

**Review Paper**

A Review of Pesticide Poisoning: Far reaching implications and the need for synergistic policy implementation in Gombe, Northeastern Nigeria.

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Abstract

Pesticides are chemical agents which include herbicides (for weed control), insecticides, and fungicides. Its application increase yields and protection against insects at post-harvest and storage, with immense benefit of enhancing the shelf life of stored agricultural products. Increased pesticide use, poor handling practices, regulation of its use and monitoring of its level in the food chain has predisposed to many outbreaks, with grave public health concerns globally. High lethality associated with pesticide poisoning is due to lack of qualified healthcare personnel to detect; poor case management and notification system. The study reported on outbreak associated with pesticide poisoning in Gombe State, Nigeria from 2005 to 2014. A desk review of all outbreaks notified to the state ministry of health from 2005 to 2014 was made. The outbreak reports that fulfilled the case definition of suspected pesticide poisoning; of abdominal pain, dizziness, vomiting \pm convulsion in the population were selected. Total of 32 reported outbreaks were investigated from 2005-2014, of which 2 were due to suspected pesticide poisoning. One of the outbreaks involved boarding institution. Two hundred and sixty-seven presented with symptoms after ingestion of the food, out of which 53 had convulsions. Odds Ratio is 9.13 (2.69- 30.97) at 95% Confidence Interval. Samples of incriminated food revealed the chemical lindane. Introduction of pesticide poisoning reporting into the disease notification system, revision of policies for monitoring pesticide level at the respective level of the food chain and research into the cumulative / long term impact of pesticides to human and animal health.

Key words: pesticide poisoning, surveillance, collaborative policy formulation.

Introduction

Pesticides are an important management tool in the agricultural enterprise as they increase yields and protection against insects at post-harvest and storage, with immense benefit of enhancing the shelf life of stored agricultural products (Olabode et al., 2011). The chemical agents called pesticides include herbicides (for weed control), insecticides, and fungicides. Pesticide poisoning raises public health concerns around the world, as a matter of fact, 150,000 metric tons of pesticides are sold each year (Miligi et al., 2005). Without doubt, the use of pesticides have greatly contributed to the increase of world food and also improved human and animal health. However, their use could also result in an unintended negative human health impacts.

A recent systematic review of the burden of disease attributable to chemicals estimated that 8.3 percent of the total 4.9 million deaths and 86 million disability-adjusted life years were due to environmental exposure to, and unsound management of selected chemicals (Genon et al., 2013). Pesticides use has dramatic consequences both in developed and developing countries; it has been associated with convulsions, severe hypotension, respiratory depression, coma (Briassoulis et al., 2001) and death (Lee et al., 2007). There is a high chance that pesticides use and pesticide – induced side effects is on the increase in developing countries as a whole than in the developed ones (Akeem and Sofoluwe, 2012).

An investigative study carried out in Senegal (Toure et al., 2011) showed that high lethality associated with pesticide poisoning was due to lack of qualified healthcare professionals and the diagnosis and the case management of poisoning are a real challenge in the health services. According to (Ogunjimi and Farinde 2012), pesticides use in Nigeria has been on the increase since in the early 1950s and particularly in 1957 when Lindane was introduced. Nigeria's insect- related post-harvest food losses are estimated at around 30 percent, and from the 1950s onwards insects control have been by the use of synthetic insecticides which have adverse effects on

human health (Otitodun *et al.*, 2012). Pesticides residues in food samples applied either directly or indirectly have been of concern in many countries; for instance in Egypt (Abbassy, 2001; Dogheim *et al.*, 2001), Jordan (Al-Nasir *et al.*, 2001), Palestine (Safi *et al.*, 2001), Kuwait (Sawaya *et al.*, 2000) and Pakistan (Tahir *et al.*, 2001). Furthermore, items reported included; honey samples (Al-Rifai and Akeel, 1997), human milk (Dagher *et al.*, 1999), chicken eggs (Hashemy and Mosstofian 1979), and fish (Dogheim *et al.* 1996).

Pesticide residues in food may be attributed to the lack of withholding/withdrawal period of pesticides applied on agricultural produce. The withholding period is the maximum length of time that must elapse, or a person must wait after applying pesticide on food crop before it is safe for consumption. It is the minimum length of time either days, weeks, or months stated on the chemical product label that must elapse between the last application of pesticide and consumption of agricultural products. According to Shrestha *et al.* (2010), waiting period is the duration after which grains treated with pesticide can be consumed or used. Every standard pesticide has the withholding period written on their labels. Failure to abide by the stipulated withholding period on pesticide label may result in high residue in the produce and a breach in maximum residue limits. Noncompliance withholding period has on several occasions led to severe outbreaks of pesticide poisoning with attendant morbidities and mortalities among the population.

