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ASSESSMENT OF THE ABILITY OF HEALTH CARE PROVIDERS TO TREAT AND PREVENT ADVERSE HEALTH EFFECTS OF PESTICIDES IN AGRICULTURAL AREAS OF TANZANIA

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Abstract. A survey of Tanzanian health care providers in agricultural areas was undertaken in 1991–1994 to assess their knowledge of toxic effects of pesticides, experiences and practices, as well as of their needs for appropriate information in order to develop effective strategies for reducing pesticide poisoning. Face-to-face interviews were conducted with 104 physicians, clinical officers and nurses at health care facilities in the coffee and cotton growing areas. Eighty percent of respondents reported to have seen one and nine of them two to four cases of pesticide poisoning in the preceding three months. A significantly higher annual number of poisonings were observed in coffee than in cotton area (GM 0.5 vs 0.1). Also the number of cases registered in hospitals was considerably higher than that in the out-patient health care (GM 1.7 vs 0.2). Pesticide poisoning was regarded as a major problem in the community by 63% of health care providers, including 77% of hospital staff. One third of health care providers thought that a certain percent of pesticide poisoning cases remain unrecognized, and that this percentage is higher in cotton than in coffee growing areas. The respiratory tract was the major route for pesticide to enter the human body; this was followed by gastrointestinal tract, skin, and eyes. Only one percent of the respondents could identify the groups of pesticides (organophosphate vs organochlorine) mostly used in the study areas. The survey indicated that training of hospital staff in toxicity of pesticide exposure is an important task and a prerequisite for efficient recognition, diagnosis and treatment of pesticide poisoning cases in Tanzania.

Key words:
Pesticides, Health care, Poisoning, Exposure, Hazard, Tanzania

INTRODUCTION

Health care providers in agricultural areas in Tanzania are insufficiently equipped for delivering appropriate care to victims of pesticide poisoning. Two major reasons have been identified: inadequate training to identify adverse effects of pesticides, and shortage of means for diagnosing and treating pesticide poisonings [1–3]. In addition, health care providers are not familiar with the agricultural practices and environment in their service areas, and are thus unable to manage the hazards effectively. Pesticides are

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transferred to Tanzania from developed countries without full understanding of their impact on human health. A wide range of pesticides is used for pest and vector control in agricultural areas in developing countries, but the communities are often not adequately informed about their proper use and associated hazards; consequently, acute and chronic exposures are common in this region of the continent [4–6]. Little research has been conducted on occupational health care of farmers, however, several studies have already provided evidence that the use of pesticides is hazardous to the farmers' health [4,7,8]. Generally, acute and chronic diseases resulting from years of exposure to pesticides are frequently undetected. Although agricultural workers and their families in Tanzania are more exposed to hazards than the general population due to the nature of their work and living environment, the occupational health service scheme does not cover them.

Efforts have been made to protect human health and environment from pesticide hazards. They have until now concentrated on the control of work environment through developing designs and technologies, as well as on strategies aimed at bringing about behavioral changes in pesticide users through legislation and educational programs. Tanzania regulates import, formulation, distribution, sale and use of pesticides, and despite limitations of resources and capacities it has been able to restrict the use of pesticides class 1a and class 1b, recognized by the World Health Organization (WHO) as extremely and highly hazardous, as well as of organochlorine compounds, known to persist in the environment [9].

Health surveillance is a key element in the control of acute pesticide poisoning [10,11], but the health care system in Tanzania has not been effectively utilized. The efficient utilization of the health care network in campaigns to prevent and control poisoning may add to the current efforts to minimize the health impact of pesticides on the population. Although health care workers have been involved in community education, including campaigns for safe use of pesticides, little is known about their knowledge, skills and practices with regard to pesticide hazards and their management. Health care providers are, however, expected to deal adequately with adverse effects of pesticides, such as poisonings and to provide reliable data for health intervention programmes.

