

Original communication

Agricultural and horticultural pesticides fatal poisoning; The Jordanian experience 1999–2002

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Abstract

A prospective autopsy study addressing fatal poisoning with agricultural and horticultural pesticides was undertaken in Jordan over a 4 year period. A total number of 140 deaths occurred during 1999–2002. The mean fatality rate was 0.68 case per 100,000 population and the age range was 2–55 years; mean 28.3 years with male to female ratio 1.03. The largest number of cases occurred in those 20–29 years ($n = 69$, 49.3%) followed by the age group 30–39 years ($n = 34$, 24.3%) and 40–49 years ($n = 17$, 12.1%). Less than 3.0% of the total fatal poisoning was noticed in both children younger than 9 years of age and those in the age group 50–59 years, with no fatal poisoning in adults at the age 60 years and above. At least 64.3% of all pesticide fatalities were due to suicide with male: female ratio (1.37:1). Accidental and homicide poisoning resulted in 24.3% and 7.9% of the total fatalities, respectively; however, only five cases 3.6% of fatal poisoning were due to unknown pesticides. The main pesticide used was carbamates with 110 cases 78.6% followed by organophosphorus 23 cases 16.4%. The study showed that the present legislation on pesticides availability in Jordan failed to reduce the number of fatal pesticides poisoning since the number of fatal pesticides poisoning was increased from 25.3 to 35 cases per year over a 20 years period. Enforcement of a new legislation addressing the availability of agricultural and horticultural pesticides for self-harm, especially carbamates and organophosphorus, is the most important strategy in the long term to prevent fatal pesticides poisoning in Jordan.

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1. Introduction

Agricultural and horticultural pesticides have definite benefit when used properly in agriculture. Despite the benefits they offer to the society, pesticides represent a risk to human health, wildlife, soil and microflora, and water. Poisoning with pesticides is a preventable health problem worldwide especially in developing countries.¹ Globally acute pesticide poisoning affected 3 millions and more than

200,000 deaths occurred annually according to the world health organization estimate.² Although acute pesticide poisoning is not a major problem in western industrialized countries,^{3,4} it is an important cause of mortality and morbidity in developing countries.^{5–7} The pattern of poisoning, however, depends on a variety of factors such as the availability of different poisons, socio-economic status, religious and cultural influences.

Agrochemical fatal poisoning is nowadays a major problem in developing countries. In Sri Lanka and Costa Rica, organophosphorus compounds account for most of fatal poisoning.^{8–11} While Aluminum phosphide is a common cause of fatal poisoning in India.¹² The herbicide

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paraquat is the major cause of fatal self-poisoning in England, Trinidad and Tobago.^{13,14}

Acute poisoning by pesticides among humans is usually the result of occupational exposure, mishandling, misuse, or careless handling use of such chemicals. In the last 20 years Jordan witnessed a substantial increase in farming business in order to maintain adequate food self-sufficiency and for export, and to overcome enormous pest induced economic loss. Such changes in the farming business in Jordan resulted in an increase in the amount and the types of pesticides use. According to the ministry of agriculture statistics, there were more than 200 kinds of agricultural and horticultural Pesticides for farm use in Jordan.

The early medical literature in Jordan on poisoning was limited to description of intoxication by alcohol and drug,^{15,16} misuse of pesticides and drugs.^{17–21} The first study addressing the pesticide mortality in Jordan was conducted by Abu-Araghib⁶ published in the mid 1980s it showed that during a 13 years period (1973–1985) 329 deaths were due to agricultural and horticultural pesticides in which organophosphorus compounds were responsible for 308 deaths (94.4%).

2. Materials and methods

The Hashemite Kingdom of Jordan (Jordan) has a population of 5.5 million people according to the 2004 census. From 1 January 1999 to 31 December 2002, a total number of 140 death certificates were issued to pesticides victims by the Nation Center of Forensic Medicine (NCFM) at the Ministry of Health and the department of forensic medicine and toxicology at Jordan university hospital both are the main referral forensic medicine centers in the country and cover all provinces in Jordan. Post-mortem examination was done on all cases of pesticides fatal poisoning. Detailed data concerning each victim were recorded, including: the victim's age, sex, type and quantity of poison ingested, possible reasons for ingestion, the case notes of the deceased if available and close relatives interviewed to obtain data leading up to the fatal poisoning. Toxicological analysis was carried out by the government forensic laboratory-department of public security on blood, stomach contents, and urine, if available in all cases. Specimens were sent for analysis in separate sealed and labeled containers. The fatality rates were calculated from census estimates published by the department of statistics – Ministry of Planning and International Cooperation. The population of Jordan was: 4.9Millions (M) in year 1999, 5.039M in 2000, 5.182M in 2001 and 5.329M in 2002.

