International Comparisons of injury mortality databases: evaluation of their usefulness for drowning prevention and surveillance.

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Our earlier studies have identified wide variations in injury rates from one country to another and even within countries (Smith, Langlois, Rockett 1994; Rockett, Smith 1987, 1989, a&b, Bacon, Smith, Baker 1989). However these and a number of other studies have raised concerns over whether these differences are real or due to differences in coding practices (Langlois, Smith, Baker, Langley, 1995)

During the International Collaborative Effort (ICE) on Injury Statistics meeting in 1994 and the subsequent follow up working group meeting, a number of issues relating to differences in coding practices and the type of data available in different countries were discussed (Fingerhut, Hartford, 1995). Included in the recommendations for follow-up projects that came out of that meeting was a recommendation to evaluate the comparability and differences in vital statistics data using a specific injury type. Our group proposed to use drowning as such a case study. For want of a better name this project has been called "Wet ICE" Project.

Drownings were chosen for study because unlike most other injuries the external cause of injury codes (E-Codes) for drownings correspond with a specific nature of injury code that describes the type of injury (ICD Code "994.1 drowning and non fatal submersion"). This would facilitate taking advantage of data from those countries that use multiple cause of death coding (Israel et al. 1986). Only burns and poisonings have similar corresponding nature of injury codes.

Initial review of available data for potential collaborating countries from the recent 1993 World Health Statistics Annual (World Health Organization, 1994) found that drownings (defined in their publication as accidental drowning E-910 only) were an important cause of injury death in many countries. As would be expected the number of drowning deaths varied widely from country to country depending both on the population size and underlying injury rate (Table 1). Rates are uniformly higher in males with Finland having the highest rate; England and Wales have the lowest, and they also have the lowest rates for females. Even, when the drowning rates were age adjusted (Figure 1) an earlier publication from Australia showed that the differences in drowning rates were just as dramatic (Harrison et al. 1995). While these data are a useful first step in understanding differences in drowning they do not reflect the true picture of all drownings that occur. Not all drownings are classified as accidental, many are also classified as suicide, and a limited number due to homicide. In Japan for example suicides are an important part of the drowning problem with many deaths being potentially misclassified (Rockett, Smith 1993). It is important to consider all drownings regardless of intent when looking at drownings. This may be especially true when comparing data between countries because of potential differences in how deaths are classified. This is one of the central issues to be explored in the WET ICE.

The aims of the "Wet ICE" Project are to:

(1) Develop a better understanding of what data are available in the vital statistics database in each country and how they differ (e.g. socioeconomic variables, rural/urban codes). We will also examine if there are certain unique features available in particular countries that may be useful to better understand both drowning causes and prevention strategies.

(2) To determine if the exercise of studying one specific injury in detail can lead to improved understanding of injury coding practices and what information is and is not available in each country. Special features in one country's system may also provide important information on areas where other countries could improve their vital statistics data not only for drowning but for all other causes.

(3) To conduct more in-depth studies in the future, such as to evaluate if trends in drowning rates, similar to those in the US, have occurred in other countries and what information is available to help explain these trends. Although we cannot really claim to have proven interventions for drowning, especially outside the toddler age group, but there have been dramatic declines in rates in the U.S.(Brenner, Smith 1994). It is hoped that a more in-depth study of both differences between countries and trends in injury rates may reveal natural experiments that suggest effective prevention strategies.

(4) To foster better links between collaborating countries in order to better understand injury problems, improve data quality, and develop prevention strategies.

The WET ICE project as proposed has multiple components; only the first will be presented here. The first phase includes an attempt to describe and compare rates for each country and compare them for a standard period (i.e. 10 years using the same codes). We also propose to examine similarities and unique features of each system. In subsequent years we propose to do a series of other studies to build on this initial study. This paper describes the preliminary findings from our study of a limited number of countries that were able to provide data in the short time frame of this initial effort. The paper also will serve as a working draft to further develop the work we have outlined, and in its current form only represents the opinions of the first author. Further input into the paper and revisions to improve it are being solicited from WET ICE participants with a view to submitting one or more papers for publication to a peer reviewed journal. It is also hoped that other countries will be able to participate and will be included in future analyses from our group.