Health care services reach the majority of the Tanzanian population through a nationwide network of dispensaries, health centers, district and regional hospitals, but there is lack of well trained local health care workers to make correct diagnosis, and hospital services to stabilize and sustain the patient in case of acute pesticide exposure [12–14]. The recognition of potential toxicity of pesticides has not received much attention in the medical settings of Tanzania, and neither are studies carried out to evaluate the presence of acute poisoning and the contribution of pesticides to existing illnesses. Consequently, pesticide poisoning cases are generally mismanaged and underreported [1,3].

This is a report on interviews with Tanzanian health care providers in the cotton and coffee growing areas, conducted with the objective to quantify the number of cases of acute pesticide poisoning they have encountered and to determine the scope of their knowledge in the area of preventing and treating adverse health effects of pesticides. The assessment of the skills of health care providers is expected to provide the way to improve their effectiveness in dealing with the problem of pesticides in their working areas.

MATERIALS AND METHODS

General study design

A field study entitled "East Africa Pesticide Network" (EAPN) was launched in 1989 in three countries: Kenya (Kenya Medical Research Institute, KEMRI); Tanzania (Tropical Pesticide Research Institute, TPRI); and Uganda (Occupational Hygiene and Health Department, OHHD, Ministry of Labour) under the sponsorship of the International Development Research Centre (IDRC), Canada, and supported by the Finnish Institute of Occupational Health (FIOH). The study aimed at assessing health hazards posed by pesticide handling, storage and use in agricultural estates and small farms in

Kenya, Tanzania and Uganda. The study included blood sampling to determine acetylcholinesterase activity; interviews with farmers/farm workers, exposed and non-exposed, and the non-exposed controls; systematic observation of coffee and cotton farms during pesticide application; and interviews with health care and agricultural extension workers [15,16].

Target areas and health care providers

The study was conducted in 1991–1993. It consisted of interviews with farm workers [17] and biological sampling in the rural areas of Northern and Southern Tanzania where coffee is mostly cultivated, and in the Northwestern area with cotton as a major crop. Intensive farming is conducted in these areas and a substantial number of pesticide poisoning are reported [1]. The target population included physicians, clinical officers and nurses at every health care facility, both state and private, within a distance of 15 km from each farm estate or village under study. The study groups were selected on the grounds that they had the opportunity to handle poisoning cases occurring in their service areas.

Data collection

A standardized questionnaire consisting of structured, semi-structured, and unstructured items was presented face to face to health care providers during the pesticide spraying and non-spraying periods. This was done by visiting all health care facilities within a 15-km radius of the study site, and interviewing the available personnel. The questionnaire included questions on general demographic data (e.g. sex, age, occupation, work experience); contacts with pesticide poisoning (e.g. number of cases ever seen, ever personally attended to); pesticide poisoning as problem perceived in the community; knowledge (six questions) how to identify, diagnose and treat pesticide poisoning; and types of pesticides used in the area. The respondents were asked about possible routes of exposure, respiratory and gastrointestinal tracts, skin, and eyes; (answer Yes/No regarding each route). The percentage of correct answers (Yes) were calculated by the type of health care facility (hospital/out-patient). Finally, the respondents were asked about the involvement in providing the community with the information on health effects of pesticide use and their own needs in this regard. After completing a pilot study, the questionnaire was standardized for use within East Africa and translated into Swahili, an official language understood by everybody in Tanzania. The interviews, mostly lasting a day, or two, were conducted during the farm workers' study. In all, 104 persons were interviewed. All members of the personnel present during visits were interviewed, and there were no refusals.

Statistical analysis

Data analyses consisted of cross-tabulations, chi-square tests without correction for continuity, and t-tests for the significance of the difference between two means with equal variance assumption. In the analyses involving counts of poisoning cases as dependent variables, geometric means and standard deviations were used, and simultaneous modeling of the independent effects and interactions of two categories of independent variables (coffee/cotton area and hospital/out-patient employment) was conducted on log transformed counts in addition to the univariate analyses. Zero counts were replaced by 0.01 for lifetime and 0.1 for a year for log transforms. The SPSS 9.0 for Windows was used.

