient was known by general category), or (c) unknown (active ingredient was not known to the clinician and/or not recorded) and then dichotomized into (a) Known versus (b) Unknown agents. The variable Agents responsible for poisoning was used to evaluate all specific products responsible for the poisoning events as well as most common chemical groups responsible for poisoning. Comparisons involving circumstances of poisoning, agents, and age were conducted using
chi-squared test and t-tests for continuous data such as age.

Bivariate associations of (a) circumstances (Suicide/Non Suicide) and agents (Known / Unknown) was conducted to evaluate status of agent across different circumstances, (b) Age group (Adolescents / mature) and agents (Known / Unknown) was conducted to evaluate status of agent across different age groups, (c) Poisoning Agent (OP/ Non OP) and Age group (Adolescents / mature) was conducted to evaluate chemical groups responsible across different age groups and (d) Poisoning Agent (OP/ Non OP) and Circumstances (Suicide/ Non Suicide) was conducted to evaluate chemical groups responsible across different circumstances of poisoning

The strength of associations was estimated as prevalence risk ratios (PRR) with 95% confidence intervals. The analyses were conducted using SPSS statistical package version 16.0 and STATA statistical package version 10.0. 39-40

APP cases were used as numerator data to calculate morbidity rates stratified for geographical area, and age. To calculate denominators for rates, population census data were obtained from the Tanzania Bureau of Statistics based on a national census conducted in 2002 41 and the population for 2007 adjusted for annual population growth of 2.7%. 42

Case Fatality rate in this study was calculated by dividing the number of women deaths due to pesticide poisoning divided by the number of individuals diagnosed with APP and then multiplied by 100 to yield a percentage. Mortality rate was calculated as the number of deaths divided by the total population in the study area and then multiplied by 100,000 to yield death per 100,000 population.

Case fatality rate was calculated as the number of APP cases divided by the total population in the study area and then multiplied by 100,000 to yield cases per 100,000
Because the study involved record review and no data were collected directly from individuals, no consent was required. To ensure confidentiality, patient names were replaced by codes, which were used as identifiers in data analysis. Ethical approval was secured from the Tropical Pesticides Research Institute (TPRI), the National Institute for Medical Research (NIMR) in Tanzania (Ref. NIMR/HQ/Vol XI/371), and the University of Cape Town (Ref. 328/2004).

Results

Of the 10 health facilities followed up for 12 months during the study, 8 facilities reported 108 cases of APP amongst females 10 years and older. The 108 cases comprised 46.5% of the total of 230 cases (all male and female, adult and children) recorded in the course of 2006. Most cases (n=77; 71.3 %) were reported from the regional hospitals while others were reported from district hospitals, health centers and dispensaries.

3.1 Characteristics of cases reported

3.1.1 Age category of female APP cases

The age category with highest proportion of poisoned women was 20 - 29 years (44.4%) (Table 1).

| Table 1: Age category and circumstances of poisoning for APP amongst females. |

3.1.2 Circumstances of poisoning

The most commonly recorded circumstance of poisoning was attempted suicide (60.2%). Occupational APP was reported in 9 cases (8.3%) (Table 1). Three of the nine occupational cases of APP involved adolescent girls (10 – 19 years). Lack of data on circumstances of poisoning was highest in the age group 20-29 years (11 unknown cases). There were 10 cases involving children aged 15 years or less. The largest proportion of
cases arising from suicide attempts were found in adult females 20 – 29 years (38.4 % of all suicide cases). Most cases involving accidents occurred amongst females between 10 and 29 years (10 cases).

Only four cases were reported to have resulted in fatalities (3.7%) involving victims who were aged 16, 17, 22 and 25 years old, and they were all from suicide cases. The outcome of APP was unknown for 27 females (25.2%). The majority of the unknown outcomes were concentrated in the age group 10 – 19 (11 cases) and 20 – 29 (12 cases).

3.1.3 Poisoning agents

The agents responsible for poisoning are reported in Table 2. Of the 108 cases in which pesticide poisoning occurred, in over half of the cases (60.2%), the exact pesticide involved was unknown. Where specific agents were reported (39.8%), organophosphates were most commonly named, accounting for 13 of the 21 cases where specific agents could be identified. All OPs reported were WHO Class II toxins with the exception of Chlorfenvinphos (3 cases), which is a WHO Class Ib toxin. Nonspecific products such as livestock dip (1.9 %), food poisoning agents (food items contaminated with unknown pesticides) (12.0 %), rat poison (5.5 %) and insecticides (0.9%) accounted for 20.3% of all 108 products reported.