Methods

Participating countries and potential collaborators were identified through participants at the ICE meeting in 1994. A standardized questionnaire was sent to each potential collaborator requesting information on a number of different variables relating to coding practices and the structure of their vital statistics system. Data was requested from collaborating countries on drowning deaths for a number of different years, at least since 1979 (when ICD-9 was implemented in most countries). Information on the availability of data far back as countries could easily go on computer or hard copy files was also sought.

The long range goal is get case level detail as a large computer file from each country. However, this would have proven logistically difficult given the limited time available to do the first phase of this study. Information was thus collected on the availability of certain data and a follow up request later asked for specific summary data for preliminary analysis. The availability of data the following variables was sought:

(1) Year: Data on drownings for individual years were requested. We proposed to group data into several years for some analyses, because some countries may have small numbers of drownings in any one year (Table 1). The following ICD-9 E-Codes were used for the basic analyses - E830, E832, E910, E954, E964, and E984 (see Table 2).

(2) Age: Data was requested for the following age groups: less 1, 1-2,3-4,5-9,10-14 and 5 year intervals thereafter to age 75 and over, and the total for all ages.

(3) Gender: male, female, total.

(4) Race/socioeconomic status : Countries all have different methods of coding racial or ethnic differences and information was requested on groups available. A separate question was asked on available data on socioeconomic status. For example are the occupations of parents available for victims of a childhood drowning? In the U.S. race is often used as a proxy for socioeconomic status, and usually presented as white, black, and other (more breakdowns are available on this group).

(5) Population data: Estimates of population size was requested for each year in the same age, gender, race/socioeconomic, and urban/rural categories.

(6) Urban/rural variable: In subsequent studies, we plan to explore if drowning rates have changed more in rural compared to urban areas. Some of the observed decline in drowning rates seen in some countries may be due to population shifts and to decreasing exposure to the outdoors. In the U.S., urban/rural status is based on county of residence. One grouping used by NCHS is: core city, fringe, medium, small (communities) and non metro (= rural). The Injury Fact Book uses central city, metro > 1 million, metro < 1 million, non metro, rural remote (Baker et al. 1992).

(8) Multiple cause data: What multiple cause data was available and how many different codes are recorded?

(9) Unique features of vital statistics database: We were keen to learn what additional data was available that would help us understand injury problems such as drowning. The major problem in looking at drownings is the lack of specific detail in the E-codes with the 4th digit of the ICD code providing little useful information. For example we cannot identify pool drownings or other sites from vital statistics data? We sought to explore the unique data fields that may be available such as place codes, free text descriptions or other coded information that improved the quality and detail of the data available.

Results

Information was received from the following nine countries: Australia, Denmark, England/Wales, France, Israel, the Netherlands, New Zealand, Sweden and the United States. All countries could provide computerized data from 1979 to 1993 with Sweden and the Netherlands having 1994 data accessible. Prior to 1979 most countries had trouble accessing data reliably by computer. France and Israel had data computerized from 1968, while England and Wales could provide data on a diskette as far back as 1901. Providing appropriate gender and age breakdowns was not difficult for any country, except for Australia which had difficulty providing specific age breakdowns by 1 year intervals in ages 1-4. The US uses a number of race categories which are usually summarized as white, black, other. New Zealand uses European, Maori, Pacific Island and several Asian categories, while Australia only uses a variable "aboriginal yes/no" which is considered to be of limited value. Israel uses Jew/non Jew and England and Wales record the country of birth which is useful for recent immigrants only. The only country to have a specific socioeconomic status variable in their data is England and Wales which uses social class variables (I to IV) based on the occupation of the individual or head of household (for children it is available separately for mother and father).

A number of countries (especially Scandinavian ones) said that linkage to census data is possible to obtain some socioeconomic data. No such information is available in the US, New Zealand or Australia, although place of residence may be used as a proxy. Most countries could provide some urban/rural breakdowns but this would usually involve more complex analyses. All countries could provide reliable population data for calculating rates of injury.

Coding

All countries were capable of generating both 3rd and 4th digit level ICD data on drownings, while the US had complete multiple cause data for all years as did England and Wales for 1985 and 1986, and for the period 1993 and 1994 (not available for other years). Denmark, France, Norway, and Sweden have some level of multiple cause codes which appear to only be the single nature of injury code without more extensive multiple cause codes. This point however needs more clarification. Australia, Israel, the Netherlands and New Zealand only code the underlying external cause with no other codes available.

