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Epidemiological Data of Human Poisoning in Taiwan, 1985-1993

Abstract

Taiwan National Poison Center, since its establishment in July 1985, has received more than 30,000 telephone calls. However, there is little epidemiological data available on those calls. In an attempt to obtain more information about poisoning exposures in Taiwan, a retrospective study was conducted.

Data from all telephones calls concerning human poisoning exposures retrieved from July 1985 through December 1993, by the PCC-Taiwan were analyzed. The following data fields were reviewed: age, sex, reason of exposure, route of exposure, substances ingested and clinical severity of those poisoning exposure victims.

During the period of 1985-1993, 23,436 telephone calls concerning human poisoning exposure were recorded. Adults accounted for most cases (75.2%) and exposures involving male were somewhat more prevalent than female poisoning exposures (54.2% vs. 44.7%). Intentional poisoning exposures were more common than unintentional poisoning exposures (54.6% vs. 40.1%), revealing an inverse relationship with pediatric poisoning exposures. Those victims aged below 7 years and those aged between 19-39 years, constituted the highest risk group in human poisoning exposure (62% of all cases). Most human poisoning exposure victims were poisoned by the oral route and excluding amphetamines, the most frequently ingested poisons were pesticides, benzodiazepines, and cleaning products. Fatalities occurred most frequently following ingestion of pesticides and the mortality rate was 5.7% for all exposures.

Human poisoning remains a serious problem in Taiwan. With pesticides being the most common offending agents, control of the wide availability and a decrease in the use of pesticides are warranted as efforts to aid in the prevention of further serious poisoning. Reduction of suicide attempts by psychiatric consultation or other necessary means is also of major concern, since most cases are intentionally poisoned.

Key words: epidemiological data, human poisoning, pesticide

Introduction

Human poisoning, either intentional or unintentional, remains a serious and growing problem in the chemical-ridden world in which we live[1]. Epidemiological studies on human poisoning reveal that the annual incidence of human poisoning may range between 0.2-2.9/1000 inhabitants[1-5]. The annual report of the American Association of Poison Control Centers shows an even higher incidence of poisoning exposures per year, revealing an average of 9.7/1000 inhabitants[6].

In Taiwan, though acute poisoning is not infrequently seen in daily practice, epidemiological data on human poisoning are extremely limited[7]. The Taiwan National Poison Center (PCC-Taiwan), founded in July, 1985, has received more than 30,000 calls since its establishment. In an attempt to survey human poisoning in Taiwan and to compare the pattern of human poisoning with other countries, a retrospective study was conducted, based on the data of PCC-Taiwan.

Materials and Methods

The PCC-Taiwan serves a population of 20.8 million inhabitants and has been in operation 24 hours a day since July 1985. It is staffed by six doctors (internist), five pharmacists, two nurses, five laboratory technicians, and about three dozens of trained senior medical student volunteers. It provides on-line information, interpretation of laboratory tests, and, because of its affiliation with the Veterans General Hospital - one of the largest hospital in Taiwan, is a referral center for the treatment of poisoning cases.

This study was performed as a retrospective analysis of PCC records. The study period covered a 8.5-year interval from July 1985 through December 1993. All telephone inquiries concerning human poisoning exposures, either acute or chronic, received by the PCC-Taiwan during this time period, were recorded and the following information is gathered: name, age, sex, phone number of both caller and patient, patient's weight (if available), relationship of caller and patient, route and dose of exposure, reasons for exposure, initial symptoms and signs, substances involved in exposure, methods of management (including use of antidotes), clinical outcome, cause of death (if applicable), and days from exposure to death. Data is then entered into a dBase III computer file for subsequent analysis. After exclusion of cases with symptoms unrelated to their exposures, all remaining cases were included in this study. The age, sex, reason for exposure (unintentional or intentional), route of exposure, substances involved and clinical outcome of those exposures were then analyzed. Special attention was paid to the fatal cases and those factors incriminated in death.

Reasons for exposure in this study were classified as (1) unintentional (including unintentional general, occupational, therapeutic error, environmental, malicious and unknown); (2) intentional (including suicidal, misuse, abuse, other and unknown); (3) adverse reaction (including prescribed drugs, Chinese herbs, food, other and unknown); and (4) totally unknown reason for exposure. Definitions for these reasons are as

follows: *Unintentional general*: All unintentional exposures not specifically defined below. *Occupational*: An exposure that occurs as a direct result of the person being on the job or in the working place. *Environmental*: Any passive, nonoccupational exposure that results from contamination of air, water, or soil. *Malicious*: Any patients who are victims of another person's intent to harm them. *Therapeutic error*: An unintentional deviation from a proper therapeutic regimen that results in the wrong dose, incorrect route of administration, administration to the wrong person, or administration of the incorrect substance. Only exposures to medications or products substituted for medications were included. *Unintentional unknown*: An exposure determined to be unintentional but the exact reason is unknown. *Suicidal*: An exposure resulting from the inappropriate use of a substance for reasons that were suspected to be self-destructive or manipulative. *Intentional misuse*: An exposure resulting from the intentonal improper or incorrect use of a substance for reasons other than the pursuit of a psychotropic effect. *Intentional abuse*: An exposure resulting from the intentional improper or incorrect use of a substance in which the victim was likely attempting to achieve a euphoric or psychotropic effect. *Intentional other*: All intentional exposures not specifically listed above. *Intentional unknown*: An exposure that is known to be intentional but the specific motive is unknown. *Adverse reaction, prescribed drugs*: An adverse reaction occurring with normal, labeled or recommended use of prescribed drugs, excluding Chinese herbs. *Adverse reaction, Chinese herbs*: An adverse reaction occurring with normal, or recommended use of prescribed Chinese herbs. *Adverse reaction, food*: An adverse reaction occurring with normal use of prepared foods. Included are cases with an unwanted effect caused by an allergic, hypersensitive, or idiosyncratic response. *Adverse reaction, other*: An adverse reaction occurring with normal use of the product not listed above. *Adverse reaction, unknown*: An adverse reaction occurring with use of undetermined product. *Totally unknown*: All cases with undetermined reason for exposure are included.

