

Survey of acute pesticide poisoning among agricultural workers in four Asian countries*

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The study investigated the extent of acute pesticide poisoning in selected agricultural communities in Indonesia, Malaysia, Sri Lanka and Thailand, as well as the contributing factors, because it is believed that this type of poisoning is a major problem in developing countries, but not in the industrialized countries, despite their extensive use of pesticides. The study confirmed the existence of this problem, which was found to be due to inadequate knowledge of the safe practices in the use of pesticides among users and to the lack of suitable protective clothing for use by agricultural workers in hot and humid climates.

Agricultural workers who constitute nearly three-quarters of the labour force in the poorest countries (1) of the world use pesticides to protect their crops, at least a third of which have been claimed to be destroyed by pests (2). However, this use of pesticides presents important hazards to human health: acute poisoning occurs when toxic reactions follow shortly after exposure, while chronic poisoning occurs when the reactions appear gradually after prolonged exposure.^a It has recently been estimated that about a million cases of unintentional acute pesticide poisoning occur every year worldwide.^b

The present study was undertaken among agricultural workers in Indonesia, Malaysia, Sri Lanka and Thailand to determine the extent of the problem

of acute pesticide poisoning and to identify the factors that should be taken into consideration for prevention.

MATERIALS AND METHODS

The selected study areas comprised mainly farmers working on their own small holdings, and were not necessarily typical examples of agricultural practice in other parts of the country. These areas had clearly defined boundaries and their population numbers were known from the census. Among the general population, both full-time and part-time agricultural workers were identified by questionnaire. Full-time workers were those whose main income was derived from agriculture, while a part-time worker carried out regular agricultural work even if this was not his or her main occupation.

The study was carried out in the four countries using a standard questionnaire which identified the characteristics of the worker's household, the type of agriculture and activities involving pesticide use, the extent of knowledge about the health hazards of pesticide usage and whether personal protective measures were used, the availability and utilization of health services, the sources of information on safe use of pesticides, etc. A separate questionnaire identified relevant data from hospital records.

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^a GOULDING, R. *Assessment of morbidity and mortality due to accidental poisoning: data collection and validation, and significance and magnitude of the problem.* Unpublished WHO document, PDS/PP85/W.P.6.

^b WORLD HEALTH ORGANIZATION. *Informal Consultation on Planning Strategy for the Prevention of Pesticide Poisoning.* Unpublished document WHO/VBC/86.926.

The principal national investigators (all physicians) were responsible for analysing the hospital case records, identifying the cause of the poisoning and the type of pesticide, training field investigators, and field testing the questionnaire before implementation. In each country the questionnaire, translated into the local language, was used to collect data from all members of the households in the study areas. This part of the study was completed in 1985 in approximately one month, but the timing in each country depended on local factors such as the rainy season, convenience of the study team, etc.

Study areas

Indonesia. The study area comprised ten kampongs (village subunits) in Bangunharjo village, located in the Bantul Regency of Yogyakarta in Java. Cultivation of paddy and cash crops was the main agricultural activity. A total of 1192 full-time and part-time agricultural workers were identified for the study.

Malaysia. The study was undertaken in the Cameron Highlands, which is approximately 2000 metres above sea level in Peninsular Malaysia. This is an area of intensive agricultural activity, largely for cash crops such as vegetables, flowers and fruit. A total of 4351 full-time and part-time agricultural workers were identified for the study.

Sri Lanka. The project was undertaken in the Anuradhapura district of the North-Central Province. Cultivation of paddy, vegetables and grains was the main activity of the farmers in this area. A total of 3439 full-time and part-time agricultural workers were identified for the study.

Thailand. The study area was in the province of Rayong, about 185 km from Bangkok, on the eastern seaboard abutting the Gulf of Thailand. The main

agricultural activity was cultivation of paddy, vegetables, fruit and other cash crops. A total of 4971 full-time and part-time agricultural workers were identified for the study.

Analysis of hospital records

The clinical records from the local hospital near the project area were analysed to estimate the number of hospital admissions due to acute pesticide poisoning, this group of patients being identified from the records of all cases of poisoning admitted to the hospital between 1 January and 31 December 1983. All the hospital cases classified as poisoning in 1983 were specially reviewed for the study by the principal national investigator in each country. The class of pesticide responsible for the poisoning and the reason for the poisoning were obtained from the clinical records.