RESULTS

Characteristcs of health care providers

Fifty-three percent of the interviewed health care providers were men (Table 1). Mean age was 33 years, men were 2 years older than women on average. Male respondents were mostly medical assistants and clinical officers, while women were predominantly nurses and nurse aids. The majority of respondents, particularly women, were employed at dispensaries with duration of employment in health care of 12 years on average and in agricultural areas 5 years on average. The proportion of male health care workers in the coffee and cotton areas was 46% and 54%, respectively.

Table 1. Distribution of the interviewed health care providers by background variable among Tanzanian health workers

	Men N (%)	Women N (%)	Total N (%)
Age (yr)			
21–29	14 (25.5)	20 (40.8)	34 (32.7)
30–39	23 (41.8)	20 (40.8)	43 (41.3)
40–49	15 (27.3)	8 (16.3)	23 (22.1)
50–57	3 (5.5)	1 (2.0)	4 (3.8)
Median (yr)	34.2	32.0	33.2
Occupation:			
Physician	3 (5.5)	1 (2.0)	4 (3.8)
Medical assistant or clinical officer	26 (47.3)	3 (6.1)	29 (27.9)
Public health nurse	1 (1.8)	2 (4.1)	3 (2.9)
Registered nurse	–	10 (20.4)	10 (9.6)
Enrolled nurse/midwife	–	2 (4.1)	2 (1.9)
Nursing aid	5 (9.1)	12 (24.5)	17 (16.3)
Other	20 (36.4)	19 (38.8)	39 (37.5)
Type of facility:			
Hospital	16 (29.1)	6 (12.2)	22 (21.2)
Health center	10 (18.2)	4 (8.2)	14 (13.5)
Dispensary	17 (30.9)	27 (55.1)	44 (42.3)
Subdispensary	7 (12.7)	11 (22.4)	18 (17.3)
Rural health post	1(1.9)	–	1 (1.0)
Other	4 (7.3)	1 (2.0)	5 (4.8)
Duration (yr) of employment in health care:			
<1	1 (1.8)	2 (41.1)	3 (2.9)
1–1.9	5 (9.1)	4 (8.2)	9 (8.7)
2–4.9	9 (16.4)	5 (10.2)	14 (13.5)
5–9.9	8 (14.5)	10 (20.4)	18 (17.3)
10–19	21 (38.2)	21 (42.()	42 (40.4)
20+	8 (14.5)	6 (12.2)	14 (12.5)
Median (yr)	11.9	11.5	11.7
Duration (yr) of employment in agricultural areas:			
<1	1 (9.1)	7 (14.3)	12 (11.5)
1–1.9	7 (12.7)	7 (14.3)	14 (13.5)
2–4.9	16 (29.1)	17 (34.7)	33 (31.7)
5–9.9	15 (27.3)	13 (26.5)	28 (26.9)
10–19	11 (20.0)	4 (8.2)	15 (14.4)
20+	1 (1.8)	1 (2.0)	2 (1.9)
Median (yr)	6.3	3.7	5.0
Main crops in area:			
Coffe	25 (45.5)	33 (67.3)	58 (55.8)
Cotton	30 (54.5)	16 (32.7)	46 (44.2)

Identification of adverse health effects of pesticides and treatment methods

The survey showed that 80% of health care providers had ever seen a patient with pesticide poisoning (Table 2); 17% attended 20 cases on average; all health workers attended 3–4 cases during the period of employment, 1–16 cases per year; nine respondents attended 2–4 cases during the past 3 months; 67% of persons treated pesticide poisoning but 71% of them reported lack of means for treating the cases. Over 30% of respondents were not aware of toxic effects of pesticides.

The univariate analysis of the number of poisonings ever seen per year of employment in health care, revealed that the coffee areas had a significantly higher geometric mean

Table 2. Number of subject reported cases of pesticide poisonings seen (entries are numbers of respondents) by Tanzanian health care workers

	Ever	Per yr ever*	Past 12 mos	Past 6 mos	Past 3 mos	Past mos
None	21	21	69	77	77	84
1	14	58**	14	14	10	9
2–4	20	17	16	8	13	9
5–10	19	6	4	2	2	–
11–20	11	1	–	–	–	–
21+	18	–	–	–	–	–
Unknown	1	1	1	1	2	2

* Calculated per year of employment in health care.
** Between 0.3–1.02 cases per year.

