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Forensic Chemical Examinations in Finland, 1979— Trends in Fatal Poisoning

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ABSTRACT: Forensic chemical examinations done between 1968 and 1979 in Finland were analyzed. Variations were discovered in the numbers and types of poisonings by year. These results can be attributed to several factors. Some trends in the types of substances occurring in poisoning cases are discussed.

KEYWORDS: toxicology, poisons, chemical analysis

In Finland, forensic chemical analysis is carried out primarily at the Division of Forensic Chemistry, Department of Forensic Medicine, University of Helsinki. Thanks to the advances made in chemical instrumentation after the 1950s, many new types of analysis have been developed [1-10].

Since the new Act on Cause of Death Investigations (459/1973), which allows medical autopsy even in certain forensic science cases, came into force at the beginning of 1974, the number of forensic autopsies has decreased substantially. Despite this, the proportion of cases referred for forensic chemical analysis has increased.

Figure 1 shows that in 1979 a total of 6513 forensic autopsies were carried out (15% of all deaths), of which 42% (2756 cases) were referred for forensic chemical analysis. Twenty-two percent of them were poisonings, 55% were violent deaths, and 23% were due to disease. The most conspicuous feature is the involvement of alcohol: it is a factor in more than 48% of all cases.

Poisoning

Table 1 shows the cases of death by poisoning in 1979 divided into groups.

Figure 2 shows the trend in the poisoning rate between 1966 and 1979 in suicides and accidents, excluding deaths from alcohol poisoning. Alcohol poisonings are the largest group of accidental deaths, and medicament and carbon monoxide cases are the largest group in suicides.

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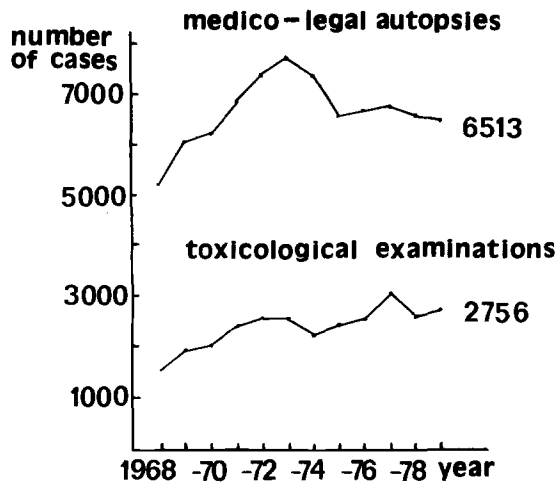


FIG. 1—Medicolegal autopsies and toxicological examinations between 1968 and 1979. Population of Finland, 4 771 098 in 1979. Mortality, 43 685 in 1979. Medical autopsies, 10 050 in 1979.

TABLE 1—Poisonings detected in forensic chemical analysis in 1979.^a

Poisoning	Accident	Suicide	Undefinable	Total
Alcohol	254	2	3	259
Medicament	57	159	38	254
Carbon monoxide	30	33	7	70
Cholinesterase inhibitor	...	9	...	9
Other	2	8	3	13
Total	343	211	51	605

^aAt the Departments of Forensic Medicine of Turku and Oulu Universities 41 fatal poisonings in all were detected: alcohol, 12 cases; carbon monoxide, 25 cases; and medicaments, 4 cases.

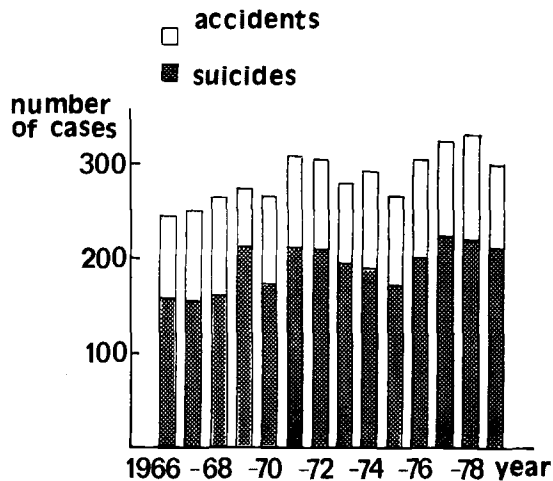


FIG. 2—Fatal poisoning cases determined by toxicological examination between 1966 and 1979, excluding cases of alcohol poisoning.

