REVIEW ARTICLE

Analysis of Recent Situation of Pesticide Poisoning in Bangladesh: Is There a Proper Estimate?

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Abstract

Background: Pesticide poisoning is a common method of suicide attempt and less commonly accidental poisoning in Bangladesh. This review for the first time estimated the extent and characteristics of pesticide poisoning in Bangladesh and explored existing limitations in methodologies of studies done on poisoning in the country.
Methods: A narrative search in electronic medical databases including MEDLINE, Google Scholar and Banglajol was carried out. Search terms used were "Bangladesh", "pesticide", "poisoning" and "organophosphate". Relevant studies were collected and assessed for their originality. Organization reports were also collected. Studies after the year 2000 were only selected. Methodologies of the studies were carefully scrutinized.
Results: Estimated case load of poisoning in hospitals of Bangladesh was 7.1% (CI 6.9-7.2) of total admissions. Pesticide poisoning accounted for 39.1% (CI 37.6-40.6%) of total poisoning cases admitted in different levels of hospitals in Bangladesh. Majority of them were due to WHO class-II pesticides (moderately hazardous). Reported frequency of different pesticides includes organophosphate compounds (OPCs) in 89.8%, rodenticides in 4.3%, carbamates in 4.0%, unknown compounds in 1.6% and pyrethroids in 0.3% of cases. Pesticide poisoning was responsible for 72.6% (CI 68.0-76.8) of total poisoning related deaths. Approximately 0.7 deaths per 100,000 population was due to pesticide poisoning. Reporting the frequency of chemical nature of pesticides varied significantly with methodology used for case identification ($P < 0.001$). In studies that toxidromic assessment was used, most cases were treated as OPC poisoning. In studies that applied sample identification by evaluation of container/pack and reading its label, over 30% of cases were due to carbamates. Presence of only one toxicological analysis center in the country has made routine chemical identification practically impossible.
Conclusion: Pesticide poisoning is responsible for great number of admissions and deaths in Bangladesh. Creating a register of commercially available pesticides in each region for rapid identification of nature of the pesticide is recommended.

Keywords: Bangladesh; Organophosphates; Pesticides; Poisoning; Research Design

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INTRODUCTION

Pesticide poisoning is a common method of suicide attempt and less commonly accidental poisoning in developing countries (1). Based on types of pests controlled, pesticides include insecticides, herbicides, acaricides, fungicides, rodenticides, etc. (2). Until 2013; 2894 different types of pesticides are approved in Bangladesh (3). Organophosphate compounds (OPCs) are the most frequently reported pesticides used for poisoning in Bangladesh (4-6). Very few non-OPCs are mentioned as poisoning agent. Why are other groups of pesticides less reported in Bangladesh? The biggest shortcoming is probably the lack of facility for toxicological confirmation. Only one toxicological analysis center is available in the country that is known as the chief chemical examiner's office situated in Institute of Public Health, Mohakhali in Dhaka. It has been maintained by Criminal Investigation Department (CID) of Bangladesh police (7). Therefore, in practice, clinicians have to rely on history and toxidromic approach to decide how to manage the patient as well as making a diagnosis for keeping record. Sometimes, there is no other choice. Even in well-equipped settings, chemical confirmation of poisoning agent may take time. Moreover, toxidromic approach is an appropriate method for rapid assessment of patient and decision making. In settings like the ones in Bangladesh, only if container of ingested poison is brought, definite nature of poison can be identified. Although this practice does not sound scientific, it serves the practical need. It is also true that not in all circumstances such samples are available or can be provided to clinicians.

The reported frequency of different pesticides used for poisoning may not be representative of the actual scenario in Bangladesh. Therefore, different methodologies used in poisoning studies of Bangladesh were carefully scrutinized to observe whether they had influenced on final output. This review for the first time estimated the extent and characteristics of pesticide poisoning in Bangladesh and

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explored existing limitations that are needed to be improved in order to assess the situation appropriately. Best practical methodology that may be applied in future poisoning studies in Bangladesh to obtain more accurate results was also suggested.