RESULTS

Among the part-time and full-time agricultural workers in each of the communities studied, the proportion handling pesticides was 29.8% in Indonesia, 91.9% in Malaysia, 38.3% in Sri Lanka, and 41.4% in Thailand (Table 1). In Indonesia there was no record of pesticide use among part-time agricultural workers; in the other countries, fewer part-time workers were found using pesticides compared with full-time workers. A minority, particularly among part-time agricultural workers, were in the age group of 10–15 years; none of them handled pesticides.

In the questionnaire survey the agricultural workers were asked if they thought they had ever suffered from acute pesticide poisoning and whether this had occurred during the previous year. Their responses, reflecting the pesticide users' perception of a

Table 1. Number of pesticide users among full-time and part-time agricultural workers

Country	Total number of workers investigated	No. of pesticide users among:		
		Full-time workers	Part-time workers	Total
Indonesia	1192	355 (32.1) ^a	0 (0)	355 (29.8)
Malaysia	4351	3893 (97.3)	107 (30.5)	4000 (91.9)
Sri Lanka	3439	1206 (53.5)	111 (9.4)	1317 (38.3)
Thailand	4971	1881 (44.4)	179 (27.4)	2060 (41.4)

^a Figures in parentheses are percentages.

Table 2. Percentage of workers with pesticide poisoning among agricultural workers and among pesticide users

Country	Percentage of agricultural workers		Percentage of pesticide users	
	Ever poisoned	Poisoned in previous year	Ever poisoned	Poisoned in previous year
Indonesia	4.1	0.08	13.8	0.3
Malaysia	13.3	6.7	14.5	7.3
Sri Lanka	4.6	2.7	11.9	7.1
Thailand	8.1	NA ^a	19.4	NA ^a

^a NA = data not available.

Table 3. Reason given for the pesticide poisoning among hospital admissions in 1983

Country	Accident					Total
	Occupational	Non-occupational	Suicide	Homicide	Unstated	
Indonesia	2 (1.9) ^a	0 (0)	67 (62.6)	0 (0)	38 (35.5)	107 (100)
Malaysia	4 (14.3)	5 (17.9)	19 (67.9)	0 (0)	0 (0)	28 (100)
Sri Lanka	30 (31.9)	27 (28.7)	34 (36.2)	3 (3.2)	0 (0)	94 (100)
Thailand	6 (13.6)	4 (9.1)	27 (61.4)	0 (0)	7 (15.9)	44 (100)

^a Figures in parentheses are percentages.

Table 4. Major classes of chemicals causing pesticide poisoning among hospital admissions

Country	Organophosphorus compounds	Carbamates	Bipyridyls	Copper	Unidentified and others	Total
Indonesia	19 (17.8) ^a	1 (0.9)	1 (0.9)	25 (23.4)	61 (57.0)	107 (100)
Malaysia	15 (53.6)	3 (10.7)	7 (25)	0 (0)	3 (10.7)	28 (100)
Sri Lanka	65 (69.1)	0 (0)	0 (0)	0 (0)	29 (30.9)	94 (100)
Thailand	10 (22.7)	7 (15.9)	11 (25)	0 (0)	16 (36.4)	44 (100)

^a Figures in parentheses are percentages.

pesticide-related acute illness, showed that in Sri Lanka and Malaysia 7.1% and 7.3%, respectively, had suffered an episode of poisoning during the previous year, compared with only 0.3% in Indonesia (Table 2); there was no result for Thailand as this particular question had by mistake been omitted. Table 2 also shows that the proportion of pesticide users ever poisoned was reasonably similar in the four countries (range, 11.9% to 19.4%).

The cause of the pesticide poisoning among hospital admissions was identified in the hospital records (Table 3). Suicides accounted for 62.6% of cases in

Indonesia, 67.9% in Malaysia, 36.2% in Sri Lanka and 61.4% in Thailand. Occupation-related accidental poisonings were only 1.9% of cases in Indonesia and as high as 31.9% in Sri Lanka. Unintentional poisonings of non-occupational origin varied from 0% in Indonesia to 28.7% in Sri Lanka. However, in Indonesia 35.5% of the clinical records did not give a reason for the poisoning.