Ingested toxins were classified as one of 14 categories: pesticides, drugs, animal bites and stings, rodenticides, insect repellents, food-borne toxins, plants, cosmetics, cleansing substances, solvents, hydrocarbons, carbon monoxide and other toxic gases, Chinese herbs and miscellaneous toxins (desiccants, elemental mercury, other heavy metals, etc.). Drugs were further subcategorized into 10 groups: cardiovascular drugs, benzodiazepines, tricyclic antidepressants and phenothiazines, amphetamine and related drugs, analgesics, other drugs acting on central nervous system (barbiturates, anticholinergic drugs, anticonvulsants, etc.), topicals, bronchodilators, others (including hormones, vitamins, diuretics, etc.) and unknown. Pesticides were also subcategorized into 7 groups: paraquat, glyphosate, organophosphates, carbamates, pyrethrin and pyrethroids, miscellaneous (fungicide, molluscide, etc.) and unknown.

In most cases, follow-up calls were made several times to determine the patient's outcome. Nonetheless, in those with a non-toxic ingestion, insignificant amount implicated in the poisoning exposure, the route of exposure being unlikely to result in a clinical effect or those leaving no telephone numbers, no follow-up calls or only one follow-up call were made.

The clinical outcomes were classified as no effect, minor effect,moderate effect, major effect, death, possible causal effect, confirmed exposure yet with inadequate clinical

information to determine its outcome and those with an unknown outcome. Definitions for these outcomes are as follows: *No effect*: The patient developed no signs or symptoms as a result of the exposure. *Minor effect*: The patient developed some signs or symptoms following the poison exposure, but they were minimally bothersome and resolved rapidly without residual disability. Signs and symptoms regarded as minor effect are usually nonspecific and are often limited to the skin or mucous membranes (e.g., self-limited gastrointestinal symptoms, skin irritation or first degree dermal burn, sinus tachycardia without hypotension, transient cough or tachypnea). *Moderate effect*: The patient exhibited signs or symptoms as a result of the exposure that were more pronounced, more prolonged, or more of a systemic nature than minor effect. Usually some form of treatment is indicated. Symptoms were not life-threatening, and there is usually no residual disability or disfigurement (e.g., corneal abrasion, transient hypotension, hypoxia that is rapidly reversed by appropriate treatment, second degree dermal burn, isolated brief seizures that respond readily to treatment). *Major effect*: The patient exhibited signs or symptoms following the poison exposure that were life-threatening or resulted in significant disability or disfigurement (e.g., repeated seizures or status epilepticus, respiratory insufficiency requiring intubation, ventricular tachycardia with hypotension, cardiac or respiratory arrest, disseminated intravascular coagulation, massive hematemesis or melena). *Death*: The patient died as a result of the exposure or as a direct complication of the exposure. *Possible causal effect*: The patient exhibited signs or symptoms as a result of the exposure, however, the effect is not clearly linked with the exposure (e.g., unconsciousness associated with mild gastrointestinal and respiratory symptoms in a patient with pyrethrin poisoning, delirium in a patient with benzodiazepine poisoning). *Confirmed exposure yet with inadequate clinical information to determine its outcome*: There was reliable and objective evidence that an exposure really occurred, however, available information on clinical signs or symptoms were inadequate to draw any conclusion. *Unknown outcome*: The patient was lost for follow-up, or refused to follow-up.

To test the hypothesis that the reason for the poison exposure, substances involved in exposure and clinical outcome were different between adults and children, the results were further analyzed for different age groups of children and adults.

Results

From July 1985 through December 1993, after excluding those calls for information only and those calls of veterinary poisoning exposure, a total of 23,436 telephone inquires concerning human poisoning exposure were recorded. The number of human poisoning exposures reported to the PCC-Taiwan increased annually until 1993 when for the first time there was a significant decline in the number of poisoning exposure. Table 1 presents the annual volume of human poisoning exposure cases reported to the PCC-Taiwan during the 8.5-year study period. The annual incidence of human poisoning exposures in Taiwan, according to the cases reported to the PCC-Taiwan, ranges between 0.16-0.22 exposures per thousand population served.

Among all poisoning exposure cases, exposures involving males exceeded those

Table 1. The Annual Volume of Human Poisoning Exposures Reported to PCC-Taiwan, 1985-1993

Year	Human Exposures Reported	Population Served (Millions)	Exposures/Thousand Population
1985	101	19.13	---*
1986	699	19.45	---
1987	1,524	19.67	---
1988	2,495	19.90	---
1989	2,787	20.10	---
1990	3,634	20.36	0.18
1991	4,505	20.56	0.22
1992	4,315	20.75	0.21
1993	3,376	20.94	0.16
Total	23,436		

* The rate of exposures per thousand population served is not feasible to calculate between 1985 and 1989 on account of the relatively few human exposures in those years.

involving females in all age groups except in those aged 19-39 years where a female predominance was found. The overall male to female ratio was 1.21 (54.2% vs. 44.7%) in this study, with sex unidentified in 259 cases (1.1%). As shown in Table 2, the majority of cases (75.2%) were adults, and those aged 19-39 years and those younger than 7 years of age were the most frequently involved age groups in human poisoning exposures, accounting for 62% of all exposures.

