Background
Standard WHO data for drowning are available for many countries worldwide but furnish no reliable figures on
the global burden of drowning because most developing countries collect no or inadequate data on water-related
mortality. WHO-reported unintentional drowning rates vary widely between countries, but international comparisons
are generally possible only for non-boating drowning based on narrowly defined WHO data. Standard WHO data
include neither drowning from natural calamities nor boating-related drowning, nor land-transport drowning.
Moreover, WHO statistics do not account for unintentional drowning concealed under the category of ‘undetermined’
drowning, i.e. unintentional or purposely inflicted. Studies on drowning classified as undetermined are exceedingly
rare, with cross-country comparisons limited to few countries.

Aims
The main aims of this study are to assess: a) cross-country differences in undetermined drowning deaths, b) reasons
for discrepancy in undetermined drowning rates among countries.

Material and Methods
The latest available ICD-10 data on unintentional non-boating drowning deaths (codes W65–W74), boating-related
drowning (V90, V92), and undetermined (Y21) drowning for each country were extracted from the WHO mortality
database. Crude drowning rates were calculated using the last WHO estimate population and the proportion of
undetermined drowning was calculated by country.

Results
As of August 2010, of the 193 member countries, 100 (51.8%) submitted mortality data to the WHO using ICD-10
codes for drowning. All 100 have data on non-boating unintentional drowning, boating-related and undetermined
drowning. Only countries (n=72) with more than 20 unintentional drowning cases were considered in this study.

We found a large discrepancy between countries regarding percentage of all drowning classified as undetermined,
in 29 countries less than 5%, in 15, 10–24%, in 8, 25–50%, and in the remaining 3 >50%. In Asia, undetermined
drowning ranged from <1% in Thailand to 37.4% in Korea, in Africa from 29.2% in Egypt to 86.9% in South Africa,
in Europe from <1% in Italy to 44.7% in the UK, in North America from 6% in the USA to 14.4% in Canada, and in
South America from <1% in Chile to 20.9% in Argentina. Undetermined drowning rates across countries vary, based
on levels of evidence (beyond reasonable doubt, balance of probabilities) required by judicial systems to assess the
intent, whether intent is determined by medical staff or legal professionals, on inadequate transfer of data to statistic
offices, low frequency of medico-legal investigations, and on inter-examiner differences. Despite accurate scene
investigations, collection of extensive information about the victim, and comprehensive medico-legal autopsies,
intent may remain undetermined due to factors inherent in single drowning cases, such as lack of reliable witnessing
and difficulty in linking victim’s background to the actual drowning.

Conclusions
The WHO undetermined-drowning category accounts for significant artifact differences in unintentional drowning
rates between countries, leaving unintentional drowning rates underestimated without considering undetermined
drowning. To minimize this discrepancy, physicians must better report information useful for codification, causes and
manner of death should be systematically transmitted to statistic offices after medico-legal investigation; differences
between intent needed for judicial purpose and probable intent should be clear on death certificates. Specific
training for certifiers and coders should focus on standardizing the approach to borderline cases, when circumstances
and individual background allow no unequivocal determination of the intent.

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