Unique Features

(1) Special Codes: One country, Australia has separate fields that are used specifically for certain types of deaths to provide additional information. For all drownings there is a special two digit code that was originally developed in New South Wales (Figure 2). This code provides extensive information on the place and circumstances of drowning. For example swimming pool drownings can be clearly identified by type of pool and it can also distinguish between falls into water and drownings occurring while swimming. This code also enables drownings coded outside the traditional ICD codes to be identified, such as drownings due to floods and presumably motor vehicle drownings, although there is no specific category for this.

(2) Free text: New Zealand has a separate 96 free character text field in their vital statistics database that can be used to describe the cause of drowning (see Langley, Smith accompanying article). This free text enables drownings from other causes such as railway accidents or motor

vehicle crashes to be identified through word searches such as the word "drown". This unique feature is also available for the hospital discharge data and has been used in a number of studies (Langley 1995).

England and Wales in addition to multiple cause coding for selected years also directly enters the text written on the death certificate into their vital statistics database. All words written in parts I and II of the death certificate are entered verbatim. This would allow free text to be researched for words that mention drown or drowning. Denmark also enters some free text from the death certificate into their computer file and it is available in English for years 1980 - 1985.

Data Analysis

Drowning rates for New Zealand, Australia, and England and Wales were first compared because these countries all have the ability to pick up drownings outside the standard ICD code groupings. This can be done either through full multiple cause coding (U.S. and England and Wales), through special codes (Australia) or free text searches (New Zealand) (see above).

The rates for accidental drowning (E910) vary widely from a high of 22.8 in New Zealand to a low of only 8.0 per million population in England and Wales (Table 2). Similar variations also occur for boating, suicidal and homicidal drownings. An unanticipated finding was that the drowning rates for those of undetermined intent (E984) were much higher in the United Kingdom (7.7 per million population) than they were for the next highest country New Zealand (1.9 per million). When all cause drowning rates regardless of intent were compared the drowning rates

for Australia, USA and England and Wales were remarkably similar in marked contrast to the accidental drowning rate which was much lower in England and Wales (almost half that of the other two countries). New Zealand had a high drowning rate in most intent categories.

When the proportional distribution of drownings by intent category are compared (Table 3) it can be seen that 39% of all drownings are coded as due to undetermined intent in England and Wales while only three to five percent were so classified in New Zealand, Australia or the U.S.A. A similarly high proportion of drownings classified to undetermined intent was noted in Sweden (24%) and France (33%), while Denmark and the Netherlands were somewhat lower. A very small proportion of deaths were classified as due to undetermined intent in Israel, with 92% being classified as accidental drowning; much higher than in any other country. It is also of interest to note that the overall drowning rate in different countries tends to cluster into two groups. New Zealand, Sweden, France, and Denmark have rates ranging from 42.5 to 37.1 per million population while rates in the other countries range from 23.2 in Australia to 19.3 in the U.S.A., Israel stands out with a much lower rate of only 15.1 per million population. As would be expected based on population size, the number of drownings in each country also varies considerably from an average of 6,300 annually in the U.S.A. to only 66 in Israel.

Hidden drownings

As mentioned earlier the existence of multiple cause codes or special features of the vital statistics system can pick up a number of additional "hidden" drownings that are not identified by standard ICD drowning codes. As discussed in the accompanying paper by Dr. John Langley (Langley, Smith In press) these drownings occur in a wide variety of situations from railway accidents (drowning due to being knocked off a bridge by a train) to motor vehicles driving into water, and to suicide from jumping from a high place which then results in drowning. In New Zealand from 1977 to 1992 the average annual drowning rate due to hidden drownings was 7.5 per million population (Table 4). These were detected (as discussed earlier) though a free text search for the word "drown". When added to the already high drowning rate of 42.5 per million population their drowning rate is thus much higher then any other country we studied. In Australia the existence of special drowning codes resulted in a hidden drowning rule of 1.7 drownings per million population. The multiple cause data in England and Wales resulted in an increase of the drowning rate by 1.3 drownings per million population. Information on multiple cause data for the U.S. is pending. These hidden drowning rates can increase the true drowning rate considerably. In New Zealand 15.0% of all drownings are "hidden" and not picked up by standard ICD groupings. Even in Australia and England 6.8 and 6.3 percent respectively of all drownings are excluded from the drownings identified by ICD codes (Table 5).