The major classes of pesticides responsible for poisoning among patients admitted to the hospitals are shown in Table 4. In Malaysia and Sri Lanka organophosphorus compounds were mostly respon-

Table 5. Preferred source of treatment among pesticide users ever poisoned

Country	Hospital or western medical practitioners	Indigenous practitioner	Self-treatment	No treatment	Information not available	Total
Indonesia	97 (14.3) ^a	1 (2.0)	6 (12.2)	4 (8.2)	31 (63.3)	49 (100)
Malaysia	263 (45.5)	2 (0.3)	24 (4.2)	287 (49.6)	2 (0.3)	578 (99.9)
Sri Lanka	63 (40.1)	3 (1.9)	55 (35.0)	36 (22.9)	0 (0)	157 (99.9)
Thailand	37 (9.2)	4 (1.0)	66 (16.3)	297 (73.5)	0 (0)	404 (100)

^a Figures in parentheses are percentages.

sible (53.6% and 69.1% of cases, respectively). In Thailand the bipyridyls were responsible for 25% of cases, compared with 22.7% due to organophosphorus compounds. In Indonesia the hospital case notes often did not indicate the type of pesticide responsible for the poisoning; from the available information it appears that copper compounds were responsible for 23.4% of cases and organophosphorus compounds for only 17.8%.

With regard to treatment after the poisoning, it appears that the majority either treated themselves or took no treatment; in other cases the local hospital or western medical practitioners were preferred (Table 5).

Table 6 shows the extent of awareness among pesticide users that pesticides were a health hazard and about the route of absorption into the body. In Indonesia, only 31.8% stated that they were aware of the route of absorption, compared with $\geq 90\%$ in the other countries. In Indonesia 26.2% stated that they were aware that pesticides were a health hazard, compared with 67.2–87.5% in the other countries. Positive replies concerning their awareness of the

early symptoms of pesticide poisoning were given in Indonesia by only 8.2% compared with 67.5% in Malaysia, 47.3% in Sri Lanka and 70.3% in Thailand. With regard to the usual route of absorption of pesticides, in all countries the dermal route was identified as the least important, inhalation as most important, and the oral route between the two. Protective measures against pesticide poisoning were taken by 82.8% of users in Indonesia, the respective figures for Malaysia, Sri Lanka and Thailand being 95.2%, 99.5% and 53.4%.

The activities identified by the pesticide users which resulted in poisoning included spraying using knapsack spray equipment, mixing and diluting of pesticides, and repairing or cleaning of spray equipment. In all four countries spraying, mixing and diluting of pesticides were the most frequently identified activities associated with poisoning. In Indonesia, only 5.1% of pesticide users used overalls, 9.3% used a respirator/mask, and 9.3% used gloves. In Malaysia, 14.7% used overalls, 11.5% used a respirator/mask, and 95% used gloves. In Sri Lanka, 26.8% used overalls, 40.8% used a respirator/mask, and 7.1% used gloves. In Thailand, 67% used overalls, 18% used a respirator/mask, and 5.2% used gloves.

With regard to the sources of information available to pesticide users about the safe use of pesticides, it appeared that in Indonesia retail outlets were identified more often than information passed on by fellow farmers or agricultural officers. In Malaysia the majority of pesticide users stated that no one had specifically told them about the safe use of pesticides, while some heard of it from retail outlets or from other farmers. In Sri Lanka the agricultural officers and, to a lesser extent, farmers provided this information but a good proportion of workers were not told by anyone. In Thailand, other farmers and retail outlets were identified as the source of information; here also many workers claimed that no one provided them with this information.

Table 6. Extent of the pesticide users' knowledge about the health hazards of pesticides and the need for protection

Country	Knew the route of absorption	Knew that pesticides are a health hazard	Used protective measures
Indonesia	113 (31.8) ^a	93 (26.2)	294 (82.8)
Malaysia	3600 (90.0)	3429 (85.7)	3810 (95.2)
Sri Lanka	1195 (90.7)	1017 (77.2)	1311 (99.5)
Thailand	1955 (94.9)	1384 (67.2)	1102 (53.4)

^a Figures in parentheses are percentages.

DISCUSSION

The present study is an attempt to estimate the extent of acute pesticide poisoning among agricultural workers who use pesticides. Previous studies in the same countries had depended on hospital records (3, 4) without particular reference to a base-line population.