3. Results

A total number of 140 deaths from poisoning with agricultural and horticultural pesticides during the 4 years period 1999–2002 are presented in Table 1. The number of deaths varied from 24 to 48, with a mean of 35 cases

Table 1
Chronological distribution of deaths from agricultural and horticultural pesticides in Jordan 1999–2002 according to year of incident

Year ^a	Male	Female	Total	M/F Ratio	Rate per 100,000
1999	11	13	24	0.85	0.49
2000	13	14	27	0.93	0.53
2001	22	19	41	1.16	0.79
2002	25	23	48	1.09	0.9
Total	71	69	140	–	–
Average	17.75	17.25	35	1.03	0.68

^a The population of Jordan was: 4.9Millions (M) in year 1999, 5.039M in 2000, 5.182M in 2001 and 5.329M in 2002.

per year. There were 71 males and 69 females; the data shows no sex difference among victims over the 4 years period with male to female ratio of 1.03. The highest and lowest fatality rates were noticed in 2002 and 1999 (0.9 and 0.49 case per 100,000) respectively, with a mean of 0.68 case per 100,000 population. The age range was 2–55 years with a mean of 28.3 years, and the largest number of cases occurred in those 20–29 years ($n = 69$, 49.3%) followed by the age group 30–39 years ($n = 34$, 24.3%) and 40–49 years ($n = 17$, 12.1%). These three age groups when combined accounted for 85.7% of the fatal poisoning. The number of fatal poisoning in children younger than 9 years of age and for those in the age group 50–59 years were both four cases (2.8%). No fatal poisoning in adults at the age 60 years and above was noticed in our study (Table 2).

The involvement of more than one pesticide in the fatal poisoning were noticed in only six cases, there distribution was; one case of two agents was recorded in year 1999 and 2000 each, while two cases of three agents were noticed in year 2001 and 2002 each. The use of more than one agent was noticed in homicide and suicide cases only, and mainly in the age group 20–29 and 30–39 years. The main agent was carbamates, which was noticed in five cases.

The manner of fatal poisoning is presented in Table 3, there were 90 cases of suicide representing (64.3%) of total fatal poisoning; number of females cases was 38 (42.2%) and 52 (57.7%) cases of male with male to female ratio of 1.37 (Table 3). Accidental poisoning resulted in 34 fatalities (24.3%) of total fatal poisoning in which female cases were 21 cases (61.7%) while male cases were 13 (38.3%) with male to female ratio of 0.62. Eleven cases of homicide were

Table 2
Age distribution of deaths from agricultural and horticultural pesticides in Jordan 1999–2002 by age and sex

Age group	Male	Female	Number of deaths (%)
0–9	1	3	4 (2.85%)
10–19	4	8	12 (8.57%)
20–29	37	32	69 (49.3%)
30–39	17	17	34 (24.3%)
40–49	9	8	17 (12.1%)
50–59	3	1	4 (2.85%)
≥60	0	0	0
Total	71	69	140 (100%)

Table 3
Distribution of deaths from agricultural and horticultural pesticides in Jordan according to manner and sex

Manner	Male (%)	Female (%)	M/F	Number of deaths
Suicide	52 (57.7%)	38 (42.2%)	1.37	90 (64.3%)
Accidental	13 (38.3%)	21 (61.7%)	0.62	34 (24.3%)
Homicide	5 (45.5%)	6 (54.5%)	0.83	11 (7.9%)
Unknown	1 (20%)	4 (80%)	0.25	5 (3.6%)
Total	71 (50.7%)	69 (49.3%)	1.03	140 (100%)

Table 4
Distribution of suicidal deaths from agricultural and horticultural pesticides in Jordan according to age and sex

Age	Male	Female	M/F Ratio	Total(%)
12–19	2	5	0.4	7 (7.7%)
20–29	29	16	1.8	45 (50%)
30–39	13	11	1.18	24 (26.6%)
≥40	9	5	1.8	14 (15.5%)
Total	53 (58.8%)	37 (41.2%)	–	90 (100%)