Alcohol

Fatalities through alcohol poisoning between 1966 and 1979 are shown in Fig. 3. There have been 15 to 30 deaths each year caused by dangerous "substitute" alcohols, such as a methanol, isopropanol, and ethylene glycol.

Ethanol is very frequently involved, especially in cases of accidental medicament poisonings and carbon monoxide poisonings. The blood alcohol concentrations in ethanol poisonings are shown in Fig. 4. The mean is 3.40 mg/g.

Medicament

Figure 5 shows the trends in medicament poisoning between 1966 and 1979, and Table 2 illustrates the trend in the involvement of substances most frequently found in medicament poisonings between 1968 and 1979.

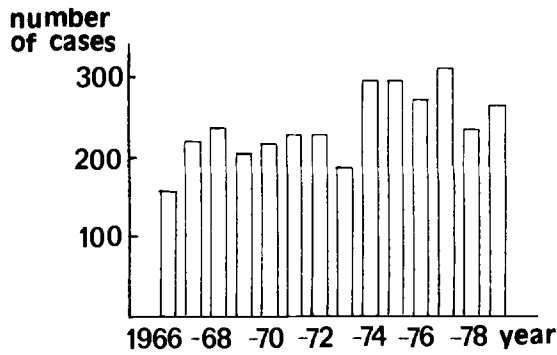


FIG. 3—Fatalities from alcohol poisoning between 1966 and 1979.

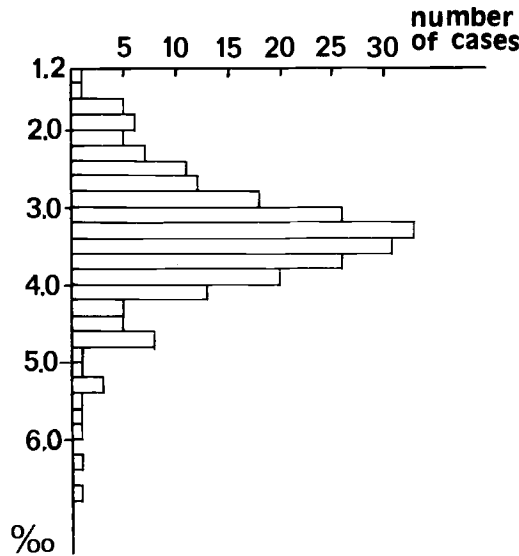


FIG. 4—Blood alcohol concentration in 243 cases of ethanol poisoning in 1979 (%o = mg/g).

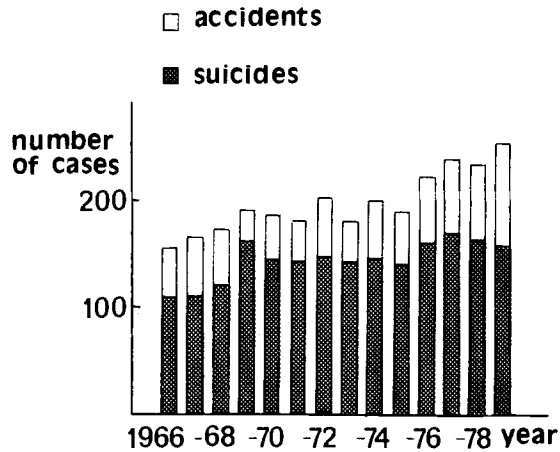


FIG. 5—Cases of fatal poisoning by medicaments determined by toxicological examination between 1966 and 1979.