METHODS

Data sources

A narrative search in electronic medical databases including MEDLINE, Google Scholar and Banglajol was carried out. Banglajol (http://www.banglajol.info/) is a database of online journals published in Bangladesh, covering the full range of academic disciplines. Search terms used were "Bangladesh", "pesticide", "poisoning" and "organophosphate". Relevant studies were gathered and assessed for their originality. In addition, organization reports were collected. Methodologies of studies were carefully scrutinized. Studies after the year 2000 were only selected in an effort to reduce the possible influence of changing trend on use of pesticides in Bangladesh.

Data analysis

Sixteen relevant native studies were found. All were conducted within 2003 to 2012. The topic of available studies were of four different categories: poisoning epidemiology (nine), clinical trial (four), postmortem study (two) and review article (one). Particular attention was given to how different poisoning cases were identified in a study. Possible methods for identification of poisons are:

1. Chemical analysis (not possible in centers outside capital city (Dhaka))
2. Sample identification by evaluation of container/pack and reading its label (the best available method)
3. Toxidromic assessment
4. Atropine challenge (limitation exists)
5. History

Abstract of conference oral presentation, poster presentation, short report, survey results, organization reports were not included for pesticide case load estimation as the results were not detailed (e.g. percentage was given for distribution of pesticide poisoning but actual figure was not stated). However, data on gender distribution and mortality rate from these papers were considered if the details were given. Two relevant case reports were also reviewed.

Difference between groups was analyzed using chi-square test. Statistical analysis was done with SPSS version 20 (IBM Corp., Armonk, NY, USA). Level of significance was considered to be less than 0.05 at the level of 95% confidence interval (CI).

RESULTS

Poisoning load in hospitals

In a survey done in primary (sub-district), secondary (district) and tertiary (medical college) level hospitals in Bangladesh, the case load of poisoning was totally found to be 14.5% (n = 4553) out of 31329 admitted patients (8). In another large series; Chowdhury et al. in Khulna Medical College Hospital in southern part of Bangladesh recorded 3.2% case load of poisonings (n = 1903) during 2003 to 2006 among 60,000 patients (9). Estimated case load of poisoning in hospitals of Bangladesh was thus 7.1% (CI 6.9-7.2) of total admissions (8,9). However national data of 2008 to 2012 reported by Bangladesh Directorate General of Health Services (DGHS) differs from discrete institutional data (10-12). In this respect, in 2012, admissions due to poisoning were 2.23%, 2.12% and 2.05% respectively for the mentioned level of hospitals (12). Poisoning remains among the top ten health problem in Bangladesh according to the annual report of Bangladesh health authority (12). The reason for higher case load in tertiary hospital-based studies than national report is probably: a) poisoning cases are mostly referred from primary or secondary care institutions to tertiary hospitals while in national reports, the statistics of all hospital levels are taken into account and b) variability exists in case load of different parts of Bangladesh.

In different parts of Bangladesh, pesticides have been responsible for poisoning in great number of patients admitted to hospitals. In a series done in Dhaka Medical College Hospital (DMCH), in central part of Bangladesh, load of poisoned patients was 19.2% of total 3030 admissions in 22 months (n = 581). Pesticides were responsible for 1.98% of total admissions and 10.3% of poisoning cases (n = 60) in this center (13). In addition, in a study in Sylhet, northeastern Bangladesh, of 4435 poisoned patients admitted to a tertiary hospital in 4 years, 25.7% were due to OPC poisoning (14). Similarly, in southern part of Bangladesh, among 1903 poisoned cases admitted to Khulna Medical College Hospital in 3 years, 27.6% were related to OPC poisoning (9).

Among seven hospital-based epidemiologic studies on poisoning in Bangladesh, one study only reported OPC and carbamate poisonings (15), while in the remaining six studies, all kinds of pesticides were reported (9,13,16-19). Occurrence of pesticide poisoning in these six studies ranged from 10.3% to 73.8% (Table 1). In mentioned six studies, of 4021 admissions due to poisoning, 1573 cases (39.1%, CI 37.6 - 40.6%) were due to pesticides (9,13,16-19).

