Drowning in Finland: “external cause” and “injury” codes

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 METHODS
Statistics Finland tabulates drowning with both I and E codes.¹ ² Statistics Finland mortality files are based on certificates of cause of death issued by a physician, who for most unnatural deaths is the forensic pathologist performing the medicolegal autopsy. The proportion of drowning cases for which a medicolegal autopsy was performed during the study period was 92.5%. This figure showed a constant upward time trend, rising to 98.2% during the last decade.

 All drowning cases tabulated by Statistics Finland, 1969–2000. More detailed information was available for unnatural deaths (n=22,148, 14.2/100 000/year) occurring in the whole country, 1969–2000. Of 13 705 drowning deaths, 644 (4.7%) were not identified with the E codes for drowning. The great majority (n=547, 84.9%) of these cases were traffic accidents resulting in drowning. No significant time trends were found even after the introduction, in 1996, of the ICD 10th revision. Significant time trends were calculated using the Poisson regression model.

 Methods: Mortality files of Statistics Finland were searched electronically using the injury codes (I codes) and E codes for drowning. Cross analysis of I and E coded drownings was performed to determine the rate and pattern of drowning cases classified with E codes other than for drowning. Time trends were calculated using the Poisson regression model.

 Results: Of 13 705 drowning deaths, 644 (4.7%) were not identified with the E codes for drowning. The great majority (n=547, 84.9%) of these cases were traffic accidents resulting in drowning. No significant time trends were found even after the introduction, in 1996, of the ICD 10th revision.

 TABLE 1 ICD (8th, 9th, and 10th revisions) external injury codes (E code) and injury codes (I code) for drowning during the period 1969–2000

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidental drowning</td>
<td>994.1</td>
<td>E910</td>
</tr>
<tr>
<td>Boating related drowning</td>
<td>E830, 832</td>
<td>V90, V92</td>
</tr>
<tr>
<td>Suicide by drowning</td>
<td>E954</td>
<td>X71</td>
</tr>
<tr>
<td>Homicide by drowning</td>
<td>E964</td>
<td>X92</td>
</tr>
<tr>
<td>Undetermined drowning</td>
<td>E984</td>
<td>Y21</td>
</tr>
</tbody>
</table>

*Finland used a modified version of the ICD-9 during the period 1987–95

 RESULTS
In Finland, during the period 1969 to 2000, of 131 722 unnatural deaths (84.2/100 000/year, M:F rate ratio 2.7) 13 705 were drownings (10.4%; 8.8/100 000/year; M:F rate ratio 4.2) recorded with the I codes for drowning. Among these, 9710 (70.9%) were accidental drownings, 2807 (20.5%) suicides, 73 (0.5%) homicides, and 1115 (8.1%) deaths of undetermined intent (table 2).

 Conversely, the search for drowning with the E code alone revealed only 13 061 drowning cases, that is, 644 (4.7%) fewer than those found with the I codes (table 2). These 644 drownings were recorded with E codes other than for drowning.

 Accidental drowning
Of 9710 accidental drownings, 9081 (93.5%) were classified with an E code for drowning. The remaining 629 cases (6.5%) had E codes other than for drowning, mostly for traffic accidents (table 3).

 Transport accident related drownings* (n=547, 0.3/100 000/year, M:F 9.3) represented 5.6% of all accidental drownings (n=9710, 6.2/100 000/year) and 2.5% of all transport accidents (n=22,148, 14.2/100 000/year) occurring in the whole country, 1969–2000. More detailed information was available

Abbreviations: CI, confidence interval; E codes, external codes; I codes, injury codes; ICD, International Classification of Diseases
The overall accidental drowning rate decreased significantly during the 32 year study period (2.74%/year, 95% confidence interval (CI) −2.95 to −2.53, p < 0.001, Poisson regression method). The accidental drowning coded with E codes other than for drowning (−1.22%/year, 95% CI −2.06 to −0.37, p = 0.005) also decreased significantly. However, the decrease in accidental drowning coded with E codes other than for drowning was less pronounced (p < 0.001, Cochrane-Armitage trend test).