TABLE 2—Substances found in the majority of fatal poisonings between 1968 and 1979. Number of findings.

Substance	1968	1974	1977	1979
Only barbiturates	48	9	29	34
Barbiturates and others	74	83	70	74
Other than barbiturates	50	108	141	145
Bromoureides (bromocarbamides)	36	16	18	9
Meprobamate	26	12	14	7
Methaqualone	...	27	5	...
Dextropropoxyphene	2	24	16	15
Chlorprothixene	5	21	20	19
Amitriptyline	13	9	25	20
Doxepin	...	10	21	7
Benzodiazepine derivative	30	42	59	77
Phenothiazine derivative	36	43	69	63
Digoxin	...	15	19	27

Increasingly often we find several substances at the same time. In 1979 two or more different medicaments were simultaneously found in 65% of cases.

If we look at the occurrence of euphoric analgesics, we find that there are very few cases where substances of the morphine group have been detected. Death from narcotics is still extremely rare in Finland.

Carbon Monoxide

Figure 6 shows the number of carbon monoxide poisonings recorded between 1966 and 1979. The sources of carbon monoxide are listed in Table 3.

Cholinesterase Inhibitor

Parathion, a fashionable means of committing suicide in the 1950s, is the most common poison. A peak year was 1958: the total was 102 recorded cases. This figure has fallen

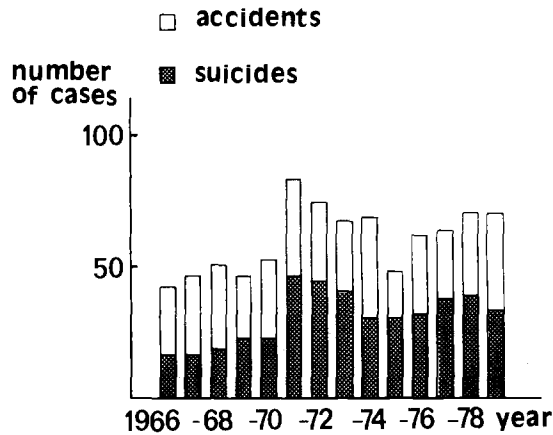


FIG. 6—Cases of fatal carbon monoxide poisoning determined by toxicological examination between 1966 and 1979.

TABLE 3—Sources of carbon monoxide poisoning in 1979 and number of cases.

Source	Accident	Suicide	Undefinable	Total
Car exhaust	2	24	1	27
Stove/oven	7	1	4	12
Heating/lighting device	11	...	1	12
Smoldering fire	5	5
Domestic gas (Helsinki)	1	8	1	10
Not known	4	4
Total	30	33	7	70

sharply since 1960 when it became statutory to obtain permission from the police for buying parathion preparations.

Homicide

Between 1973 and 1977 and in 1979 there were no homicides by poisoning. In 1978 two cases (smoke bomb) were classified as homicides by poisoning. Carbon monoxide was used in seven cases of homicide in 1971.

In the history of murders carried out by poisoning, the majority of the victims have been small children. In obscure child deaths, murder by medicament poisoning should be considered along with the possibility of carbon monoxide poisoning.

Special Features

Blood Alcohol from Hematoma—In 62 cases the blood alcohol concentration was determined both from a hematoma and from a usual peripheral blood sample. In these cases the deceased had lived between a few hours and a few days after suffering damage. All happened to be cases of dura mater encephali hematoma bleeding clots. In eight cases the alcohol concentration of the hematoma blood was considerably higher (0.37 to 1.15 mg/ml), whereas in five cases the alcohol concentration of peripheral blood already was eliminated to 0.

Level of Ketone Bodies in Blood—The level of ketone bodies in blood was determined in 94 cases.² The indications were (1) suspected diabetes, (2) positive reactions of glucose or ketone bodies or both in urine, (3) suspected ingestion of isopropanol (acetone, as known, is a metabolite of isopropanol), and (4) obscure death, in which the cause of death was not revealed by autopsy or forensic chemical analysis. Table 4 shows that ketone bodies were positive in 25 cases.