The objective of this work is to report on outbreak associated with pesticide poisoning in Gombe State, Nigeria from 2005 to 2014 and discuss its implication on the population.

Material and Methods

Study area

Gombe State, located in the northeastern part of Nigeria, is one of the country's 36 states with its capital as Gombe city. It is located between latitude 9°30' and 12°30'N and longitudes 8°45' and 11°45'E of the Greenwich Meridian with a total land area of about 20,265sq.km. It is bounded by Borno and Yobe to the north and east, Taraba and Adamawa to the south, and Bauchi to the west. The projected population from the 1996 National Census estimated at 3,225,382 at annual growth rate of 3.2 percent (NPC, 2014).

Gombe has two distinct climates, the dry season (November–March) and the rainy season (April–October) with an average rainfall of 850mm. It is an agrarian state with about 60 percent of the population engaged in agriculture. Year round cultivation is possible in some parts of the state due to favourable weather and an extensive irrigation programme. A number of food and cash crops which include: Cereals: maize, millet, sorghum, rice and wheat; Legumes: Cowpeas, groundnuts, soya beans and bambara nuts are produced in the state.

Study Design

This study reviewed the reported outbreaks of diseases by the Epidemiology Unit of the Ministry of Health from 2005 to 2014 to determine the number that was attributed to pesticide poisoning. Furthermore, the disease reporting system (Integrated Disease Surveillance) core indicators were examined. The Integrated Disease Surveillance is a strategy for collection of information on priority communicable diseases from the health facilities and transmission to designated higher levels for action. It is however expanded under the International Health Regulations (IHR) for State parties to utilize the existing national structure and resources to meet their core capacity requirements for surveillance, reporting, notification, verification, response and collaboration activities for other public health events of international concern (International Health Regulations 2009).

Strategy

A desk review of all outbreaks notified to the state ministry of health from 2005 to 2014 was made. Using the core indicators stated for the IDS, the outbreaks were classified into those that had investigation reports, those with nationally recommended public health response, those with laboratory reports and those that fulfilled the case definition of suspected pesticide poisoning. Reports which fulfilled the case definition of suspected pesticide poisoning; of abdominal pain, dizziness, vomiting \pm convulsion in the population were selected.

Results

A total of 32 reported outbreaks were investigated from 2005-2014, of which 2 were due to suspected pesticide poisoning as shown in figure 1. Pesticide poisoning is not among the conditions reported as part of the routine IDS reporting system. One of the outbreaks was reported on the 27th, May 2005. At about 11.00 am report reached the Ministry of Health Gombe, Nigeria of the suspected cases of food poisoning after ingestion of breakfast in a public institution in Gombe.

An outbreak investigation team comprising of the State Epidemiologist, two Physicians from the State Specialist Hospital and WHO, Gombe Local Government Disease Surveillance and Environmental Health Officers was deployed to the institution. The team arrived the site, interviewed the medical team of the public institution for background information and examined some suspected cases.

Samples of the incriminated food (both left-over of the cooked and raw food items) were collected. The cases presented with the complaints of abdominal pain, dizziness and fits. The index case occurred within one hour of ingesting breakfast with beans porridge. Clinical examination revealed transient loss of consciousness, jerking episodes of convulsions and hypersalivation. Most of the cases regained consciousness after the episode and treatment with atropine injection.

A standard case definition for this outbreak is any person with abdominal pain, dizziness, vomiting + convulsion is considered a suspected case. The investigation team made a roll of all the persons in the institution, and each was asked questions about the food ingested over the previous 24 hours before the outbreak. They were also asked if they had any symptoms of abdominal pain, cramps, nausea, vomiting or fits after ingestion of the meal. The meal of beans porridge was provided for all the persons as breakfast. The sources of water in the institution are hand pumps and a well. The food is cooked by the residents. Of the three hundred and ninety-eight residents; 385 were interviewed. Two hundred and sixty-seven presented with symptoms after ingestion of the food, out of which 53 had convulsions as shown in Table 1.