Of the 23,436 telephone inquiries, most of the calls were from the health care professionals and only 19.2% of the calls directly came from the general public. The peak call volumes of PCC activity were noted from 8 AM to 6 PM, with 57.2% of calls being logged during this 10-hour period. Among all reasons for human poisoning exposures, suicide attempt was the most common reason, with 44% of all cases being classified in this group. Table 3 presents the various reasons for human poisoning exposure cases.

In contrast to the high rate of intentional exposure in adults (11,722 cases, 66.5% of all poison exposure in adults), unintentional exposure was the most common reason for exposures in children (4,515 cases, 77.7% of poison exposure in children). The proportion of unintentional exposures was highest in those younger than 6 years of age (93.3%). Table 4 shows the distribution of the various reasons for poisoning exposure in different age groups.

Table 2. Age and Gender Distribution of Human Poisoning Exposures Reported to PCC-Taiwan, 1985-1993

Age (years)	Male		Female		Unknown		Total		Cumulative Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
≤6	2,432	60.1	1,568	38.7	47	1.2	4,047	17.3	4,047	17.3
7-12	330	59.4	222	39.9	4	0.7	556	2.4	4,604	19.6
13-18	649	53.7	559	46.2	1	0.1	1,209	5.2	5,812	24.8
Total Children (≤18)	3,411	58.7	2,349	40.4	52	0.9	5,812	24.8		
19-29	3,028	49.9	3,034	50.1	5	0.1	6,067	25.9	11,879	50.7
30-39	2,177	49.3	2,233	50.1	4	0.1	4,414	18.8	16,293	69.5
40-49	1,059	51.7	985	48.1	4	0.2	2,048	8.7	18,341	78.3
50-59	1,078	60.0	719	40.0	1	0.1	1,798	7.7	20,139	85.9
60-69	943	68.1	435	31.4	6	0.4	1,384	5.9	21,523	91.8
≥70	665	59.0	460	40.8	3	0.3	1,128	4.8	22,651	96.7
Unknown adult	332	42.3	269	34.3	184	23.4	785	3.3	23,436	100.0
Total adults(≥18)	9,282	52.7	8,135	46.2	207	1.2	17,624	75.2		
Total	12,693	54.2	10,484	44.7	259	1.1	23,436	100.0	23,436	100.0

In human poisoning exposures, the substances most commonly involved were pesticides, and drugs, which accounted for more than half (58.1%) of all exposures. Most of the pesticide exposure cases were adults, yet the proportion of drug exposure cases was slightly higher for children. (Table 5) Among various pesticides, organophosphates (1854 cases) were the most common offending agents, followed by glyphosate (983 cases), pyrethrin and pyrethroids (936 cases), paraquat (892 cases), and carbamates (721 cases).

Males were more commonly involved in pesticide exposure than females, as 33.2% of all males were exposed to pesticides compared with 26.9% of pesticide exposures in females . Benzodiazepines (1,889 cases) were most commonly involved in drug exposure cases, followed by amphetamines (1,388 cases), CNS-acting drugs (e.g., phenobarbital, phenytoin, carbamazepine, atropine, 1,006 cases), tricyclic antidepressants and phenothiazines (419 cases), analgesics (409 cases), and topicals (294 cases). Table 5 presents the distribution of human poisoning exposure cases by different categories of substances.

As might be predicted, drugs and common household products, such as insect repellents, and cosmetics were more frequently encountered in children. Among those

Table 3. Reason for Human Poisoning Exposures Reported to PCC-Taiwan, 1985-1993

	Reason	No.	%
Unintentional	General	7,605	32.5
	Occupational	1,293	5.5
	Environmental	142	0.6
	Malicious	83	0.4
	Therapeutic error	124	0.5
	Unknown	154	0.7
	Total	9,401	40.1
Intentional	Suicidal	10,311	44.0
	Misuse	471	2.0
	Abuse	1,704	7.3
	Others	101	0.4
	Unknown	219	0.9
	Total	12,806	54.6
Adverse Reaction	Drugs	254	1.1
	Chinese herbs	55	0.2
	Food	71	0.3
	Others	13	0.1
	Unknown	5	0.0
	Total	398	1.7
Unknown		831	3.5
Total		23,436	100.0

with drug exposure, topicals, cardiovascular drugs, bronchodilators, and analgesics were more common in those with younger age, while benzodiazepines, and CNS-acting drugs were more frequently incriminated in adults. (Table 6) Amphetamine exposures were equally distributed among adults and children. However, most of the amphetamine addicts were adolescents or young adults. Females were most commonly involved in drug exposures, with 31.5% of all females being exposed to drugs, compared with only 26.5% of drug exposure cases being in males.