Demographic characteristics of pesticide poisoned patients

Pesticide poisoning was predominantly occurred among men except in a series done in Pabna, Rajshahi in west Bangladesh (20). Among 12614 pesticide poisoned patients, men accounted for 60.3% (n = 7611) (8,9,13-16,18,20,21-23). Considering the age, the highest number of patients belonged to age group of 21 to 30 years (38.1%) followed by patients aged under 20 years (33.8%) (9,13,15). This shows that adolescents and young adults are the most vulnerable population of the country to this kind of poisoning (Figure 1). Marital status was reported in two studies and that most of the patients were unmarried (56.4%) (13,21). Occupation was reported in a small series in DMCH that 18.3% of patients were student, 16.7% housewife, 11.7% businessman, 11.6% farmer, 1.7% government employee and 40% other occupations (13). In another study, 47% of patients were farmer, 16% student and 13% housewife (23). Regarding the place of residence of patients, majority (80%) lived in rural areas (13). Illiteracy observed in 36.7% and psychiatric illness was observed in 11.7% of patients (13).

Table 1. Summary of hospital-based epidemiological studies on poisoning in Bangladesh

Reference No.	Study design and period	Method used to identify poisoning agent	Total number of poisoning cases	Pesticide poisoning, No. (%)
9	Retrospective 2003-2006	Not mentioned	1903	592 (31.1)
13	Prospective 2005-2006	History Toxidromic assessment Sample identification	581	60 (10.3)
15	Prospective 2010-2011	History Toxidromic assessment Sample identification	168	168 (100)
16	Prospective 2004	History Toxidromic assessment	100	42 (42.0)
17	Prospective 2005	Not mentioned	397	114 (28.7)
18	Prospective 2010-2011	History Toxidromic assessment	956	703 (73.5)
19	Retrospective 2010	Toxidromic assessment	84	62 (73.8)

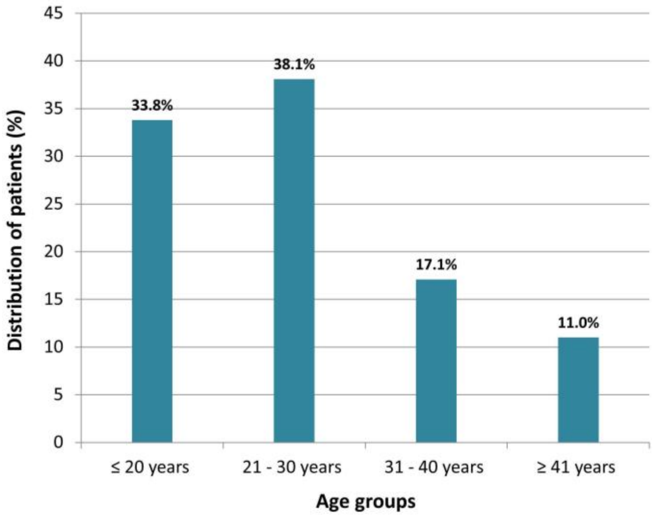

Figure 1. Age distribution of pesticide poisoning cases in Bangladesh

Intention of poisoning and reason behind suicidal intention

In six studies, intention of pesticide poisoning was reported. Total number of patients in these studies was 7357 that among them, the most common reason for poisoning was suicidal (5316, 72.2%) (9,13,14,21,23,24). Shadequl-Islam et al. reported the motive of pesticide poisoning in their study that 45% of cases were due to familial disharmony, 15% unknown, 13.3% depression, 8.3% marital problems, 5% financial problems and 13.3% due to other reasons (13). In most cases, the patient could access to the poison by self-purchasing from poison retailers (13,23).