Table 2 Classification of agents responsible for poisoning in women in Tanzania

The majority of the specific agents reported (95.21%) were WHO Class I and II pesticides and OPs (n=13) accounted for 61.9% of all known poisoning agents (n=21) (Table 2).

3.2 Measure of associations

The proportion of circumstances due to suicide was higher in cases with unknown agents compared to cases with known agents and the difference was marginally significant (82.2% versus 65.1%; PRR unknown/known = 1.6; 95% CI = 0.9–2.9).

Adolescent girls were more likely to be involved in an APP where the agent was unknown
than adult women (74.2% vs 54.5%, respectively; PRR Adolescent girls/Adult women = 1.9, 95% CI = 0.9 – 3.9).

The proportion of cases with OP poisoning agents was significantly higher in:
(a) Adult women compared to Adolescent girls (PRR Adult women/ Adolescent girls = 1.3, 95% CI = 1.01 – 1.6);
(b) Suicide compared to Non suicide circumstance (PRR Suicide/Non Suicide = 1.35, 95% CI = 1.1 – 1.6).

The proportion of suicide as a circumstance for APP was not significantly higher in adolescent girls compared to adult women (78.3% vs 73.4%, respectively; PRR adolescent girls/adult women = 1.1, 98% CI = 0.5 – 2.6).

3.3 Acute pesticide poisoning rates

The annual Mortality rate (MR) and Case Fatality Rate (CFR) for women were 0.2 per 100,000 and 3.7 per 100 respectively.

The annual IR for APP was 5.1/100,000 with higher rates reported for the Arusha region.

The age group 20 - 29 years reported the highest IR (8.3/100,000) (Table 3).

Table 3: Incidence rates for APP for women in Tanzania

Discussion

In the period of one year this study identified 108 acute pesticide poisoning cases involving adolescent girls and adult women in 8 of the 10 facilities in this study. The fact that most facilities visited reported poisoning indicates that APP in women is widespread in the study area. Given that APP is under-reported in many developing countries, particularly amongst women, it is likely that there are further cases which are not captured due to the absence of an adequate surveillance system.

The most commonly recorded circumstance of poisoning in this study was suicide (60.2%).
This proportion is lower than that reported among females in Sri Lanka (88.7%) but higher than reported in Kenya (14.6%). The higher proportion of suicide in Sri Lanka women could be due to the Sri Lankan study including only rural facilities in areas of high pesticide use whereas this study included both rural and urban facilities (Annex 1). Occupational exposure as circumstance for APP was very low for females (only 8.3% of the cases reported). Again, this may be a function of under-reporting resulting from the absence of a comprehensive surveillance system for APP in Tanzania as well as misdiagnosis of signs and symptoms of pesticides exposure. Previous research suggests that occupational cases may be missed since farmers do not present to hospitals, especially for less severe poisonings, but rather wait to recover or use alternative treatments.

The age distribution of APP in females suggests that the highest proportion of cases was found in the age group 20-29 years. This is broadly consistent with findings from studies in India, South Africa and Nepal although the Nepalese and South African studies included females in the younger age range. Females aged 15 to 40 years may be involved in pesticide handling and may attempt suicide using pesticides as a result of easy access to toxic chemicals. Suicide risk in this age group is exacerbated by factors such as physical or sexual abuse, persistent psychosocial stresses, loss of social support, financial hardship, and heavy seasonal workloads. Similarly, depression arising from OP exposure may also contribute to increase risk for suicidal attempts.

Organophosphates (OPs) emerged as the single most important group of agents responsible for poisoning in females in this study. This pattern is consistent with studies conducted in India, Sri Lanka and Nepal and reflects the widespread use of
organophosphate insecticides in Tanzania.\textsuperscript{50} Previous research suggest that, broadly speaking, usage patterns appear to be correlated with APP in Tanzania.\textsuperscript{38} Poisoning with OPs was significantly associated with older age (PRR Adult women/Adolescent girls = 1.3, 95% CI =1.01 – 1.6). Adult women may be more likely to handle pesticides, both directly while working in the farm and indirectly through handling contaminated containers and clothing than adolescent girls and therefore have a higher chance of coming into contact with OP products. The lower frequency of handling pesticides in adolescent girls could also arise because of legislative measures to limit child labour and tasks associated with pesticide exposure of children.\textsuperscript{51}