Pesticide users among agricultural workers in the countries studied ranged from 29.8% in Indonesia to 91.9% in Malaysia. The extent of pesticide usage among agricultural workers is probably influenced by the nature of the crops and agricultural practices. For instance, in Indonesia these workers were mostly cultivating paddy while in Malaysia they were engaged in the cultivation of cash crops that require more frequent use of pesticides. A similar variation in the extent of pesticide usage depending on the nature of the crop may be seen in a study in the Netherlands (5), where pesticides were identified as a problem by 76% of workers in arable farms, 85% of workers in glass-house nurseries, 83% of workers in outdoor horticulture, and 92% of workers in mushroom farming.

Although the approach of questioning pesticide users as to whether, in their opinion, they had ever suffered from acute pesticide poisoning is not fool-proof, the results showed that illness, presumably due to acute pesticide poisoning, was directly related to the workers' immediately previous use and exposure to pesticides. The problem in the four countries studied appears to be reasonably similar, 10–20% of pesticide users considering themselves to have suffered an episode of pesticide poisoning at some time during their working life (Table 2). Each episode reflects a failure in the prevention of poisoning among pesticide users. Further, in Malaysia and Sri Lanka it was observed that 2–7% of pesticide users stated that this illness occurred in the previous year (Table 2), which is an unacceptably high level for an occupational hazard. The low result from Indonesia (0.08%) for poisoning in the preceding year is atypical, compared with the previous years, and is probably the result of an interview error.

Among the patients admitted to hospital, suicide was the leading cause of acute pesticide poisoning in all the countries (Table 3), a feature reported previously (3, 6). Except in Indonesia, unintentional poisonings of occupational and non-occupational origin were responsible for 9–32% of cases of poisoning. The relatively low figures for unintentional poisoning in Indonesia and Thailand are probably due to the fact that for 35.5% of patients in Indonesia and 15.9% in Thailand the case records did not indicate the immediate circumstances of the poisoning. Such unintentional pesticide poisonings, both occupational

and non-occupational, are mostly preventable, even in developing countries; this problem in the industrialized countries, despite the extensive use of pesticides, has been controlled by appropriate safeguards.^c

While the organophosphorus compounds were frequently responsible for the poisoning, it is disconcerting that in Indonesia, Sri Lanka and Thailand the class of pesticide responsible for the poisoning was often not identified. Whatever the reasons for this, it must create problems in the treatment and management of patients and increase the case fatality. In a previous study in Sri Lanka, a high case fatality rate (28.5%) was noted among patients where no information was available on the class of pesticides (3).

The instances of acute poisoning reported by the pesticide users could not be related to the hospital admissions for acute poisoning because the study periods were not the same—in 1984 and 1983, respectively. While a large majority of the episodes of acute poisoning recorded by the users must have been very mild because they improved with either no treatment or self-treatment, it must be recognized that each one represents a failure of prevention and could have been serious.

The study demonstrates that in all four countries occupation-related acute pesticide poisoning presents a major problem in the communities studied. Specific attention should therefore be focused on the prevention of such poisoning; some of the factors contributing to this problem are discussed below.

Because spraying and the mixing or diluting of pesticides were the two most frequently associated occupational activities resulting in poisoning, special attention has to be paid to them, a view endorsed by Copplestone who states, "we are more likely to be effective in preventing accidental poisoning by pesticides if we concentrate our activities in relevant terms on those areas where hazard is really high than by trying to give blanket coverage to all pesticide users" (7). One of the important factors contributing to accidental acute pesticide poisoning was malfunctioning spray equipment which resulted in contamination of the workers' skin surface with pesticides (8). It is in this context that the extent of the pesticide users' knowledge on safe use of pesticides was examined. But although a large proportion of users, except in Indonesia, were of the opinion that they knew the route of absorption of pesticides and the early symptoms of acute poisoning, it was evident that the content of their knowledge was inadequate to prevent pesticide poisoning. For instance, in all the countries the users considered inhalation to be the most important route while pesticide absorption through the skin was less important. In fact, there is substantial evidence to

^c See footnote b.

show that dermal absorption is by far the most important, and that absorption by inhalation is relatively unimportant (9, 10). This misconception among pesticide users must be corrected through educational programmes on the safe use of pesticides.