Type of pesticides used for poisoning

In seven studies, types of pesticides consumed for poisoning were reported (9,14-19). In total of 1741 cases with pesticide poisoning, 1564 cases were due to OPCs (89.8%,CI 88.3-91.2), 74 cases due to rodenticides (4.3%,CI 3.4-5.3), 70 cases due to carbamates (4.0%,CI 3.2-5.1), 28 cases due to unknown pesticide agent (1.6%) and 5 cases due to pyrethroids (0.3%) (13-19). In table 2, the frequency of reported types of pesticides used for poisoning in different series in Bangladesh are summarized. In overall, 149 cases (8.7%) were due to non-OPCs (CI 7.4-10.2). In two studies that the poison was confirmed by evaluation of poison container and reading the label, frequency of OPCs as the responsible toxic agent was found to be 59.5% and 78.1% (cumulative 62.5%) (13,15). Studies based on toxidromic diagnosis mentioned 99.1% of agents as OPC (Table 3). Frequency of OPC poisoning varied significantly with method of diagnosis (clinical vs. sample identification) in study design ($P < 0.001$).

Different chemicals that could be identified in pesticide poisoning cases are presented in Table 4. OPCs comprised of 71.3% of cases (CI 66.1-76.0) followed by carbamates in 22.3% of cases (CI 18.0-27.2), pretilachlor in 4.4% of cases (CI 2.6 -7.3) and cypermethrin in 1.6% of cases (CI 0.6-3.6) (13,15,21,23,25). Majority of the identified poisons belonged to World Health Organization (WHO) class-II (moderately hazardous pesticides). Malathion was the commonest pesticide used, followed by carbamates. However, the chemical nature of carbamate compounds was not reported individually in any study. Similarly, chemical nature of rodenticides was not mentioned in any study. But it is known that aluminum phosphide and zinc phosphide are the available rodenticides in the country.

Pre-hospital managements and outcome among survivors

Pre-admission management that is an important issue in saving patients' lives was assessed only in two studies. Almost half of patients (47.7%) received no pre-hospital treatment and first aids (13,21). Majority of cases (67.9%) arrived in hospital within 4 hours post-ingestion (21,23). Shadequl-Islam et al.

Table 2. Observed frequency of different pesticide agents

Method of diagnosis	Reference No.	Total cases of pesticide poisoning, No.	OPC*, No. (%)	Non-OPC**, No. (%)
Toxidromic assessment	16	42	35 (83.3)	7 (16.7)
	18	703	703 (100)	-
	19	62	62 (100)	-
Sample identification	13	32***	25 (78.1)	7 (21.9)
	15	168	100 (59.5)	68 (40.5)
Not mentioned	9	592	526 (88.9)	66 (11.1)
	17	114	113 (99.1)	1 (0.9)

* OPC: organophosphate compound
** Non-OPC: carbamates, rodenticides, pyrethroides
*** There were additional 28 unidentified pesticides

Table 3. Analysis of impact of study methodology on reported frequency of OPC vs. non-OPC poisoning in studies done on pesticide poisoning in Bangladesh

Method of poison identification	Reference No.	Total cases of pesticide poisoning, No.	OPC*, No. (%)	Non-OPC**, No. (%)	P-value
Sample identification (Examination of poison container)	13,15	200	125 (62.5)	75 (37.4)	< 0.001
Toxidromic assessment (Clinical Presentation)	16,18,19	807	800 (99.1)	7 (0.8)	
Not mentioned	9,17	706	639 (90.4)	67 (9.5)	

* OPC: organophosphate compound
** Non-OPC: carbamates, rodenticides, pyrethroides

found that 75% of cases contacted a physician within one hour of ingestion (13). Median hospital stay was 4 days according to the study by Ahmed et al.; while, more than a week hospital stay was rare (13,15,21,22).