The study also suggested an association between suicide and poisoning by OPs (PRR Suicide/Non Suicide = 1.35, 95% CI - 1.1 - 1.6). OP’s are freely available in Tanzania in various pesticide retail shops and can be easily used in suicide attempts. Controlling easy access to OPs may therefore be an important measure to prevent suicide. Investigating the causative factors in suicide attempts might also help to inform preventive strategies. Other agents reported in APP cases included paraquat, Endosulfan and zinc phosphide, all of which are significant hazards. Endosulfan is associated with adverse male and female reproductive effects. Endosulfan metabolites bio-accumulate in adipose tissue, depending on their lipophilicity.\textsuperscript{52} Endosulfan is said to be a neurotoxin, haematoxin, genotoxin, nephrotoxin and carcinogenic, causing both acute and chronic toxicity in males and females, with some laboratory evidence suggesting greater susceptibility amongst females.\textsuperscript{53} As a chemical endocrine disruptor\textsuperscript{54-55} exposure to even small concentrations of Endosulfan can lead to serious health effects. Endosulfan has been banned in Tanzania for health risks since 2013 and it has also been earmarked for elimination under the Stockholm Convention on Persistent Organic Pollutants (POPs) and listed under the
Rotterdam Convention on Prior Informed Consent.\textsuperscript{56}

Zinc phosphide is extremely toxic, causing acute respiratory distress in exposed persons due to the release of phosphine gas when it comes into contact with moisture.\textsuperscript{57} However, it is not registered for use in Tanzania and its distribution is therefore illegal, its use being mainly for domestic rats control.\textsuperscript{1} Because the main use of this highly hazardous product occurs within households, the proximity to human habitation is likely to increase risks for human poisoning. The illegal distribution also means that control of this hazard will require methods of enforcement different to products registered in Tanzania.

Paraquat is another pesticide commonly used as herbicide in Tanzania but also commonly misused for suicide attempts.\textsuperscript{1} The concentrated product is highly toxic, has no antidote and, as a result, has been responsible for many fatal poisonings in Tanzania.\textsuperscript{1} Poisoning of women using paraquat is also reported in Sri Lanka.\textsuperscript{18}

This study reported a relatively high proportion of APP cases (60.2\%) with no data on the responsible agents, a proportion much higher than studies amongst women in Sri Lanka\textsuperscript{18} and California.\textsuperscript{58} This difference could result from the existence of better surveillance systems in Sri Lanka and California compared to Tanzania. For example, the study by Pearson and colleagues, which demonstrated how close collaboration between stakeholders in Sri Lanka made use of surveillance data to implement effective policies to prevent pesticide poisoning, confirms the presence of a robust surveillance system for APP in that country.\textsuperscript{59} Absence of information on the poisoning agent was associated with younger age in that adolescent girls were more likely to be involved in an APP where the agent was unknown (PRR Adolescent girls/Adult women = 1.9, 95\% CI =0.9 - 3.9). This higher proportion of unknown poisoning agents in adolescent girls could be linked to
inexperienced in pesticides handling in that they are less likely to identify the poisoning agents. Similarly, restriction of hazardous forms of child labour implies that young workers in agriculture will rarely handle pesticides. This may be another factor explaining why adolescents may be unable to identify poisoning agents.

Population-based APP incidence rates in this study (5.1/100,000) were far lower than reported in Nepalese females aged 15 to 50+ years (77.5/100,000)\(^4\) and South Korean females aged 0 to 65+ years (27.4/100,000).\(^6\) This could be explained by (a) poorer hygiene resulting in unsafe pesticide handling practices in Nepal or (b) under-reporting due to the lack of a surveillance system in Tanzania. For the Korean study, there were also age differences in the study population including children aged 1 to 10.

Conversely, the incidence rates found in this study were about three times higher than reported in a US study\(^9\) where better preventive practices and legislation in the US may explain this difference.

The APP cases found in this study may signal a problem of long-term adverse effects from pesticide exposures. Endosulfan is an example of an organochlorine insecticide which is fat soluble, may bio-accumulate in both environmental media and human tissues and has many adverse long-term effects. Those surviving APP may be left with residual neurologic impairment, particularly if the poisoning resulted in multi-organ failure or nervous system hypoxia. Research suggests that patients with a history of a single acute organophosphate or other pesticide poisoning are at risk of long-term neuropsychiatric sequelae.\(^6\) Thus, while the absolute numbers of women and adolescent girls affected by acute poisoning is not that high, it may be the tip of an iceberg of wider exposures needing investigation.

APP data as documented in this study was associated with missing information. Health information Management System (HIMS) did not seem to rank APP as high priority
notifiable disease condition. If policy makers are convinced that APP has a serious burden to human health the APP surveillance system can be developed given that the data medical recorders are well trained on capturing data using standard data collection tools.