(0.5) than cotton areas (0.1; Table 3). Hospital staff had reported a larger number of cases than out-patient health workers (GM 1.7 vs 0.2). There were no difference in the number of poisoning cases in the preceding year between coffee and cotton areas or between hospital and other facilities. In the two-way analysis of variance, main effects in the coffee area and hospital employment on the number of cases ever seen per year of employment remained significant.

The proportion of health care workers considering pesticide poisoning as a major problem in their community was high (63%), especially among hospital staff (77%) (Table 4). But among out-patient health workers it was only 13%. One third of the health care providers thought that health care workers were not aware of all pesticide poisonings (Table 4). This percentage was higher in cotton than in coffee areas. The conjectured reasons for unattended poisonings were diversified (Table 5), but in cotton grow-

Table 3. Cases of pesticide poisoning seen, by type of crops (coffee/cotton) and health service (hospital/out-patient) among Tanzanian health care staff

	No. of cases	No. of pesticide poisoning seen					
		During employment year*			During past 12 mos		
		GM (SD)	Range	p**	GM (SD)	Range	p***
Coffee area	58	0.53 (1.9)	0–17		0.32 (1.6)	0–10	
Cotton area	45	0.11 (1.9)	0–5	<0.0001	0.31 (1.2)	0–3	0.97
Hospital	22	1.74 (1.2)	0–10		0.29 (1.7)	0–10	
Out-patient	81	0.16 (1.9)	0–17	<0.0001	0.25 (1.4)	0–5	0.71

* Calculated per year of employment in health care.
** Coffee/cotton.
*** Hospital/out-patient.

Table 4. Perception of health hazards posed by pesticides. Percentage of health care providers in coffee and cotton growing areas in hospitals and out-patient health facilities

	Coffee (58)	Cotton (46)	P coffee/cotton	Hospital (22)	Out-patient (81)	P hospital/out-patient
Pesticide poisoning a major problem in your community?						
Yes	56.9	69.6	0.19	77.3	13.4	<0.001
Poisonings that do not come to attention of health care workers?						
Yes	25.9	45.7	0.036	31.8	35.4	0.76

P – values based on the chi-square distribution.

Table 5. Assumed major reasons (one per respondent) for poisoning cases not attended by health care personnel. Entries are number of health care providers

Reasons	Coffee area (58)	Cotton area (46)
Lack of transport	1	–
Health facility not easily available	–	2
Death before hospitalization	4	–
Poorly equipped medical facilities	–	1
Attended by a traditional healer	1	3
Suicide	2	1
Homicide	3	–
Ignorance	1	14
Illiteracy	–	1
Negligence	2	–
Total	14	22

ing areas ignorance was regarded as a major factor by fourteen health care providers.

It was observed that the respiratory tract was the most frequent route of pesticide exposure followed by gastrointestinal tract, skin, and eyes. Health care providers in out-patient settings identified a larger number of routes (Table 6).

Familiarity with agricultural practices

The following pesticides were found responsible for poisonings: endosulfan (19%), chloropyrifos (15%), and to less extent (<7%) profenofos, diazinon, cypermethrin, paraquat, methidathion and DDT, chlorothalonil, and cyhalothrin. Parathion, DDT, deltamethrin, gesaprim, triadimefon, difolatan and red copper were also listed. Only 1% of respondents was able to distinguish between organophosphorus and organochlorines groups of pesticides.

Table 6. Proportion (%) of "Yes" to "Can pesticides enter the body through..." responses

Route	Total	Hospital	Out-patient	Phospital/out-patient
Gastrointestinal	51.0	45.5	52.4	0.56
Skin	39.4	18.2	45.1	0.022
Respiratory	77.9	68.2	80.5	0.22
Eyes	3.9	–	4.9	

P – values based on the chi-square distribution.
Denominator: all subjects, including those who declined from expressing opinion.

Persons unable to discriminate between these two groups gave a long list of pesticides used in the area. Although far from exhaustive, the list contained the majority of pesticides used in the areas, including those banned or restricted for general use.