Complete recovery of patients was reported in 3 studies that occurred in 81.2% of cases, and 2.9% cases recovered with complications (13,15,21). The most commonly reported complications following pesticide poisoning were atropine toxicity (15.6%), intermediate syndrome (13.6%), acute cholinergic crisis (13.3%), respiratory failure (7.9%), arrhythmia (2.6%) and aspiration pneumonia/hypoxic encephalopathy (1.8%) (13,21,22). These studies were done in different tertiary level hospitals and in all of them inadequate ICU facility was stated as the major shortcoming. Among those who required ICU transfer; 50% of them died due to lack of this support (13,21,22). None of the district and sub-district hospitals in Bangladesh have ICU facility to manage these complications.

Mortality rate

Based on studies done in Bangladesh, poisoning related mortality rate (irrespective of type of agent) was estimated to be 5.1% (CI 4.6-5.6) (8,9,13,15,18). However, among the fatal cases, 72.6% (CI 68.0-76.8) were due to pesticides. Estimated mortality rate solely among cases of pesticide poisoning has been reported to be 9.2% (CI 8.0-10.5) (13,15,20-22). Group wise mortality rate was 8.9% (CI 7.7-10.4) for OPCs, 1.4% (CI 0.2-7.7) for carbamates and 3.0% (CI 0.8-10.4) for rodenticides (9,13-15,20-22). Except for malathion with mortality rate of 20%, this rate is not determined for the other specifically identified OPCs (13).

Empiric treatment of pesticide poisoning

Diagnostic limitations and unavailable sample at presentation has resulted in management of some non-OPC poisonings as OPC poisoning. In DMCH, 40% of cases with pyrethroid poisoning were treated with atropine before exact confirmation via sample identification (13). Majumder et al. reported cases with paraquat poisoning that were treated with atropine despite clinical features were distinct from OPC poisoning (25). They also showed that when sample identification has not been done for patients, all of them might have been recorded as OPC poisoning and real diagnosis would never have been known. It is a fact that other than research purposes, chemical analysis and sample identification are not practiced in Bangladesh.

Knowledge about poisonings in and economic impacts of poisoning on general population

A knowledge, attitude and practice (KAP) survey among rural people in Bangladesh showed inadequate knowledge regarding poisoning agents (26). All respondents mentioned easy availability of pesticides in locality. One third claimed to know safe use of pesticides. Although most respondents claimed to keep poisons in safe places, the poisons were

Table 4. Chemical nature and hazard potential of identified pesticides in poisoning studies in Bangladesh (No. of cases = 314)

Pesticide type	WHO pesticide hazard class*	GHS category**	No. (%)
Organophosphates			
Malathion	II	5	81 (25.8)
Dichlorvos	Ib	3	25 (7.9)
Chlorpyrifos	II	5	23 (7.3)
Dimethoate	II	3	21 (6.6)
Diazinon	II	4	20 (6.3)
Quinalphos	II	3	16 (5.0)
Fenitrothion	II	4	11 (3.5)
Fenthion	II	3	11 (3.5)
Phenthoate	II	4	9 (2.8)
Monocrotophos	Ib	2	7 (2.2)
Carbamates	I-II	1-3	70 (22.3)
Pretilachlor	U	5	14 (4.4)
Cypermethrin	II	3	5 (1.6)
Paraquat	II	1	1 (0.3)

* World Health Organization (WHO) pesticide hazard class: Ia = Extremely hazardous, Ib = Highly hazardous, II = Moderately hazardous, III = Slightly hazardous, U = Unlikely to present acute hazard

** Globally Harmonized System of Classification and Labeling of Chemicals (GHS): 1-2 = Fatal if swallowed, 3 = Toxic if swallowed, 4 = Harmful if swallowed, 5 = May be harmful if swallowed

not adequately kept safe. Following the poisoning, majority of respondents stated that they would try local remedy/ traditional treatments prior to hospital admission.

Average income in a family in Bangladesh was estimated to be about 1200 Tk (US17$) in a study (26), but mean expenditure for a single event of poisoning occurred for a family member was about 3500 Tk (US 50$), which clearly indicates the economic impact of poisoning on the society.