Conclusion

The study indicates that acute pesticide poisoning is common among women in northern Tanzania with estimated IR of 5.1/100,000, MR of 0.2/100,000 and CFR of 3.7%. The most common known agents were WHO Class I and II pesticides including a number of Organophosphates. The most common circumstances for APP in women were suicide for women of the age group 10 – 29 years. To reduce suicide related to APP, attention should be paid to addressing the causes of suicide, safer storage, (storage far away from home premises), improved hygiene measures and control of access to toxic pesticides. Occupational APP and APP associated with child labour, though uncommon amongst hospital admissions, need to be addressed by improving safe handling conditions and notification systems, and stronger child labour regulation and enforcement. Multifaceted intervention efforts are needed to reduce acute pesticide poisoning among women in Tanzania

Abbreviations

**APP**: Acute pesticide poisoning

**CI**: Confidence interval

**IR**: Incidence rate

**WHO**: World Health Organization

Declarations

**Ethical consideration**

The study protocol was approved by the National Institute of Medical Research (NIMR) in

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Tanzania (REF NIMR/HQ/Vol XI/371) as well as University of Cape Town (UCT) Health Science Faculty Research Ethics Committee (REF:328/2004).

Consent for participation was implemented by signing a special form which was administered by the researcher.

**Consent for publication**: Not applicable

**Availability of supporting data**: The detailed data is available at the University of Cape Town, South Africa

**Competing interests**: The authors declare that they have no competing interests.

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**Authors’ contributions**: EEL: Designed the study, conducted data collection and analysis, and led the interpretation and drafting and revisions of the manuscript.

AVN: Guided the study design and data collection, participated fully in the interpretation of findings, comments on the manuscript and its revisions.

JK: Participated in the data interpretation and analysis, comments on the manuscript and its revisions.

LL: Guided the study design, statistical data analysis and interpretation and commented on the manuscript and its revisions. All authors read and approved the final manuscript

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Table 1: Age category and circumstances of poisoning for APP amongst females.

| Age category (Years) | Unknown | Accidental | Occupational | Suicide | Total |
|----------------------|---------|------------|--------------|---------|-------|
| 10-19                | 7       | 3          | 3            | 18      | 31 (28.7%) |
| 20-29                | 11      | 7          | 5            | 25      | 48 (44.4%) |
| 30-39                | 2       | 2          | 0            | 10      | 14 (13.0%) |
| 40+                  | 0       | 2          | 1            | 12      | 15 (13.9%) |
| Total                | 20 (18.5%) | 14 (13.0%) | 9 (8.3%)    | 65 (60.2%) | 108 (100%) |

*Definitions: Suicide as poisoning arising from an act of deliberate self-harm; homicide as poisoning arising from a deliberate exposure experience by one person/s as a result of the actions of another person; occupational as poisoning arising amongst workers as a result of handing (mixing, spraying, storage or other usage) of pesticides for work purposes; accidental as poisoning occurring outside of the work context as a result of an unintended exposure; known as a circumstance that includes one or more of accidental, occupational, suicide or homicide; unknown as a poisoning case for which the circumstance was none of the above and was unknown.

Table 2 Classification of agents responsible for poisoning in women in Tanzania
| Product               | Chemical group | WHO Class | Frequency | Percentage by category | Percentage all agents (n=108) |
|-----------------------|----------------|-----------|-----------|------------------------|-----------------------------|
| 1. Known products     |                |           |           |                        |                             |
| OP                    | OP             | Ib and II | 13        | 61.9                   |                             |
| Sulphur               | IN             | IV        | 1         | 4.8                    |                             |
| Endosulfan            | OC             | II        | 1         | 4.8                    |                             |
| Zinc Phosphide        | IN             | Ib        | 4         | 19.0                   |                             |
| Paraquat              | BP             | II        | 2         | 9.5                    |                             |
| SUB TOTAL 1           |                |           | 21        | 100.0                  |                             |
| 2. Unspecific Products|                |           |           |                        |                             |
| Livestock Dip         | UN             | UN        | 2         | 9.1                    |                             |
| Food poisoning        | UN             | UN        | 13        | 59.1                   |                             |
| Rat Poison            | UN             | UN        | 6         | 27.3                   |                             |
| Insecticide poison    | UN             | UN        | 1         | 4.5                    |                             |
| SUB TOTAL 2           |                |           | 22        | 100.0                  |                             |
| 3. Unknown            |                |           |           |                        |                             |
| UN                    | UN             | UN        | 65        | 100.00%                | 60.2%                       |
| SUB TOTAL 3           |                |           | 65        | 100.00%                |                             |
| All Agents            |                |           | 108       |                        |                             |