Discussion

This paper presents the first preliminary analyses of data from the WET ICE project. This draft will hopefully serve as the basis for more in-depth analyses of drowning data from different

countries and promote discussion among participants. One important finding from this study is that there are marked differences between countries in both the type of data collected by the vital statistics databases and the availability of additional data with which to look at both drownings and other injuries.

While it was expected that drowning rates would vary dramatically by country the most surprising finding was the wide variation in the proportion of drowning deaths classified as of undetermined intent (E984). This is the first study to our knowledge to examine this category of deaths. In England and Wales almost 40% of all drowning deaths are coded as of undetermined intent while less than 1% are so coded in Israel. One possible explanation of the reasons for the high undetermined category in England and Wales is that unlike in many other countries the external cause of death, including intent is determined by the judicial system following a legal inquest. The intent is thus determined by a magistrate and held to higher legal standards of proof that may be different to that required in other countries. It is interesting to note that a number of other countries also have a high proportion of undetermined drowning deaths, including France (33%), Sweden (26%), and Denmark (13%). More work is needed to determine exactly how deaths are certified in each country and to what standards of proof the certifiers of cause are held to. These are similarly wide variations in the proportion of drownings coded as suicide ranging from 56% in the Netherlands to only 7% in Israel. It is unknown at this time whether these charges are real or simply due to differences in coding practices. An interesting follow-up study may be to compare coding practices by country using common case scenarios and also using the same death certificates. When all drownings regardless of intent were compared it was

remarkable how similar drowning rates were in some countries compared to wide variations observed when accidental drowning rates (E910) alone were compared (Table 2). There also appeared to be clustering of drowning rates into two broad categories, the high drowning rate countries and the lower drowning rate countries (Table 3). More work is needed to examine if these differences are real or not.

Another important finding from this study is that the standard ICD codes for drownings do not capture all drownings. While this has been known for some time (Baker, et al. 1992) the true extent of this problem has not been examined. The ability to analyze free text such as found in New Zealand is a major advance in our ability to examine all drownings. A full 15% of all drownings were "hidden" from standard analyses using only ICD codes. It is interesting to note that in both Australia, using special a separate coding field, and England, using multiple cause coding, between 6 to 7% of all drownings were not picked up using standard ICD codes. In these same countries if only accidental drownings (E910) were used to compare the drownings between countries only about 40 to 60 percent of drownings would have been considered. This illustrates the fallacy of using one simple code to compare drownings and presumably other injuries between countries.

This study also demonstrates the value of examining all drownings as a group regardless of intent. The method of considering all injuries regardless of intent has proven very valuable to define the true public health impact of firearm injuries (Fingerhut LA, Personal Communication, 1995). Our study of drownings further illustrates this point, particularly when a number of

countries have a considerable proportion of their injuries coded as due to intent undetermined. More research is needed as to what these drownings represent and if similar variations are seen for coding other injuries. Our earlier work for example remarked on the much lower injury rates in the United Kingdom for injuries coded as accidental (unintentional for the injury prevention purists) (Rockett, Smith 1989b). Our current study casts doubt as to whether these findings are real, especially given that in almost 40% of drowning deaths the intent was not determined. A valid question to be answered is "Is England and Wales really so safe", or is it just an artifact of differences in injury coding practices. This issue is one of the major reasons to continue the work began by Louis Fingerhut and Bob Hartford when they created this Injury ICE. Our thanks must go to them for making this and future studies possible.

It is proposed that we will continue this work on the WET ICE to better understand both injury coding practices globally and to also gain insights into how drownings can be prevented. Other potential projects could include:

(1) Comparison of drowning trends over time. There have been dramatic declines in recent years in drowning rates for most age groups among children and youth in the U.S. (Brenner, Smith 1994) (Figure 3). We are unable to explain this trend and would very much like to determine if there have been similar trends in other countries such as has been shown in Australia in an analysis by their National Injury Surveillance Unit (1995.b) (Figure 4).

(2) Analysis of hospital discharge data for drowning admissions and calculations of case fatality rates. Our earlier work shows dramatic differences in a fatality by age group, although little is known regarding hospitalized drownings (Smith, Brenner, 1995).

(3) Analysis of emergency department (A & E) visits for drowning using data from different countries and estimation of admission rates.