Most of the patients were exposed to poisons through ingestion (75.8%), followed by inhalation (12.1%), animal bites or stings (3.9%), dermal absorption (2.6%), intravascular, intradermal or subcutaneous injection (1.1%), ocular exposure (0.5%),

Table 4. Distribution of Reason for Poisoning Exposures by Age for Human Poisoning Exposures Reported to PCC-Taiwan, 1985-1993

Age (yr)	Unintentional		Intentional		Adverse Reaction		Unknown		Total
	No.	Row %	No.	Row %	No.	Row %	No.	Row %	
<1	327	88.6	17	4.6	14	3.8	11	3.0	369
1	1,056	92.2	69	6.0	5	0.4	15	1.3	1,145
2	1,039	96.4	18	1.7	6	0.6	15	1.4	1,078
3	685	95.9	17	2.4	4	0.6	8	1.1	714
4	350	92.6	16	4.2	6	1.6	6	1.6	378
5	206	89.6	12	5.2	6	2.6	6	2.6	230
6	113	85.0	9	6.8	7	5.3	4	3.0	133
All children (≤6)	3,776	93.3	158	3.9	48	1.2	65	1.6	4,047
7-12	435	78.2	58	10.4	34	6.1	29	5.2	556
13-18	304	25.1	861	71.2	19	1.6	25	2.1	1,209
19-29	1,073	17.7	4,729	77.9	61	1.0	204	3.4	6,067
30-39	1,106	25.1	3,072	69.6	78	17.7	158	3.6	4,414
40-49	722	35.3	1,221	59.6	35	1.7	70	3.4	2,048
50-59	774	43.0	924	51.4	37	2.1	63	3.5	1,798
60-69	547	39.5	740	53.5	30	2.2	67	4.8	1,384
≥70	331	29.3	708	62.7	31	2.7	58	5.1	1,128
Unknown adults	333	42.4	335	42.7	25	3.2	92	11.7	785
Total	9,410	40.2	12,799	54.6	396	1.7	831	3.5	23,436

and other routes (0.1%). Exposure by more than one route had been noted in 698 cases (3.0%), and concomitant exposure from inhalation and dermal contact accounted for 62.3% of such cases (435 cases).

A single substance was implicated in 86% (20,150 cases) of all reports, and only 114 cases involved more than two possibly poisonous drugs or products. Concomitant ingestion of alcohol was present in 1,283 exposures (5.5%) and among these, most cases were adults (1,234 cases). The overwhelming majority of poisoning exposures were acute exposure (90.3%), while chronic exposures comprised 8.0% of all reported poisoning exposures (chronic exposures were defined as continuous exposures occurring in a period exceeding 8 hours or repeated exposures in a period exceeding 1 week). The actual type of exposure was unable to be determined in 390 cases.

The clinical severity of most cases was rather mild in this study as 65.4% of

Table 5. Categoric Distribution of Human Poisoning Exposures Reported to PCC-Taiwan, 1985-1993

Category	Children		Adults		Total	
	No.	%*	No.	%*	No.	%
Pesticides	633	10.9	6,239	35.4	6,872	29.3
Drugs	1,886	32.4	4,874	27.7	6,760	28.8
Cleaning substances	410	7.1	1,196	6.7	1,606	6.9
Solvents	285	4.9	736	4.2	1,021	4.4
Animal bites & stings	172	3.0	781	4.4	953	4.1
Rodenticides	148	2.5	658	3.7	806	3.4
Cosmetics	246	4.2	383	2.2	629	2.7
Insect repellents	251	4.3	257	1.5	508	2.2
Chinese Herbs	111	1.9	319	1.8	430	1.8
CO & toxic gases	93	1.6	331	1.9	424	1.8
Food-borne toxins	89	1.5	190	1.1	279	1.2
Hydrocarbons	49	0.8	168	1.0	217	0.9
Plants	63	1.1	126	0.7	189	0.8
Miscellaneous	1,376	23.7	1,366	7.8	2,742	11.7
Total	5,812	100.0	17,624	100.0	23,436	100.0

* The relative proportion of various categories among children and adults poison exposure cases in stead of all human exposure cases.

all cases being mildly affected or asymptomatic. Nonetheless, there were 1325 fatalities in all exposure cases, which accounted for a mortality rate of 5.7%. Fatalities increased significantly with growing age, with the mortality rate being 0.7% in those younger than 7 years, 3.6% in adolescents, and 7.0% in all adults, reaching the highest mortality rate (16%) in those older than 70 years of age. Suicide attempt was the most common reason for fatalities with 941 cases (9.1% of all cases committing suicide) being dead after an intentional poisoning exposure. For all poisoning victims, males were more apt to have fatal outcomes than females and the mortality rate in males was 6.3%, compared with the mortality rate of only 4.9% in females. Table 7 delineates the distribution of the reason for exposure and age for the 1,325 fatalities. While Table 8 presents the distribution of age and gender for the 1,325 fatalities.