Table 5
Distribution of deaths from agricultural and horticultural pesticides in Jordan according to the type of pesticide

Type of pesticides	Male (%)	Female (%)	Number of deaths (%)
Organophosphorus compounds	14 (60.9%)	9 (39.1%)	23 (16.4%)
Carbamates	55 (50%)	55 (50%)	110 (78.6%)
Rodenticides (anticoagulants)	1 (20%)	4 (80%)	5 (3.6%)
Others	1 (50%)	1 (50%)	2 (1.4%)
Total	71 (50.7%)	69 (49.35)	140 (100%)

reported in this study which represents only 7.9% of total fatal poisoning, with six females 54.5% and five males 45.5% of the total homicide, mean age 29.6 years (range 22–42 years). Only five cases of fatal poisoning with unknown pesticides were reported.

Since suicides contributed in >60% of the total fatal poisoning in our study, the sex and age group of suicide cases were also investigated; Table 4 shows that the age group 20–29 years represents (50%) of suicide cases followed by the age group 30–39 years (26.6%). Males were 53 (58.8%) while females were 37 cases (41.2%), with a significant average male to female ratio of 1.4. The highest male to female ratio of 1.8 was noticed in age group 20–29 years and ≥40 while the lowest was 0.4 at the age group 12–19 years. Carbamates (predominantly by Methomyl) were the main pesticide involved in fatal poisoning with 110 cases (78.6%) followed by organophosphorus 23 cases (16.4%); both were implicated in 133 cases (95%) of the total fatal poisoning Table 5.

4. Discussion

This study provides a comprehensive analysis of agricultural and horticultural fatal pesticides poisoning in Jordan.

An average of 35 deaths occurred annually in Jordan; which represent an annual mortality rate of 0.68 per 100,000. The high incidence of suicide was considered as the main factor in such high mortality rate in Jordan which was similar to those noticed in developing countries,^{4,14} but higher than those reported in United States.¹

Carbamates accounted for the highest number of fatal pesticides poisoning 110 cases (78.6%) in Jordan. This finding is in marked contrast to the situation noticed in the previous Jordanian study (organophosphorus pesticides were responsible for 94.4% the fatal poisoning), and those in developed and developing countries in which organophosphorus compounds, Paraquat are still encountered as the most common agents involved in fatal poisoning.^{6,3,5,23–25} This shift from organophosphorus compounds to carbamates could be attributed to limited availability of the most potent organophosphorus agent (parathion) within Jordanian market from the mid 1980s due to strict regulation imposed in importing or manufacturing of this agent.⁶

The highest number of fatal poisoning 69 cases (49.3%) were noted in the age group 20–29 years, this finding is in agreement with those noticed in developing countries.^{5,22} In developed countries death due to pesticides was more common in older people; more than 40 years.³ Our study showed a that over the last 20 years, Jordan witnessed a shift to the age group 20–29 years (49.3%) from the age group 10–19 years (32.2%) of the fatal poisoning in the mid 1980s.⁶ Such shift could be attributed to decrease in the number of fatal accidental poisoning in children due to the increased awareness among parents regarding the dangerous and harmful effects of pesticides. There is no significant difference in male to female ratio 1.03 and 1.04 over 20 years. Males outnumbered females in suicide cases with M/F ratio 1.3, and around (50%) of all suicide cases have been committed by persons in their second decade of life. It was also noticed that the rate of males' suicide in Jordan was less than those noticed in other developing countries.⁵ A clear increase, almost 40% rise in the proportion of death with pesticides was seen in Jordan over the last 20 years. This increase is parallels with the increase in the use of pesticides especially carbamates.

It is known that limited employment opportunities, social and economic hardships drive youths to commit suicide.⁵ In Jordan, suicide showed a slight increase in its proportion (64.3%) from (61%) and a significant increase in homicide (7.9%) from (1%), while accidental fatal poisoning has fallen from 35% to 24.3% over the last 20 years.

Legislation to restrict the sale of pesticides is strongly recommend in preventing and reducing the number of fatal poisoning in Jordan, besides increasing public education programs regarding the high toxicity of pesticides and increasing the awareness among public regarding the first aid management of intoxication could be beneficial. Health services should also emphasis in the curricula for medical and nursing graduate on management of pesticides. Poison

centers could also play a main role in reducing the number of fatal poisoning by providing treatment protocol to the treating physicians, ensuring the availability of antidotes in most hospitals.

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