Advisory service on safe use of pesticides

Sixty-seven health care providers (64%) reported their involvement in providing information on health effects of pesticides. This figure contained 24% of hospital staff and 76% of out-patient practitioners. All respondents were in need of information or training on health effects of pesticides.

DISCUSSION

In summary, this study shows that the 8 of 10 Tanzanian health care providers had contact with pesticide poisoning; the substantial proportion reported contact with over 20 cases. Health workers in coffee areas reported a significantly higher number of cases than those in cotton areas, and hospital staff more frequently than other health workers. Pesticide poisoning was considered as a major problem in the community by two thirds of health care providers, especially by hospital staff. One third of health care providers believed that health care workers were not aware of all pesticide poisonings and that happen more often in cotton than in coffee growing areas. When assessing the knowledge of routes of pesticide exposure, the respiratory tract was most frequently mentioned, gastrointestinal tract, skin, and eyes occupied consecutive places. Out-patient personnel identified more routes of exposure than hospital staff. It was alarming since the hospital staff is responsible for providing training in the field of pesticide hazards.

Health care providers were not able to classify pesticides into organophosphate, organochlorine or pyrethroid groups. Failure to distinguish organophosphorus and organochlorines reflects a lack of understanding of fundamental principles of diagnosis and treatment of pesticide poisoning, and its impact on the prognosis.

Although the present study showed that pesticide poisoning is a problem, particularly in coffee growing areas, the

farm worker study [17] of acute pesticide exposures, based on biological monitoring and symptoms, did not detect cases in the coffee growing areas at the time of the field study. It is difficult to assess the extent of the problem, as the national health management information system [18] does not require to distingush in the medical records between pesticide poisoning and other poisonings. A higher percentage of hospital staff considers pesticide poisoning as a major problem if compared to that of out-patient health workers, which reflects the fact that poisonings are treated more frequently in hospitals than in other health care facilities [19,20]. Referral of poisoning victims to hospitals is a common practice in many countries, but delays in correct diagnosis, evaluation and treatment of poisonings, particularly of those due to organophosphate pesticides, so frequent in developing countries, result in a large number of casualties. Despite strict pesticide regulations and measures in many developed countries, exposure to pesticides continues to induce illness and injuries [21].

We asked the respondents to provide a list of possible routes of pesticide exposure, as well as of signs and symptoms typically induced by pesticides. The questions addressed the basic issues regarding diagnosis and treatment of pesticide poisonings, and accordingly, it was expected that the majority of the respondents would answer them correctly. A low percentage of correct answers on the skin as an exposure route (39%, vs 18% among hospital staff) was quite surprising. With such emphasis given to personal protection when working with pesticides, one could expect that everybody should know that pesticides may enter the body through the skin. This could be explain by the fact that the respondents were thinking about poisoning manifestations as encountered in the treatment of the patient during medical practice rather than about actual conditions in the field setting. This was supported by the apparent correct answers received from out-patient health workers who were familiar with the situation in the field, but handled less poisoning cases. Since the questions presented did not cover the whole subject matter, a cautious interpretation of the results was necessary.

Health care providers reported to disseminate information on health effects of pesticides, particularly on their safe use, yet only one percent could classify the pesticides. The majority realized their lack of appropriate knowledge and expressed need for more detailed information about pesticides.

The hospital staff needs to be trained in the field of pesticide properties and hazards in view of their lower level of knowledge of these issues as compared to out-patient health care workers.

Alternatively, the higher knowledge among out-patient workers could be utilized in preventive occupational health services. Improving medical records is also necessary to ensure proper public health interventions.

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Many individuals and workers who experience health effects from APP may never present to a health-care provider due to distance from a medical facility, lack of resources, economic factors, fear of job loss or other reasons.25,26 Some health-care providers may be unaware of the relationship between pesticide and illnesses and fail to diagnose or report the incident properly.Â Nested case control analysis of high pesticide exposure events from the agricultural health study. Am J Ind Med 2001; 39: 557-63. Litchfield MH.Â Pesticide-related illness and injury surveillance: a how to guide for state-based programs. Publication number 2006-102.