Among all fatal cases, paraquat was the leading cause of death in both children and adults, with 485 cases fatalities after exposure to paraquat. Organophosphate insecticide was another substance commonly incriminated in fatalities and 204 patients died from

Table 6. Categoric Distribution of Drugs for Human Poisoning Exposures Reported to PCC-Taiwan, 1985-1993

Category	Children		Adults		Total	
	No.	%*	No.	%*	No.	%
Benzodiazepines	201	3.5	1,688	9.6	1,889	8.1
Amphetamine	311	5.4	1,077	6.1	1,388	5.9
CNS-acting drugs	220	3.8	786	4.5	1,006	4.3
Tricyclic antidepressants & phenothiazines	108	1.9	311	1.8	419	1.8
Analgesics	137	2.4	272	1.5	409	1.7
Topicals	164	2.8	130	0.7	294	1.3
Cardiovascular drugs	149	2.6	101	0.6	250	1.1
Bronchodilators	84	1.4	93	0.5	177	0.8
Others	485	8.3	307	1.7	792	3.4
Unknown	27	0.5	109	0.6	136	0.6
Total	1,886	32.5	4,874	27.7	6,760	28.8

* The percentage of various drugs for all children or adults exposure cases, in stead of all human exposure cases.

organophosphate poisoning. Other substances also frequently implicated in fatalities were glyphosate, amphetamines, carbamates, cyanide, and other pesticides. Table 9 shows the various substances with largest number of deaths in all poisoning exposure cases.

Suicidal intent was more frequent among females than males, especially in adolescents and adults aged less than 40 years. Figure 1 shows the percentage of suicide attempts among different sexes. The rate of completed suicide, however, was much higher in males being two times that observed in females (13.4% vs. 6.7%). Pesticides and drugs remain those substances that were most frequently involved in suicide attempts (7,041 cases, 68.3% of all suicide attempts) and hence those substances commonly incriminated in deaths.

Occupational exposure to poisonous substances were recorded in 1,293 exposures (5.5%), with 17 fatalities. Most cases (1,134 cases) involved pesticides (793 cases), solvents, and toxic gases. The route of exposure in most cases was either by inhalation or dermal contact, with only 48 cases being exposed mainly by the oral route. Among those 17 fatalities, 8 were caused by pesticides, 3 by fluorinated hydrocarbons, 2 by hydrogen sulfide, and the other 4 by toluene, hydrogen fluoride, trichloroethylene

Table 7. Distribution of Reason for Exposure and Age for 1,325 Poisoning-Related Fatalities Reported to PCC-Taiwan, 1985-1993

Reason	≤6 Years	7-12 Years	13-18 Years	≥19 Years	Total
Unintentional					
General	24	5	6	110	145
Occupational	0	0	0	17	17
Environmental	0	0	0	2	2
Malicious	3	1	0	0	4
Therapeutic error	0	0	0	3	3
Unknown	0	1	0	9	10
Total	27	7	6	141	181
Intentional					
Suicidal	0	1	31	941	973
Misuse	0	0	0	16	16
Abuse	0	0	4	29	33
Others	0	0	0	5	5
Unknown	0	0	0	8	8
Total	0	1	35	999	1,035
Adverse Reaction					
Drugs	1	1	0	5	7
Chinese herbs	1	0	0	0	1
Food	0	1	0	1	2
Others	0	0	0	0	0
Unknown	0	0	0	1	1
Total	2	2	0	7	11
Unknown	0	0	3	95	98
Total	29	10	44	1,242	1,325

and an unknown agent, respectively.

Discussion

Though difficult to estimate, the number of poisoning exposure cases continue to increase annually worldwide and to be a burden on the National Health Service in most countries[1,6,8]. In Taiwan, between July 1985 and December 1993, 23,436 telephones

Table 8. Distribution of Age and Gender for 1,325 Poisoning-Related Fatalities Reported to PCC-Taiwan, 1985-1993

Age (yr)	Male	Female	Unknown	Total	%	Cumulative Total	Cumulative %
≤6	17	12	0	29	2.2	29	2.2
7-12	6	4	0	10	0.8	39	2.9
13-18	24	20	0	44	3.3	83	6.3
19-29	205	128	1	334	25.2	417	31.5
30-39	140	81	1	222	16.8	639	48.2
40-49	96	51	0	147	11.1	786	59.3
50-59	90	79	0	169	12.8	955	72.1
60-69	97	57	0	154	11.6	1,109	83.7
≥70	109	71	1	181	13.7	1,290	97.4
Unknown adults	21	10	4	35	2.6	1,325	100.0
Total	805	513	7	1,325	100.0		

Table 9. Substances with Largest Number of Poisoning-Related Fatalities Reported to PCC-Taiwan, 1985-1993

Substance	No. of deaths	%*
Paraquat	485	54.4
Organophosphates	204	11.0
Glyphosate	53	5.4
Amphetamine	48	3.5
Carbamates	42	5.8
Cyanide	40	24.1
Other pesticides	91	6.3
Cleaning substances	31	1.9
Rodenticides	28	3.5
Benzodiazepines	20	1.1
Solvents	20	2.0
Animal bites & stings	18	1.9
CO & toxic gases	18	4.2