DISCUSSION

World Bank (WB) estimated that in Bangladesh, among different pesticide classes, insecticides were used for about 1365 million tons, fungicides for 708 million, herbicides for 62 million and rodenticide for 6 million tons in 2004 (27). This means insecticides and fungicides accounted for 97% of pesticide use. Analysis of active ingredients showed high share of carbamates and OPCs in insecticides and dithiocarbamates in fungicides (27). Among the sold insecticides, according to chemical nature, OPCs accounted for 74.7% followed by carbamates (21.9%) and pyrethroids (0.1%) (27).

Miah et al. found insecticides (76%) as the dominant form of pesticides used by Bangladeshi farmers in their study (28). They revealed that major pesticides used by the farmers are cypermethrin, dichlorvos, malathion, carbofuran, mancozeb and diazinon depending on the invading pests (28). Besides, they showed that many pesticides banned or restricted under international agreements are still available and in use in Bangladesh (28).

WHO class I (extremely toxic) and class-II (moderately toxic) pesticides are used by 77.7% of Bangladeshi farmers (27,29). There is a region-based difference in pesticide use. Use of carbamates, OPCs and organochloro compounds (OCCs) ranks the highest in northern part of the country, while OCCs are mainly used in central and eastern parts, carbamates are mostly used in southwestern regions, and in southern parts OPCs are the most frequently used agents (27). Therefore, OPCs, carbamates, OCCs are the main expected group of pesticides responsible for human poisoning in Bangladesh. According to a study by Ahmad et al.; OPCs, OCCs and synthetic pyrethroids are the commonest chemical groups of pesticides used for poisoning in Bangladesh (7). Their observations are supported by the study of WB and Miah et al. (27,28).

The frequency of pesticide poisoning in South East Asia region of WHO was estimated to be 20.7% by Gunnell et al. in 2007 (30). Global estimates was 30% (range: 27-37%) (30). Our estimated pesticide poisoning case load in Bangladesh is 39.1% (CI 37.6-40.6). In a study on poisoning statistics of DMCH, Chittagong Medical College Hospital, Jhenaidah General Hospital, Cox's Bazar General Hospital and 7 primary care level health centers in Bangladesh during 2006 to 2007, it was estimated that 29% of poisonings were due to pesticides (8). Similarly, in a study done in Sylhet Medical College Hospital from 2008 to 2011, reported frequency of pesticide poisoning was 29.6% (14). In 2002, a study in nine medical college hospitals in Bangladesh found a case load of 40% for pesticide poisoning (31). The estimated frequency by Gunnell et al. is based on an assumption that all countries have equal load in a defined WHO region. This figure highly relied on statistics from India, Sri Lanka and Thailand; therefore, it may not display the exact situation for Bangladesh (30).

In this review we showed that OPCs are the most common pesticides used for poisoning (89.8%). However, the reported frequencies ranged from 12% to 100% in different series (9,13,15-19,32). Twelve-year statistics of national forensic science laboratory of Nepal showed that among 1016 poisoning cases, the poisons used by 34% of cases (n = 342) were insecticides and by 4% of cases (n = 45) were rodenticides (33). Among insecticides, OPCs were used by 71% of cases, pyrethroids by 13%, mixed insecticides (OPC + Pyrethroid) by 7%, carbamates by 5% and OCCs by 4% (33). Considering chemical nature of poisons, 15 different compounds were identified (33). In Mysore (South India) pesticides were responsible for 39.5% of poisoning cases and frequency of different pesticides were OPCs in 71%, rodenticides in 13%, pyrethroids in 7%, carbamates in 6.5% and OCCs in 2.5% of cases (34). Frequency of carbamate and rodenticides used in Bangladesh were almost identical with Nepal but that of OPC and pyrethroids were noticeably different from what in India and Nepal (~70%) as the rate of use of OPCs in Bangladesh is about 90% and for pyrethroids is less than 1%.