Through such analyses as we have proposed it is hoped that important new insights can be gained regarding differences in injury coding practices between countries. It is also hoped that through such understandings we can improve our own respective injury data sources to better understand the true injury problem. In addition once valid comparisons can be made between countries it is hoped that we will be able to then examine factors that are responsible for the apparent wide variations in drowning and other injury rates between countries. Such studies for other diseases lead to important new hypotheses that then lead to better understanding of etiology and prevention of a number of diseases including heart disease, diet, and cancer (Reid, 1975; Armstrong and Doll, 1975; Schrauzer et al., 1977). It is hoped that similar natural experiments may be going on with drowning and that by examining factors responsible for low drowning rates in some countries such as Israel as compared, for example, to the very high rates in New Zealand may suggest important new areas to reduce the toll of drownings on our society.

Acknowledgments

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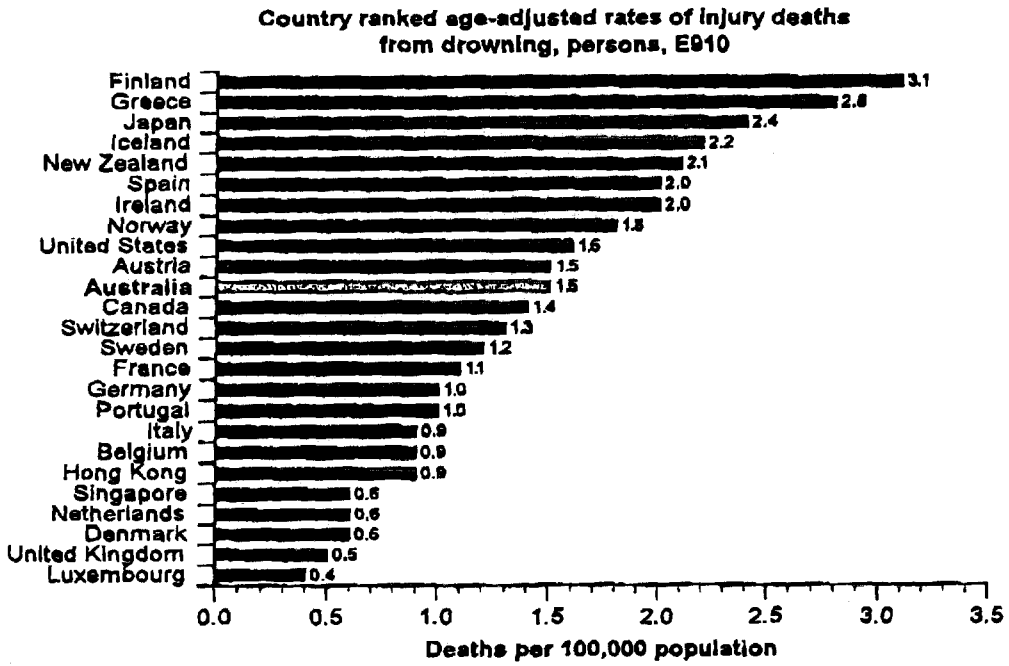
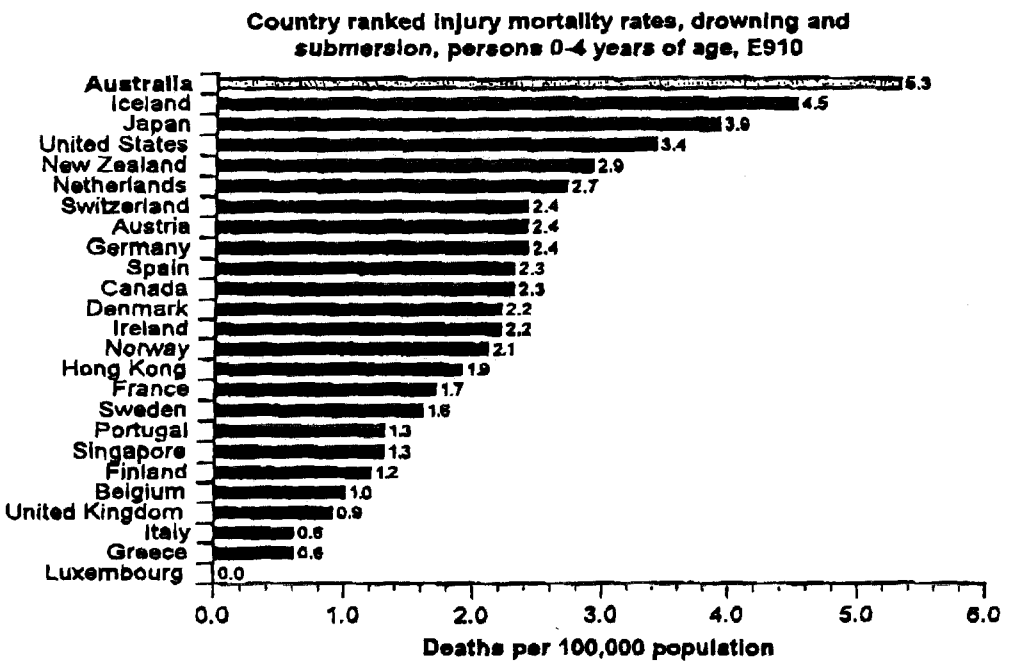
FIGURE 1
Drowning rates (E910) by country for most recent year available
Source: National Injury Surveillance Unit, 1995, a.