* The percentage of fatalities of various poisonous substances

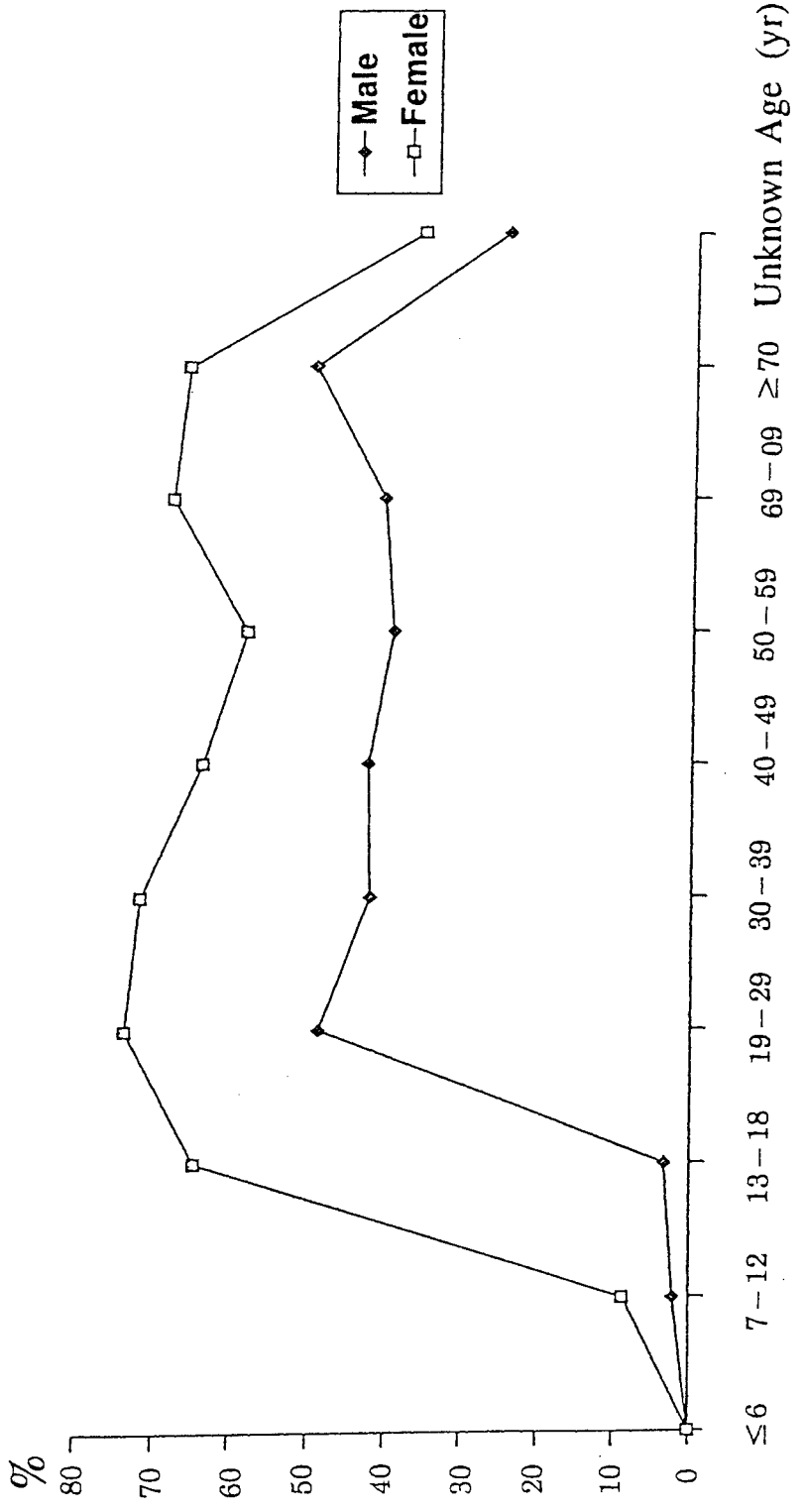

Figure 1. Rate of suicide attempts in each sex as a function of age in 23,436 human poisoning exposures.

calls concerning human poisoning exposures were reported to the PCC, which represented an annual incidence of some 0.19 exposures per 1000 population served. As extrapolating from data collected in the United States, at least 81,130 calls, representing a penetrance of 3.9 per 1,000 population, would be expected in a country the size of Taiwan (population 20.8 million - statistical year book of Taiwan, 1993)[6]. The absence of a comprehensive poison prevention campaign and child resistant closures, as well as easy availability of pesticides and over-the-counter drugs, would even predict more poisoning exposures in this country. Therefore, such a low incidence of poisoning exposure is of special interest. Underutilization and general unawareness of the existence and role of the PCC-Taiwan have been proposed as the major reasons for such discrepancy between Taiwan and the western countries[7]. In addition, actually low incidence of poisoning exposures may also play a role in Taiwan. Nonetheless, in considering health care professionals as the major callers (80.2%), and the much higher mortality rate in Taiwan (5.7%), underutilization and unawareness of the role of the PCC may be the most important reasons for the existence of such a low incidence. Since most children are accidentally exposed to poisons, less severely affected and usually under-reported in poisoning, relatively few cases of pediatric poisoning exposure (24.8%) in Taiwan would also support the role of underutilization of the PCC.

As might be expected, inadequate poison center use frequently leads to unnecessary health care expenditures including unnecessary emergency department visits and ambulance transports[6,9]. Inadequate poison center use also affects the outcome of poisoned patients, mostly resulting from overtreatment or inappropriate therapies. Therefore, how to increase proper utilization of the PCC should be a major issue in further poison control in this country and deserves more collaborative work.

The decline of reported poisoning exposure cases in 1993 is another issue worthy of particular concern. Although this leveling of use could be heralded as a welcome decrease in poisoning exposure incidence in Taiwan, such a conclusion is probably premature. As described earlier, the utilization of the PCC remains low in Taiwan and there is no convincing evidence to support the actual decline of poisoning exposure cases during the last 2 years. Therefore, this decrease in exposure cases may simply show no annual improvement in the use of the PCC, and suggests that optimal use of the poison center in Taiwan is yet to be achieved.