Estimated mortality rate from poisoning in the year 2012 in Bangladesh was 1.1 per 100,000 population (12). This is much lower than India where death rate due to poisoning in WHO reports is 10.3 deaths per 100,000 (35). WHO estimated 55% of mortality in suicide cases in Bangladesh resulted from self-poisoning (36). In this this review, we found that 72.6% of poisoning deaths were due to pesticides. In that case, pesticide poisoning approximately causes 0.7 deaths per 100,000 population in Bangladesh.

According our analysis and available literature, pesticide poisoning in Bangladesh is more common among men, people aged 21 to 30 years, living in rural areas, farmers, students and housewives and persons without previous or concurrent psychiatric disorders (8,9,13-16,18,20-23). The findings are similar to that of India, China and Malaysia (1). A substantial portion of poisoning cases did not have diagnosable mental illness in the mentioned countries (1). In fact, only in one study previous mental illness was reported among Bangladeshi poisoning cases (11.7%) (13). This observation corresponds to findings by Eddleston et al. who opined that in Asia, impulsive act is the main reason for poisoning not mental illness (1).

Case fatality from self-poisoning in rural Asia is 10-20% (1). In our review fatality rate for pesticide poisoning (9.2%) is almost similar to Asian estimate. Litchfield classified the reason for pesticides exposures as intentional, accidental and occupational (37). Acute occupational pesticide poisoning (AOPP) are usually mild and occurs at field level and not reported since most epidemiological studies are hospital-based and on severely affected cases. AOPP incidence represents a small proportion of total poisoning cases in less developed countries (37). Among 702 Bangladeshi farmers who reported AOPP symptoms, burning/itching eye was present in 30.6%, dermatologic irritations in 29.9%, muscle twitching in 26.7%, excessive sweating in 24.5%, gastrointestinal disturbances (appetite loss, nausea, vomiting) in 22.3%, fatigue in 21.9%, and dizziness in 19.0% of cases (29,38). The frequency of these symptoms is higher than studies done on Chinese farmers (39). AOPP has been estimated to occur among 0.3% of farmers in Indonesia, 7.1% in Sri Lanka, 7.3% in Malaysia and 8.8-9.9% in China (39). The discrepancy in rate of the mentioned countries is mostly related to cultural and educational characteristics of farmers. WB revealed 47% of Bangladeshi farmers use excessive pesticides on crops (40). Moreover, WB showed that only 4% of farmers were properly trained to use pesticides and 87% used inadequate protective measures while applying pesticides (40). Consumers of agricultural products (e.g. vegetable, fruits) are at risk of unintentional exposure to pesticide residues (29). Because majority of farmers do not maintain the pre-harvesting interval period; pesticide residue are found in marketed vegetables. Even, some pesticides penetrate vegetables and cannot be washed off (29). Data are limited regarding AOPP among farmers and health effects of residues on consumers. The health effects on consumers of such residues were pointed out by Miah et al. (29).

Non-OPC insecticides, herbicides, acaricides were not reported frequently as poisoning agent despite their substantial use in Bangladesh. In three studies, except OPCs, rodenticides were the only other mentioned pesticides (9,16,17). Sarkar et al. and Parvin et al. observed an exceptional rate of 100% of pesticides used for poisoning as OPCs (Table 2) (18,19). Carbamates and pyrethroids were reported in few studies (13,15). Probable reasons are differences in methodology used for case definition as well as prospective/retrospective design of study.

Comparison of methodologies used in poisoning studies in Bangladesh suggests that studies based on toxidromic case definition possibly overestimated OPC poisoning. In this respect, in some studies patients with pyrethroids or paraquat poisoning were treated with atropine (13,25). Furthermore, if container/pack of poison was not brought by poisoned patients, they were destined to be recorded as OPC poisoning. In fact, it cannot be stated with certainty that the outcome of patients treated with toxidromic identification approach would not be influenced by wrong diagnosis. Because except OPCs and carbamates, in poisoning due to other pesticides, patients do not benefit from atropine therapy and if so, they are vulnerable to atropine toxicity (41). However, toxidromic approach is more appropriate for prompt decision making and treatment of poisoned patients since the rapid analytical confirmation of the nature of toxicants is impossible to perform in the majority of health care facilities in both developing and developed countries (42). Nevertheless, it should be kept in mind that poisoning with some non-OPC pesticides may mimic OPC poisoning. For example, cases with pyrethroid poisoning may manifest with miosis (43). Also, carbamates cause cholinergic effects, though they are mild (44). In the absence of chemical analysis; carbamate poisoning can be passed off as mild form of OPC poisoning (44). This can be the reason of underreporting of carbamate poisoning in all studies that only relied on toxidromic identification (16,18,19).