Data Source: World Health Statistics Annual 1993. WHO, Geneva 1994.

Part 1: Illustrated country ranks, 1992 or nearest available year

FIGURE 2

Supplemental drowning codes use in Australia based on codes originally developed in New South Wales, Australia.

Source: Personal communication, James Harrison, Adelaide Australia, August 1995.

NSW DROWNING CODES

Swimming, paddling or wading -
Swimming pool -
01 Private
02 Public
03 Other
04 Unspecified
05 **Surfbeach**
06 **Ocean, river, estuary, harbor, bay (i.e. tidal influenced body of water)**
07 **Lake, lagoon, dam, water-hole (i.e. non-tidal bodies of water)**
08 **Irrigation canal, drain, trench**
09 **Other**
10 **Unspecified**

11 **Surfboard riding**
12 **Waterskiing**

Swept off rocks, breakwater -
13 Fishing
14 Other
15 Unspecified

Skin-diving, spear-fishing -
16 Using underwater breathing equipment
17 Other
18 Unspecified

Attempting a rescue -
19 Surf beach
20 Public swimming pool
21 Other
22 Unspecified

Fell or wandered into -
Swimming pool -
23 Private
24 Public
25 Other
26 Unspecified

Fell or Wandered into -
Ocean, river, estuary, harbor, bay (tidal)
27 Fishing
28 Other
29 Unspecified
30 **Lake, lagoon, dam, water-hole (non-tidal)**
31 **Irrigation, canal, drain, trench**
32 **Object containing water or other liquid**
33 **Other**
34 **Unspecified**

35 **Fell from bridge, wharf or other structure**
36 **Drowned in bathtub**

Accident to watercraft causing submersion
Motorized craft -
37 River
38 Estuary, harbor, bay (tidal)
39 Lake, lagoon, dam, water-hole (non-tidal)
40 Ocean
41 Unspecified
Non-motorized craft -
42 River
43 Estuary, harbor, bay (tidal)
44 Lake, lagoon, dam (non-tidal)
45 Ocean
46 Unspecified
Unspecified craft -
47 River
48 Estuary, harbor, bay (tidal)
49 Lake, lagoon, dam (non-tidal)
50 Ocean
51 Unspecified

52 **Other accidental submersion in water transport-**
53 **Drowning caused by cataclysm or other environmental factors**
88 **Incidental drowning**
99 **Other unspecified circumstances**

FIGURE 3
Unintentional drowning rates among adolescents by age group, U.S., 1979-91.
Source: Smith, Brenner 1995.