The preponderance of males in poisoning exposures was another striking feature in this study as females were usually more prevalent in adult poisoning exposure, especially in those classified as suicide attempts[1,6,10,11]. In our cases, females were still more prevalent in suicide attempts. Nevertheless, excluding adults aged 19-39 years, males outnumbered females in all age groups. The reason for this difference is not known. However, with the relatively minor effect in females (the proportion of major effect and death was 9.3% in females compared with 11.6% in males), the contribution of under-reporting of female exposures should not be neglected. More cases of pesticide exposure in males also have some role in the male preponderance, as females are usually exposed to drugs in most western countries[2,3,10].

Intentional poisoning exposure was more common than accidental poisoning exposure

in all cases (54.6 vs. 40.1%), yet revealing an inverse relationship with pediatric poisoning exposures (18.5% vs. 77.7%). The tendency toward intentional poisoning exposure was more prevalent in adolescent and adult females, with 76.2% of females in these age groups being self-poisoned. As suicide attempt is rather common in females, this trend of increased intentional poison exposure in females, is therefore not unusual. In most studies, this preponderance of females over males as suicide attempters is almost without exception and most studies report a female/male ratio of about 2:1[12-14].

Among all poisoning exposure cases, those aged less than 6 years and those aged 19-39 years appear to be most frequently involved, accounting for 61.4% of all poisoning exposure cases. Children aged less than 6 years have long been recognized as the age group that is frequently involved in accidental poisonings[6,15,16]. Most hazardous substances involved in this age group are those of household products and drugs. Child-resistant packaging has been recommended as an effective method of poison control and several studies have proved its role in the prevention of pediatric poisoning[16-18]. In this retrospective study, most children aged less than 5 years were unintentionally exposed (93.6% of all children in this age group) and substances commonly involved were household products and drugs. Since child-resistant closures (CRC) are not prevalent in Taiwan, the increased use of CRC could be an important factor in the further reduction of pediatric exposure cases. Education of parents and caregivers is of paramount importance as well, since the use of CRC doesn't control all poison exposures[16,18].

Those cases aged 19-39 years was another high risk group in poisoning exposures. With suicide attempters constituting the largest part in this age group, reduction in the rate of suicide attempts would obviously decrease the number of poisoning exposures. The combination of pharmacotherapy and psychological intervention in the acute setting, as well as identification of high risk groups, control of social contagion involving the influence of the media, and the ability of the major institutions of learning to guide and integrate the young in prevention, have been suggested by some authors to be crucial in minimizing suicide attempts[11,12]. Nonetheless, more work is still required to solve this problem.

In Taiwan, exposure to agrochemicals remains a major problem in human poisoning. Those substances frequently involved in poisoning exposures, excluding benzodiazepines and amphetamines, are organophosphates, glyphosate-surfactant mixture, paraquat, pyrethrin and pyrethroids, and carbamates, all of which are pesticides. The reasons for the large number of pesticide-induced poisoning exposures in Taiwan are various. Among these, easy accessibility to pesticides and frequent suicidal ingestion of pesticides are most important. Since most pesticides are highly toxic and exposures are usually intentional, those cases frequently result in a severe effect or death, in contrast to the frequent asymptomatic or only mildly effected patients following exposure to common household products or benzodiazepines. To avoid further poisoning from pesticides, legislation to control the easy accessibility of pesticides should be undertaken.

The type of substances involved in poisoning exposures between adults and children was another issue of interest. In adults, most cases involved pesticides and benzodiazepines, while children were more frequently exposed to household products,

analgesics, topicals, cardiovascular drugs, and bronchodilators. (Table 5 & 6) The large number of household products and common drug exposures in children were not unexpected, as most cases of accidental poisoning exposure occurred in preschool children. However, the prevalence of such drugs in children should readily alert the physician and parents in designing further poison prevention programs for children.

As might be expected, benzodiazepines were the drugs most frequently implicated in poisoning exposures. In most studies, benzodiazepines have long been regarded as the most common substance involved in drug poisoning since the 1970s'[1,2,19]. This is also true in our study in which adult suicide attempt cases accounted for most of benzodiazepine poisoning exposures. Easy availability of benzodiazepines as over-the-counter drugs is also of particular concern since exposures involving these medications could be reduced if there was legislative control of drug dispension.

The prevalence of poisonings from amphetamines and related substances in adolescents and young adults is another striking feature of poisoning exposures in Taiwan. An epidemic of amphetamine and heroin abuse has been noted in Taiwan since 1990 and the number of addicts has been estimated to reach 200,000 people by the end of 1994.[20-22] With the dramatically increasing number of drug addicts, more cases with poisoning following inadvertent use or suicide attempts of illicit drugs should be readily seen. However, owing to the frequent underreporting of poisoning exposure in drug addicts, the PCC-Taiwan data would probably under-estimate the real situation.

With the frequent occurrence of intentional poisoning exposure in adults and the prevalence of pesticide exposure, the mortality rate was 5.7% (1,325 fatalities) in this study, which was a figure much higher than the rate in most studies[1,3,4,6,10,23]. Increasing mortality rate with growing age was also noted in our cases, with the rate being highest in those older than 70 years of age (16%). Since most deaths (66% of all fatalities) in this study involved intentional exposure to pesticides (75.4% of all fatalities), reduction in the availability of pesticides and development of appropriate therapeutic regimens, including first aid, should be sought to decrease the deaths following intentional pesticide exposures. Avoiding unnecessary emesis or gastric lavage in pediatric poisoning following the ingestion of hydrocarbons was also of importance, as 7 fatalities were probably the consequence of aspiration pneumonitis after inappropriate treatment.