Using the ICD 8th revision (1969–86) the proportion of drowning classified with an E code other than for drowning was 5.6% (346/6152) of all drownings. This frequency grew during the Finnish classification (1987–95) and also after the introduction of the ICD 10th revision (1996–2000), respectively, to 7.7% (186/2401) and 8.3% (96/1156) of all cases (table 2).

The overall rates of transport accident decreased significantly (−1.42%/year, 95% CI −2.35 to −0.48, p = 0.003), but the decrease in transport accident related drownings was less pronounced (p < 0.001; Cochrane-Armitage trend test).

### Table 2  I and E coded drowning, by manner of death, during the period 1969–2000

<table>
<thead>
<tr>
<th>Manner of death</th>
<th>I codes</th>
<th>E codes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>No/100000 year</td>
</tr>
<tr>
<td>Accident</td>
<td>9710</td>
<td>6.2</td>
</tr>
<tr>
<td>Suicide</td>
<td>2807</td>
<td>1.8</td>
</tr>
<tr>
<td>Homicide</td>
<td>73</td>
<td>0.05</td>
</tr>
<tr>
<td>Undetermined</td>
<td>1115</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>13705</td>
<td>8.8</td>
</tr>
</tbody>
</table>

### Table 3  E coded accidental drowning (n=9710), by external cause of death, in Finland (1969–2000)

<table>
<thead>
<tr>
<th>Cause</th>
<th>No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drowning</td>
<td>9081 (93.5)</td>
</tr>
<tr>
<td>Transport accident</td>
<td>547 (5.6)</td>
</tr>
<tr>
<td>Water traffic</td>
<td>23 (0.2)</td>
</tr>
<tr>
<td>Late effects</td>
<td>21 (0.2)</td>
</tr>
<tr>
<td>Cataclysm</td>
<td>8 (0.1)</td>
</tr>
<tr>
<td>Aircraft accident</td>
<td>8 (0.1)</td>
</tr>
<tr>
<td>Other</td>
<td>22 (0.3)</td>
</tr>
</tbody>
</table>

*The reported figures include all fatal transport accidents with the exclusion of air traffic, railways, and water transport fatal accidents.

### Table 4  Accidental drowning with E code other than for drowning in Finland (1969–2000), by classification mode

<table>
<thead>
<tr>
<th>Classification</th>
<th>ICD-8</th>
<th>ICD-9</th>
<th>ICD-10</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport accident</td>
<td>298</td>
<td>168</td>
<td>81</td>
<td>547</td>
</tr>
<tr>
<td>Water traffic</td>
<td>2</td>
<td>13</td>
<td>8</td>
<td>23</td>
</tr>
<tr>
<td>Late effect</td>
<td>20</td>
<td>–</td>
<td>1</td>
<td>21</td>
</tr>
<tr>
<td>Cataclysm</td>
<td>7</td>
<td>–</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Aircraft accident</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
<td>4</td>
<td>4</td>
<td>22</td>
</tr>
<tr>
<td>All†</td>
<td>346</td>
<td>187</td>
<td>96</td>
<td>629</td>
</tr>
</tbody>
</table>

*ICD 8th, 9th, and 10th revisions.
†The number in parenthesis indicates the percentage of all drowning.

**Other unnatural causes of drowning**

Among 2807 suicides by drowning, only 10 (0.4%) had an E code other than for drowning (six asphyxia, three late effect of injury, and one poisoning), while among 1115 drownings of undetermined intent, five (0.4%) were those with E codes other than for drowning (one motor traffic accident, one late effect of accident, three other). Conversely, all 73 homicides by drowning were coded with the E codes specific for drowning (table 2).