Glucose and Lactate Contents of the Vitreous Humor—According to the experience in the Department of Forensic Medicine, Helsinki University, a total glucose and lactate content of 375 to 410 mg/100 mL in vitreous humor is an indication of increase, and totals exceeding 410 are definite evidence of hyperglycemia. Low totals may reveal hypoglycemia.

Table 5 shows the cases of diabetes in which the concentration of ketone bodies in the blood and the glucose and lactate contents of the vitreous humor were simultaneously determined. It is obvious that, when diagnosing diabetes in fatal cases, the determinations of ketone bodies in the blood and vitreous humor components are complementary.

TABLE 4—Cause of death and the level of ketone bodies in blood—25 cases with an elevated level (higher than 10 mg/100 mL of blood) in 1979.

Underlying Cause of Death/ Contributory Factor	Cases, <i>n</i>	Ketone Body Concentration, mg/100 mL Blood
Isopropanol poisoning	8	230-991
Isopropanol and ethanol poisoning	2	26-53
Ethanol poisoning	2	23-50
Diabetes	5	47-120
Diabetes (shooting case)	1	296
Spleen inflammation	1	95
Epilepsy	1	28
Heart disease	1	138
Delirium tremens	1	17
Cold	1	13
Drowning	1	16
Undefinable	1	10
Total	25	...

TABLE 5—Cases of diabetes involving examination of blood ketone bodies and of vitreous humor for glucose and lactate.

Case Number	Blood Ketone Body Concentration, mg/100 mL	Vitreous Humor, mg/100 mL		
		Glucose	Lactate	Total
1	47	255	383	638
2	93	135	418	553
3	4	56	417	473
4	6	7	378	385
5 ^a	8	6	229	235

^aDied from insulin overdose (hypoglycemia).

²H. Sippel and A-R. Parviainen, unpublished data.

Discussion

There is substantial variation in the annual numbers and types of poisonings.

Some of the factors influencing the trends in poisoning are legislative, measures taken in alcohol and medicament policies, and, in the case of suicides, various "fashions."

Along with the liberalization of policy concerning alcohol, the consumption of alcohol has more than doubled in ten years. According to statistics compiled by the state alcohol monopoly (Alko), the consumption of 100% alcohol was 2.9 L per capita in 1968 and 6.2 L in 1979.

Deaths from medicament poisoning are characterized by the simultaneous use of several medicaments and by the complicating effect of alcohol. The trend in medicament poisonings is primarily influenced by the directives of the National Board of Health. The increase in the number of poisonings caused by psychopharmaceuticals is a consequence of the changes that have taken place in consumption figures [11].

In 1974 restrictions were issued concerning prescriptions for anti-anxiety medicaments and sedatives; the result was reduced consumption. The use of barbiturates went down from 32 daily doses per 1000 inhabitants in 1967 to approximately 10 doses in 1974.

When methaqualone was proved to be a habit-forming sedative that considerably strengthens the effect of alcohol, it was decreed in 1977 that it could be used only in hospitals.

On 1 Feb. 1979, it was stipulated that all dextropropoxyphene preparations were to be purchased only with the original prescriptions given by the doctor.

The majority of medicament poisonings up to 1970 were due to barbiturates, bromourides (bromocarbamides), and meprobamate. After 1970 their number decreased, whereas poisonings from methaqualone appeared frequently and psychopharmaceuticals became increasingly common. Phenothiazines, amitriptyline, doxepin, and chlorprothixene were often encountered. Benzodiazepines appeared in many cases. The number of cases involving psychopharmaceuticals is on the increase as new products are continually being launched. Digoxin cases have increased. Among the analgesics, dextropropoxyphene has become common. Barbiturate cases, on the other hand, have increased recently, possibly reflecting the difficulty in obtaining other potent sedatives.

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