Toxidromic approach may not be suitable in case of multiple poisoning. Treating patients poisoned with pesticides other than OPCs and carbamates with atropine exposes them to atropine toxicity. However, atropine challenge test can differentiate poisoning due to OPCs or carbamates from other pseticides (41). Hence, we strongly suggest the use of test dose of atropine to differentiate OPC (and carbamte) poisoning from others as it is clearly recommended in the national poisoning management guideline of Bangladesh (45). Not only the diagnostic method, but also type of study may have influenced the obtained results. Retrospective studies have disadvantages because records in register cannot guarantee uniformity of diagnostic method applied in the past. But a prospective study ensures that every patient has received same protocol for diagnosis and the quality has been controlled by study team members.

Sample identification was applied only in two epidemiologic studies (13,15). Such method was also used in clinical trials on OPC poisoning (21-23). Therefore, the findings of these two studies appear more reliable. In the study by Haque et al. that only OPC and carbamate poisoning were studied, OPC and carbamates were reported to constitute 59.5% (n = 100) and 40.5% (n = 68) of cases (15). In the study by Shadequl-Islam et al., OPCs were found in 78.1% of cases, carbamates in 6.2% and pyrethroids such as cypermethrin in 15.6% of cases (13). On other hand, in two studies with 703 and 62 cases studied, 100% of pesticides responsible for poisoning were reported as OPCs (18,19). It is extremely unlikely that no compound other than OPCs be recorded in a series of 703 cases of pesticide poisoning. Therefore, studies relying on toxidromic assessment might have overestimated OPC poisoning by an assumed value of approximately 30%.

Pretilachlor was the only herbicidal agent responsible for poisoning that was mentioned in studies done in Bangladesh, and unfortunately, it was incorrectly labeled as OPC (23). Paraquat -the most fatal herbicidal agent- is available in Bangladesh and one case report of its poisoning was published in 2009 (25). Paraquat chemically belongs to bipiridil group and 19 million tons of this poison is sold annually in Bangladesh (27). This deadly agent most commonly endangers farmers’ health. The very nonspecific features of occupational paraquat poisoning make it almost unidentifiable in our country.

It is evident that some mislabeling and inappropriate treatment of pesticide poisoning did occur. With existing limited facilities in Bangladesh, such problem is likely to recur. The question is what alternatives to chemical analysis might be suitable. Poisoning is a neglected health issue in Bangladesh. The experience regarding different classes of pesticides and difference in their chemical properties may be limited among substantial number of physicians (23,25,46,47). Creating public awareness to bring sample of ingested material with the patient might be a solution. Alternately, each hospital can build up a register of trade names of commercially available pesticides for that particular region to be showed to victims or their relatives. This method can be highly useful in Bangladesh.

Lack of toxicology laboratories, limited knowledge, reliance on toxidromic diagnosis still leave some unexplored area of pesticide poisoning in Bangladesh. Our clinicians are in fact dealing with pesticide poisoning cases with almost no additional logistic help.

CONCLUSION

Pesticide poisoning is responsible for great number of admissions and deaths in Bangladesh. A major portion of them is due to OPCs; nevertheless, non-OPC poisoning is underreported. Creating a register of common pesticides in each region for rapid identification of nature of the pesticide is recommended. Poisoning studies in Bangladesh require more strict criteria for case definition. Undoubtedly, conducting prospective studies by application of sample identification to determine the nature of toxicant will increase accuracy of findings.

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