**DISCUSSION**

Drowning is a multifactorial event that cannot be always described by a single external cause of death. For this reason, there are well defined exclusion rules that give precedence not to drowning but to the initiating event, that is, the cause that determines the victim’s fall into water.† The ICD 10th revision gives precedence to transportation and flood over drowning.‡

In other cases, for example, accidental fall or suicide by jumping from a high place, no precise coding rules exist, and the certifying doctor has wider discretion in selecting codes. Coding the underlying cause of death on the basis of the initiating event leading to death has a rationale for prevention but can hamper the determination of the real cause of death. In countries where statistical data are tabulated only with E code, there will be situations, for example, traffic accidents, in which—although there are no significant lesions caused by the car accident itself—there is no way possible to determine whether death occurred as a result of drowning. These cases will be missing from national statistics and the overall drowning rate underestimated.§

Previous studies have shown that reliance solely on E codes results in many drownings remaining unidentified. In Canada, a cross analysis of E and I codes revealed that 15% of all 1987 drownings (n=952) were missed by using the E codes alone.¶ Over a 15 year period in New Zealand (1977–92), a death certificate narrative search including the word “drowning” revealed 17.7% more drownings than those (n=2310) recorded by E codes.‖ In Australia, from 1992–97, a “flag system” for drowning allowed the identification of 5.4% more cases than those (n=2673) identified by the E codes.¶ In Finland, the proportion of missing drownings by use of only the E code (4.7%) is thus of the same magnitude as in the Australian study, but much lower than in Canada and New Zealand.

Most of the missed cases are transport accident related drownings. In Australia the proportion of transportation related drowning has been estimated to be 4.7%,¶ in Canada 7%,‖ and in New Zealand 11%.¶ In Finland, the proportion (5.6%) of transport related accidents was again similar to Australia’s, but lower than in Canada and New Zealand. In other studies, the frequency of drowning coded as accidental...
fall or suicide by jumping from a high place is relatively high.

For instance, in the New Zealand study, 7% of suicides leading
to drowning were classified as suicide by jumping from a high
place.4 Finland had no drowning cases classified under falls or
jumping from a high place, due to the fact that deaths in water
caused, for instance, by falling or jumping from a bridge, are
generally classified as drowning when the autopsy shows
signs of drowning without severe injuries. During the study
period, drownings tabulated with an E code other than for
drowning and transport accident related drownings declined
significantly, but less markedly than overall drowning cases,
giving a relative increase in their proportion also after the
introduction of the ICD 10th revision.1

The accuracy of vital statistics can be improved in various
ways.4 5 In Finland, where drowning rates are significantly
higher than in the European Union and Nordic countries’
average,5 Statistic Finland reports drowning—as does
Canada—with both I and E codes.5 6 The utilization of multi-
ple E codes is not allowed, but a I code is added beside the
selected E code. Therefore the cross analysis of the I and N
codes allows the identification of those cases in which drown-
ing is the injury causing death, but the E code indicates a dif-
ferent event. In conclusion, the utilization of both the I and E
codes increase accuracy in epidemiological studies on drown-
ing and offer better compatibility for cross country compari-
son. The utilization of free narrative and flag systems can also
improve the identification of drowning deaths. We believe,
however, that accurate drowning estimates can be obtained
only when police investigation and autopsy rates are high,
since a number of deaths in water can be determined by a
wide range of natural (for example, epilepsy) or unnatural
causes other than drowning. In the cases of death in water
caused by a natural disease actual coding rules appear
inadequate. In Finland, the underestimation of overall drown-
ing rates due to the use of the E axis alone is less pronounced
than in some other countries where similar studies have been
performed. The relatively high number of transport accidents
leading to submersion and the association of such accidents
with alcohol represent, however, selective targets for preven-
tive actions.

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REFERENCES
1 World Health Organization. International classification of diseases and
2 Longley JD, Chalmers DJ. Coding the circumstances of injury: ICD-10 a
3 Bracker A. Drowning deaths: a cross-analysis of external and nature of
4 Smith G, Langley J. Drowning surveillance: how well do E codes identify
5 Lääkintöhallitus. Tautiluokitus, 1987. Valtion painatuskeskus, Helsinki,
1986.
6 Stokes. Finnish version of the international classification of diseases and
7 World Health Organization. International classification of diseases. 8th
1999;171:587–90.
9 Lunetta P, Penttilä A, Sanna S. Water traffic accidents, drowning and