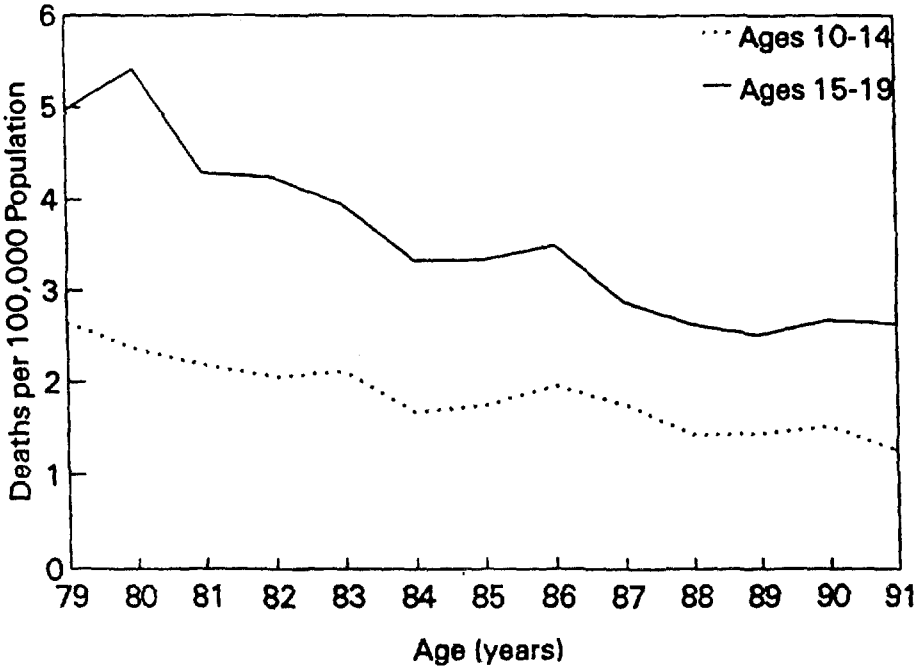
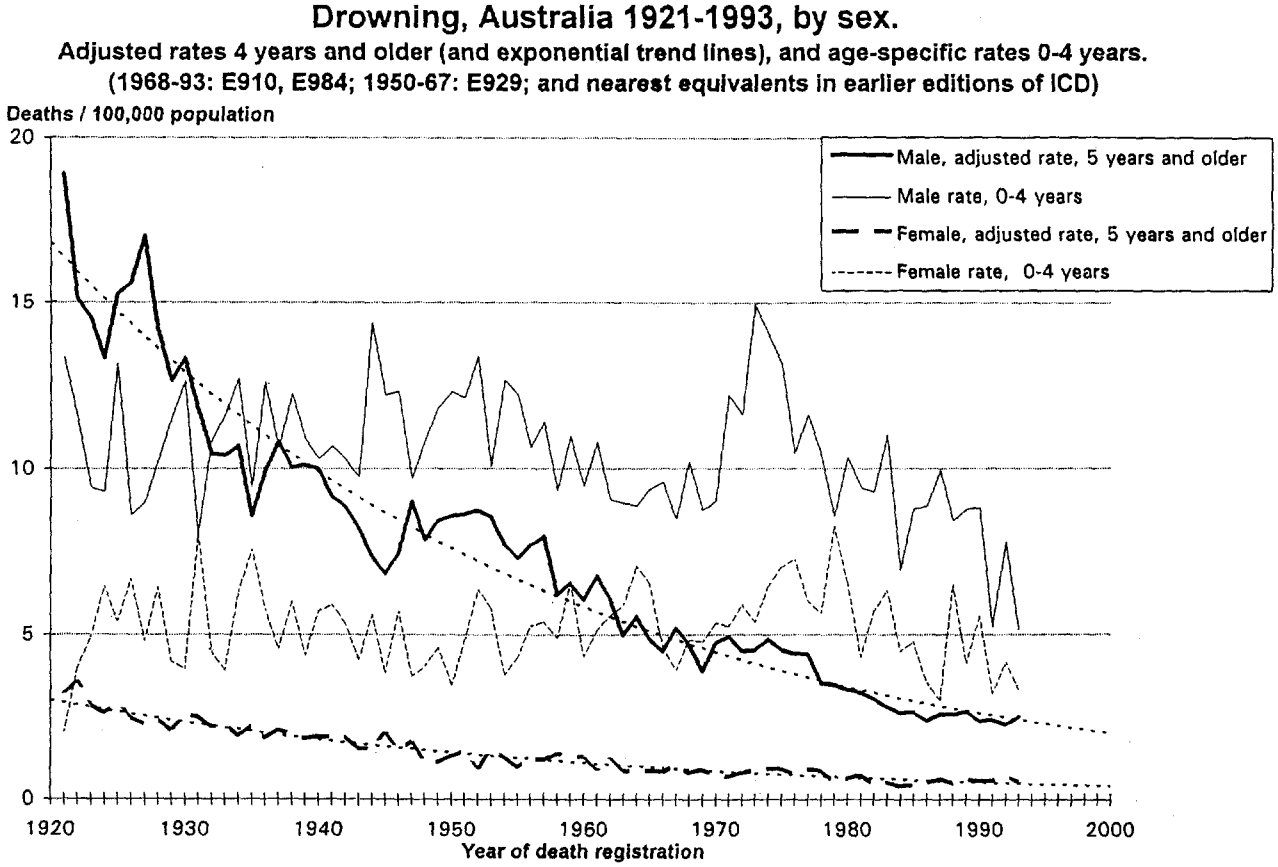


FIGURE 4
Drowning rates in Australia by sex and age group, 1921-1993.
Source: National Injury Surveillance Unit, 1995, b.