Similarly, a large proportion of pesticide users thought that adequate protective measures were being taken when actually, except for Thailand, these measures were not extensively used or their efficacy was questionable. This is evident in the observations of the principal national investigator for Sri Lanka who wrote that the protective clothing worn was inadequate for prevention of pesticide absorption: a handkerchief or shawl was used as a mask, polythene bags were tied round the hands or feet, open slippers or old shoes, and a turban or old cotton hat on the head; the forearms, face and head were usually exposed. Although cotton overalls do provide adequate protection provided they are washed daily, this was not the practice in Sri Lanka.

With regard to the available sources of information on the safe use of pesticides, in all four countries a significant proportion of pesticide users could not identify a specific source of information. When information was available, it often came from other farmers and retail outlets; only in Malaysia and Sri

Lanka were agricultural officers identified as a frequent source of information. The implication of this finding is that in these countries most of the information available to pesticide users is not provided on an officially organized basis. None of the countries had any legislative controls requiring pesticide users to be formally trained in safe work practices, which contrasts sharply with the situation in the industrialized world (11). As an interim measure, all countries without formal training requirements may consider enforcing these requirements, at least in order to control and train the users of pesticides grouped under classes 1A and 1B of the WHO classification by hazards.^d

The large problem of acute pesticide poisoning in the four countries studied requires to be controlled. In the first instance, education and a training programme on the safe use of pesticides for occupationally exposed workers will have to be instituted; governments should recognize this problem and make every effort to contain it. The primary health care approach appears to be most suitable to overcome the problem (12).

^d *The WHO recommended classification of pesticides by hazard and guidelines to classification.* Unpublished WHO document, VBC/84.2.

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RÉSUMÉ

ENQUÊTE SUR L'INTOXICATION AIGUË PAR LES PESTICIDES CHEZ LES TRAVAILLEURS AGRICOLES DANS QUATRE PAYS D'ASIE

Cette étude a été entreprise pour évaluer l'ampleur de l'intoxication aiguë par les pesticides ainsi que les facteurs qui y contribuent dans plusieurs communautés agricoles d'Indonésie, de Malaisie, de Sri Lanka et de Thaïlande. L'étude a porté sur 1192 travailleurs agricoles en Indonésie; 4351 en Malaisie, 3439 à Sri Lanka et 4971 en Thaïlande. La proportion des travailleurs agricoles qui ont déclaré qu'à leur avis ils ont souffert d'un épisode d'intoxication aiguë au cours de leur vie professionnelle était de 4,1% en Indonésie, 13,3% en Malaisie, 4,6% à Sri Lanka et 8,1% en Thaïlande. On a également observé que l'intoxication était plus

répandue parmi les utilisateurs de pesticides que parmi les autres travailleurs agricoles.

L'analyse des registres des hôpitaux a montré que dans les quatre pays, la tentative de suicide était la cause la plus fréquente d'intoxication aiguë par les pesticides. L'intoxication accidentelle, tant professionnelle que non professionnelle, était à l'origine d'une proportion notable des hospitalisations sauf en Indonésie où elle n'intervenait que pour 1,9% des admissions; elle était à l'origine de 32,2% des cas en Malaisie, 60,6% des cas à Sri Lanka et 22,7% des cas en Thaïlande. En Malaisie et à Sri Lanka, les pesticides le plus

souvent incriminés étaient les organophosphorés, alors qu'en Thaïlande, les bipyridyles étaient responsables de 25,0% des intoxications, suivis par les organophosphorés (22,7%). En ce qui concerne l'Indonésie, les données disponibles montrent par contre que les composés à base de cuivre occupaient la première place avec 23,4% des cas, contre seulement 17,8% pour les organophosphorés.

Sauf en Indonésie, une forte proportion d'utilisateurs de pesticides estimaient qu'ils avaient les connaissances

nécessaires pour éviter une intoxication. Toutefois, un interrogatoire plus approfondi a montré que ces connaissances étaient souvent erronées. De plus, sauf à Sri Lanka où les fonctionnaires des services agricoles étaient souvent mentionnés comme dispensateurs d'information au sujet de la sécurité d'emploi des pesticides, les travailleurs agricoles ont désigné comme source principale d'information les agriculteurs ou les détaillants.

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