Occupational exposure to hazardous substances was also common in our cases (5.5%), which occurred much more frequently than that reported in the United States (2.1% in 1993)[6]. Among these, more than half of all cases (61.3%) including 8 fatalities, were exposed to pesticides, reflecting the wide availability of pesticides and poor education about poison prevention in this country. More education in the prevention of poisoning from pesticides and appropriate first aid are of extreme importance in reducing occupational exposure to pesticides.

Excluding pesticides, the other occupational exposures mainly included solvents and toxic gases, with 9 fatalities encountered following such exposures. The mortality rate (1.8% of all non-pesticide exposures) was relatively low in occupational setting, as

compared with the overall mortality of 5.7% in this study. Nevertheless, with greater attention to the appropriate working environment and necessary protective equipment, these fatalities should be preventable. Therefore, considerable work remains to be achieved in eliminating these occupational fatalities.

The presence of 28 occupational exposure cases in children in this study is also of major concern. In reviewing the charts, most pediatric exposures were caused either by inattention about working protection or by "true" accidents (such as a leak of ammonia gas). Therefore, improvement of the working environment is crucial in the prevention of further children exposures.

The possibility of employment of child labor in these children exposures is also worthy of consideration. Employment of child labor is illegal in Taiwan, however, some factories continue to use child labor to reduce the cost of manpower. Though, there was insufficient evidence to indicate the existence of child labor in our cases, this possibility should always be sought. In addition, necessary means to control the illegal employment of child labor would be important in minimizing occupational exposures in children as well.

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References

1. Mannaioni PF. Pattern of acute intoxication in Florence: a comparative investigation. Intensive Care Med 1991; 17 Suppl: S24-31.
2. Jacobsen D, Frederichsen PS, Knutsen KM, Sorum Y, Talseth T, Odegaard OR: A prospective study of 1212 cases of acute poisoning: general epidemiology. Human Toxicol 1984; 3: 93-106.
3. Stewart RB, Forgnone M, May FE, Forbes J, Cluff LE: Epidemiology of acute drug intoxications: patient characteristics, drugs, and medical complications. Clin Toxicol 1974; 7: 513-30.
4. Petersen H, Brosstad F: Pattern of acute drug poisoning in Oslo. Acta Med Scand 1977; 201: 233-7.
5. Rygnestad TK: Prospective study of social and psychiatric aspects in self-poisoned patients. Acta Psychiatr Scand 1982; 66: 139-53.
6. Litovitz TL, Clark LR, Soloway RN: 1993 Annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. Am J Emerg Med 1994; 12: 546-84.
7. Ger J, Deng JF, Chung HM, et al: A comparison of Poison Control Center data between Taiwan and USA. Vet Hum Toxicol 1991; 33: 380.
8. Pinar A, Fowler J, Bond GR: Acute poisoning in Izmir, Turkey - a pilot epidemiologic study. Clin Toxicol 1993; 31: 593-601.
9. Chafee-Bahamon C, Lovejoy FH: Effectiveness of a regional poison center in

reducing excess emergency room visits for children's poisonings. Pediatrics 1983; 72: 164-9.
10. Masini E, Fantozzi R, Blandina P, et al: Epidemiological survey of intoxications in the last ten years. Clin Toxicol 1981; 18: 1157-62.
11. Klerman GL: Clinical epidemiology of suicide. J Clin Psychiatry 1987; 48 Suppl 33-8.
12. Weissman MM, Conn NH: The epidemiology of suicide attempts. 1960-1971. Arch Gen Psychiatry 1974; 30: 737-46.
13. Smith JS, Davison K: Changes in the pattern of admissions for attempted suicide in Newcastle upon Tyne during the 1960s. Br Med J 1971; 4: 412-5.
14. Bridges PK, Koller KM: Attempted suicide: A comparative study. Compr Psychiatry 1966; 7: 240-7.
15. Deeths TM, Breeden JT: Poisoning in children - a statistical study of 1057 cases. J Pediatr 1971; 78: 299-305.
16. Scherz RG: Prevention of childhood poisoning: a community project. Pediatr Clin North Am 1970; 17: 713-27.
17. Clarke A, Walton WW: Effect of safety packaging on aspirin ingestion by children. Pediatrics 1979; 63: 687-93.
18. Walton WW: An evaluation of the poison prevention packaging act. Pediatrics 1982; 69: 363-70.
19. Proudfoot AT, Park J: Changing pattern of drugs used for self-poisoning. Br Med J 1978; 1: 90-3.
20. The 1993 Annual Report of the Ministry of Justice, Executive Yuan, Taiwan, R.O.C.
21. Chou P: The prevalence and risk factors of illict drug abuse by adolescents. (in Chinese) 1994 International Symposium on Drug Abuse - Epidemiology and Treatment, Taipei, Taiwan. May 26-28.
22. Chen KT: Drug abuse warning network program in Taiwan. (in Chinese) 1994 International Symposium on Drug Abuse - Epidemiology and Treatment, Taipei, Taiwan. May 26-28.
23. Jacobsen D, Frederichsen PS, Knutsen Y, Sorum Y, Talseth T, Odegaard OR. Clinical course in acute self-poisoning: A prospective study of 1125 consecutively hospitalized adults. Human Toxicol 1984; 3:107-16.