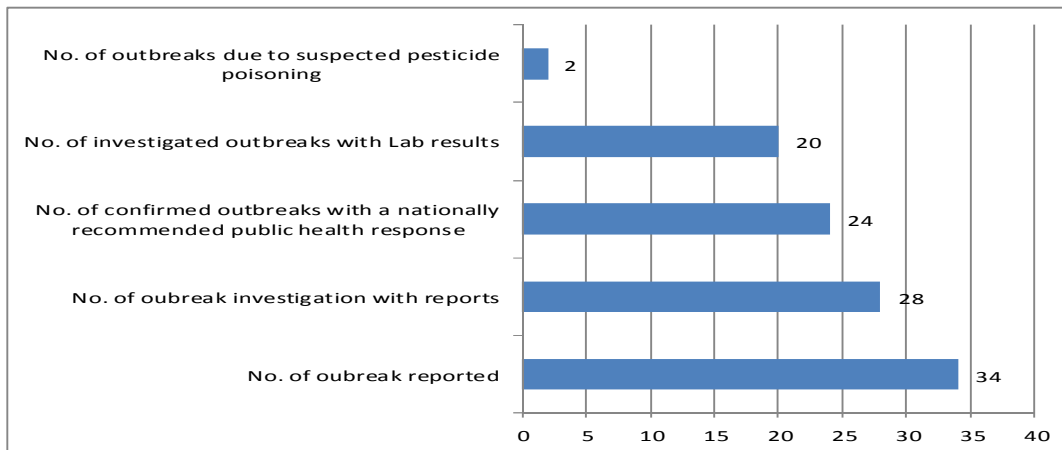


Fig 1: Number of outbreaks of diseases reported to Ministry of Health, Gombe state, 2005-2014.

Table 1: Distribution of subjects during outbreak investigation of suspected pesticide poisoning, Gombe state, May 2005

ATE	ILL		Total
	Yes	No	
Yes	193	162	355
No	3	23	26
Total	193	162	355
		95% Confidence Interval	
		Lower	Upper
Odds Ratio	9.13	2.69	30.97

Laboratory analysis

Chemical analysis showed lindane while no pathogens were isolated from the incriminated food specimen consumed. On 28th April 2008, 81 students of a public school were hospitalized with the history of consuming breakfast of beans porridge. They presented with complaints of headache, abdominal pain, nausea, vomiting and drowsiness in the school clinic. Analysis of the incriminated food showed lindane with no bacterial growth.

Discussion

The findings on the number of outbreaks of pesticide poisoning might have been grossly under-reported as it was only the records found at the ministry of health that were considered. All the outbreaks occurred in boarding public institutions where meals are prepared for those in-house. Large outbreaks involving large number of persons are likely to be reported because of the number involved. This corroborates with other findings from India whereby outbreak in similar schools were reported (ref). There was a strong odd of having the symptoms among those who ate the suspected meals compared with those that did not eat. This finding is similar to that of the study done in Senegal (Toure et al., 2011). Involvement of large number of people in an outbreak has a tendency of inviting media attention, which is why most of the suspected pesticide poisoning cases were reported through the media. Furthermore, reporting of suspected pesticide poisoning through the routine surveillance system was incidental as it is not part of the notifiable conditions in the integrated diseases surveillance system in most developing countries. The chemical detected in the incriminated food consumed is lindane (Gammalin), an organochlorinated pesticide banned under the 1989 Rotterdam convention (Rotterdam, 2009).

The in-country mechanism for systematic monitoring of pesticides in the food chain is sub-optimal. The only times it is realized that foods consumed in Nigeria have harmful chemical above the threshold are when they do not fulfil international standards for export, and usually detected by the importing countries (Vanguard, 2015). We are yet to realize the enormity of the problem; unless research into the effects of these harmful substances, if not we may have population that is threatened by diseases such as cancer (Vanguard, 2015).

Though controlled use of pesticides is expected to improve crop yields, reduce post-harvest loss and enhance food security; the guiding principles of its regulation, application, user-education is not well disseminated to the end-users. For instance, the concept of withholding period is expected to be shared with users but there is inadequate information, education and communication given to the farmers, grain merchants and other stakeholders (Shrestha et al. 2010).

There is limited information on the burden of pesticide poisoning, the short and long term effects on human, animal and environment. This therefore requires a deliberate need for research into the cumulative / long term impact of pesticides on human and animal health.

Conclusion

There is an evidence of weaknesses in pesticide use, strict monitoring and regulation of pesticide level in the food chain and reporting of cases of pesticide poisoning to the health system. Introduction of pesticide poisoning as notifiable condition into the disease notification system (both animal and human) assist in early detection and institution of appropriate actions. Agricultural extension workers should be used extensively to inform and educate farmers on approved pesticides for use and proper application methods. Furthermore, revise policies for monitoring pesticide level at the respective level of the food chain and research into the cumulative / long term impact of pesticides to human and animal health.

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Ethics

All the authors read and approved the manuscript and no ethical issues involved.

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