*IN: Inorganic OP: Organophosphate OC: Organochlorine
UN: Unknown BP Bipyridylium derivative*
Table 3: Incidence rates for APP for women in Tanzania
|                | Poisoning cases per year | Population (2007) | A |
|----------------|--------------------------|-------------------|---|
| **Regions**    |                          |                   |   |
| Arusha         | 36                       | 495,525           | 7 |
| Mwanza         | 57                       | 1,072,533         | 5 |
| Kilimanjaro    | 15                       | 566,922           | 2 |
| **Total**      | **108**                  | **2,134,980**     | 5 |
| **Age groups** |                          |                   |   |
| 10 to 19       | 31                       | 748,449           | 4 |
| 20 to 29       | 48                       | 577,650           | 8 |
| 30 to 39       | 14                       | 333,549           | 4 |
| 40+            | 15                       | 475,332           | 3 |
| **Total**      | **108**                  | **2,134,980**     | 5 |
## Annex 1

**Annex 1: Comparison of different studies on Acute Pesticide Poisoning for their settings and findings.**

| Study first Author | Setting | Definition of APP | Age range of participants (Years) | Incidence rates per 100,000 | Age distribution of APPs (Years) | Proportion suicide/accidental |
|--------------------|---------|-------------------|-----------------------------------|-----------------------------|---------------------------------|-------------------------------|
| Gyenwali et al, 2017 | Quantitative survey of pesticides poisoning among hospital-admitted cases in selected hospitals of Chitwan District of Nepal. | World Health Organization’s (WHO) case definition. | 1 - 80 | Adolescent girls: Age 15-19: (8.9) Adult females: Age 20-29: (49.9) Age 30-49: 89.6 Age 50 and above: 29.5 | Females: 15-19: 22.0% 19 and older: 74.0% | Females: Suicide - 90.8%  Accidental/Occupational - 9.2% |
| Van Der Hoek et al, 2005 | Hospital review and characterization of patients with acute pesticide poisoning in a rural area of Sri Lanka | Any patient diagnosed by the attending physician as Pesticide poisoning, or treated as such. | 16 and older | Females & males combined: 163 | Age group (Males and females combined) | Females: Intentional (Suicide): 88.7% Non Intentional: 7.8% Unknown: 3.3% |
| Lamsal, 2013 | Retrospective Review of acute pesticide poisoning patients attending at emergency department in Chitwan medical college | Based on history provided and pesticide container Information if any. | 0 to 60 | Not given | Females: 10 - 14: 11.3% 15 - 19: 43.3% 30 - 44: 37.7% 45 - 60: 7.5% Over 60: 0% | Not given |
| Choi et al, 2012 | Survey of APP cases from the Korean National Health Insurance Reimbursement database. | A case of pesticide poisoning reimbursed by National Health Insurance (NHI) or subsidized by National Medical Aid (NMA) | 0 – 65 | Females: Age 0-19: 1.0 Age 20-64: 8.4 Age 65 and older: 28.3 All **females**: 9.2 | Females: 0-19: 2.5% 20-64: 59.25 65 and above: 38.3%. | Not given |
| Razwiedani et al, 2017 | Cross-sectional study, review of retrospective, secondary data of OP poisoning cases over a 3-year period | A case was based on notification requirements of the South Africa National | 1 to 40 | Not given | Females: 1-10: 29.5% 11-20: 23.5% 21-30: 27.1% 31-40: 12.9% 40+: 11.0% | Females: Accident: Suicide: 4 Unknown: Occupational |
| Reference | Period and Location | Notes | Age Range | Gender | Source |
|-----------|---------------------|-------|-----------|--------|---------|
| Calvert et al, 2016 | Collection of data on acute pesticide related illness and injury arising from no occupational exposure reported by 12 states in the US | Symptoms consistent with the pesticide formulation involving one/more of: (i) systemic signs/symptoms (ii): dermatologic lesions, and (iii): Ocular lesions. | 1 and older | Females (Occupational): Agricultural: 21.5 Non agricultural: 0.4 Industrial sector: 0.7 | Not given |
| Ko et al, 2018 | (a) Data from Statistics Korea on mortality due to APP 2006-2014 (http://www.kostat.go.kr). (b) Data on APP from Korean National Health Insurance claims 2006-2014. | Prevalent case defined as episode with ICD-10 code T60.0-T60.9 as primary diagnosis. | 0 to 80 | Females: 5.9 | Age groups (For both males and females combined in the year 2014): 0-10: 0% 10-19: 0.3% 20-29: 1.4% 30-39: 6.3% 40-49: 15.5% 50-59: 25.3% 60-69: 20% 70-79: 22.3% 80 and above: 8.9% | Males and females combined Suicide: 9 Non Inten |

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