Source: AIHW National Injury Surveillance Unit, based on ABS unit record deaths data, and aggregate tables before 1964. .
Rates are based on interim ABS population estimates for 1992 and 1993; final estimates were used for earlier years.
Sept. 1995

TABLE 1
Drowning Deaths (E910 only) by country & year.
1993 World Health Statistics Annual

		Number of Deaths			Rate/100,000	
Country	Year	Male	Female	Total	Male	Female
Denmark	1992	25	6	31	1.0	0.2
Finland	1992	139	30	169	5.7	1.2
France	1991	499	158	657	1.8	0.5
Israel	1990	35	12	47	1.5	0.5
Norway	1991	71	13	84	3.4	0.6
Netherlands	1991	65	18	83	0.9	0.2
Sweden	1990	96	25	111	2.3	0.3
UK (total)	1992	237	75	312	0.8	0.3
*Scotland	1992	30	5	35	1.2	0.2
*N. Ireland	1992	14	4	18	1.8	0.5
*England/Wales	1992	193	66	259	0.8	0.3
Australia	1990	216	65	281	2.5	0.8
Japan	1992	2,007	1,262	3,269	3.3	2.0
New Zealand	1990	55	19	74	3.3	1.1
Canada	1991	300	90	390	2.2	0.7
USA	1990	3,203	776	3,979	2.6	0.6

TABLE 2
Drowning Rates Per Million Population for selected countries

E Codes	New Zealand	Australia	England/Wales	USA
Boating E830, 832	11.6	3.1	1.4	2.6
Accident E910	22.8	15.2	8.0	13.8
Suicide E954	5.9	3.8	2.3	1.6
Homicide E964	0.2	0.4	0.1	0.3
Undetermined E984	1.9	0.7	7.7	1.0
TOTAL	42.5	23.2	19.5	19.3

TABLE 3
Distribution of Drowning Deaths by Intent for Participating Countries (%)

E Code	New Zealand	Australia	England/ Wales	USA	Denmark	Netherlands	Sweden	Fran
Boating E830, 832	27	13	7	14	12	4	13	0.8
Accident E910	54	66	41	72	21	33	32	25
Suicide E954	13	16	12	8	54	56	31	41
Homicide E964	0.4	2	0.5	2	--	0.7	0.3	0.2
Undet. E984	5	3	39	5	13	7	24	33
TOTAL	100	100	100	100	100	100	100	10
Av No /Yr	144	454	483	6,300	191	297	354	2,30
Rate/Mill.	42.5	23.2	19.5	19.3	37.1	19.8	41.2	40.

TABLE 4
Drowning Rates Per Million Population by Country, Including "Hidden" Drownings

E Codes	New Zealand	Australia	England/Wales	USA
Boating E830, 832	11.6	3.1	1.4	2.6
Accident E910	22.8	15.2	8.0	13.8
Suicide E954	5.9	3.8	2.3	1.6
Homicide E964	0.2	0.4	0.1	0.3
Undetermined E984	1.9	0.7	7.7	1.0
ALL ICD	42.5	23.2	19.5	19.3
Hidden*	**7.5**	**1.7**	**1.3**	**
NEW TOTAL	50.0	24.9	20.8	**

* Hidden = additional drownings picked up by other means (see text)
** Data not available at this time

TABLE 5
Distribution of Drowning Deaths by Intent Category
(% of Total for selected Countries)

E Code	New Zealand	Australia	England/Wales	USA
Boating E830, 832	23.3	12.4	6.7	13.5
Accident E910	45.7	61.0	38.5	71.5
Suicide E954	11.8	15.3	11.1	8.3
Homicide E964	0.4	1.6	0.5	1.6
Undetermined E985	3.8	2.8	37.0	5.2
ALL ICD	85.0	93.2	93.8	100.0
Hidden*	**15.0**	**6.8**	**6.3**	***
NEW TOTAL	100.0	100.0	100.0**	***

* Hidden = additional drownings picked up by other means (see text)
** Does not add due to rounding error
*** Data not available at this time

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