Lifeboats

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Estimating the global economic cost of drowning

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Contractor: Frontier Economics
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This research sought to quantify the economic cost of drowning for all countries, with the aim of highlighting the wider burden to society of a so-called hidden epidemic. Drowning mortality figures and approximated values of a statistical life for each country were analysed in order to arrive at a global figure. This is the first piece of research into the economic burden of drowning conducted by the RNLI and the first that we are aware of in global literature. As such, the results of the work should be seen as preliminary estimates, which could be improved through further study and analysis.

Summary

The World Health Organization (WHO) estimate that, worldwide, 372,000 people drown each year. Drowning is among the 10 leading causes of death for children and young people in every region of the world. An epidemic on this scale presents a strong moral case for intervention. There is also an economic impact caused by the loss of lives due to drowning. Estimates of economic costs, quantified in a common currency, can help policymakers to compare a single issue to other public health concerns and appraise the options for intervening.

While some studies have sought to determine the economic burden of drowning in specific countries, little has been done to provide a comparative analysis of the cost of drowning internationally. Pioneering work in the field of road traffic accidents by the International Road Assessment Programme (iRAP) has provided a paradigm for approximating the economic cost of fatalities.

This research seeks to build on the iRAP study and explores the application of this approach to the issue of drowning.

Estimates of the economic cost of a death, commonly referred to as the value of a statistical life (VSL), are only available for a handful of countries. In line with the iRAP study mentioned above, this research used evidence from countries where both values of a statistical life (VSL) and gross domestic product (GDP) are known, in order to calculate a ratio of VSL to GDP per capita. In doing so, we create a rule of thumb that can then be applied to countries where only GDP is known.

The annual global cost of drowning mortality is estimated to be I$146.9B[1]. The research also found that many low-income countries have a disproportionately high cost of drowning, equivalent to over 0.8% of gross national income (GNI).


Photo: RNLI/Nathan Williams


Photo: RNLI/Mike Lavis

[1]An international dollar (I$) is a hypothetical unit of currency that, in the cited country, would buy a comparable amount of goods and services that a US dollar would buy in the United States. This allows for comparison between prices and times.

Value of a statistical life (VSL)

In its simplest terms, the value of a statistical life (VSL) is a hypothetical monetary cost to society of a life lost. The VSL also tells us about the benefits to society of safety measures, beyond the number of lives they save. The VSL is, therefore, potentially a useful economic tool for making tough policy decisions regarding how to reduce the risk of death or injury to the public.

As an example, the economic cost of global injury has recently been estimated to be between $758B and $786B per year, an estimate that relied heavily on VSL. The resulting analysis was used to highlight the benefits of improved prevention and better trauma care worldwide[2].

There are two principal ways for determining VSL within a particular country or region. Firstly, by carrying out a willingness-to-pay analysis, which aims to estimate the amount of money that people would be willing to spend to reduce their risk by a measurable amount. Economists adopt a number of different approaches to estimating this value. Some studies have directly surveyed members of the public, while others have used data about implicit decisions or trade-offs (such as the amount individuals would pay to move out of a city with poor air quality).

The second method is the human capital approach, which equates the VSL to the economic output of an average lifetime, as well as considering the direct costs of death, such as hospitalisation and medical treatment.

The following sections explain how the study treated estimates derived from these two different methods. The accompanying technical annex also provides further detail on VSL and its application to this study.

VSL is not the same as how much we value the life of individuals – the concept is designed to aid policy and spending decisions rather than to make moral judgements.

Given its wide use by governments and multinational organisations such as the World Bank, World Health Organization, United Nations Environment Programme[3] and the Department for Transport in the UK, the VSL was considered suitable to be applied to drowning.

Research aim and objectives

The project aim was to assign a monetary cost to drowning mortality by determining an appropriate VSL for each country and applying this to estimates of drowning mortality.

The specific objectives of this research project were to:

- assess the appropriateness and applicability of VSL for developing a model to estimate the economic cost of drowning
- determine the most practical approach for modelling the economic cost of drowning
- develop a statistical model for estimating the cost of drowning across countries, regions and globally
- provide the RNLI with estimates of the cost of drowning and provide guidance on the use of these findings.

[2]Kotagal M, Agarwal-Harding KJ, Mock C, Quansah R, Arreola-Risa C and Meara JG, 2014. *Health and Economic Benefits of Improved Injury Prevention and Trauma Care Worldwide*, PLoS ONE Vol 9 No 3
[3]Viscusi, W and Aldy, Joseph E, 2003. *The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World*, Journal of Risk and Uncertainty, Springer, Vol 27 No 1, pages 5–76

Method and approach

The research was undertaken by Frontier Economics between January 2015 and May 2015. The researchers gathered VSL estimates from existing literature. The study team used 22 VSL estimates identified by an earlier iRAP (2011) study and found a further 9 from additional literature.

In order to estimate the cost of drowning, it is necessary to develop estimated VSL values for every country. Literature has suggested that there is a positive relationship between the economic output of a country and the VSL – richer countries are prepared to pay more to avoid risk than poorer ones.

The statistical relationship between GDP per capita and VSL was examined in order to determine a rule of thumb for estimating the VSLs where no value was available from the academic literature.

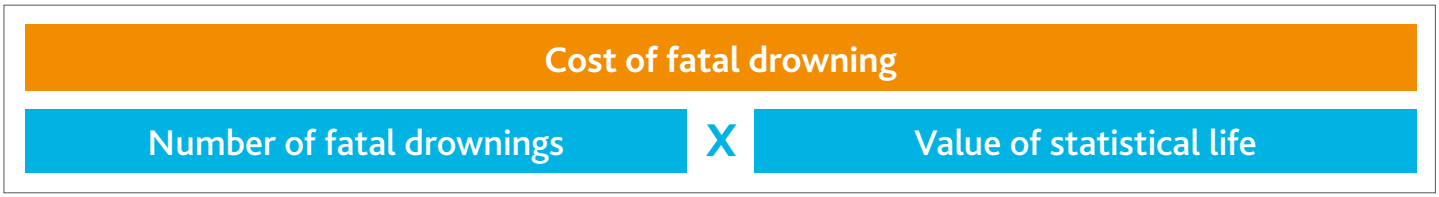
Drowning mortality data was gathered from the World Health Organization (WHO) *Global Report on Drowning* (2014), WHO Mortality Database and Global Burden of Disease data.

Drowning mortality data is subject to high levels of uncertainty, because many countries are unable to provide data on the number of people who die each year. Countries that can provide information to the WHO from their vital registration system typically have the most robust data, but are in the minority globally. Where vital registration data is not available, both the WHO Mortality Database and Global Burden of Disease data provide estimates based on actual data from nearby or similar countries.

Using different datasets for the study presented a number of issues for the project team. Data on GDP per capita and VSL from the literature needed to be expressed in the same unit for the same year, individually for each country. For both datasets, this required some adjustments to the data collected. These adjustments are explained in the accompanying technical annex to the study.

Once this process was complete, the study team could begin the process of calculating the ratio of VSL to GDP per capita, in order to create a rule of thumb that could be applied to drowning deaths.

Figure 1: Estimating the cost of drowning



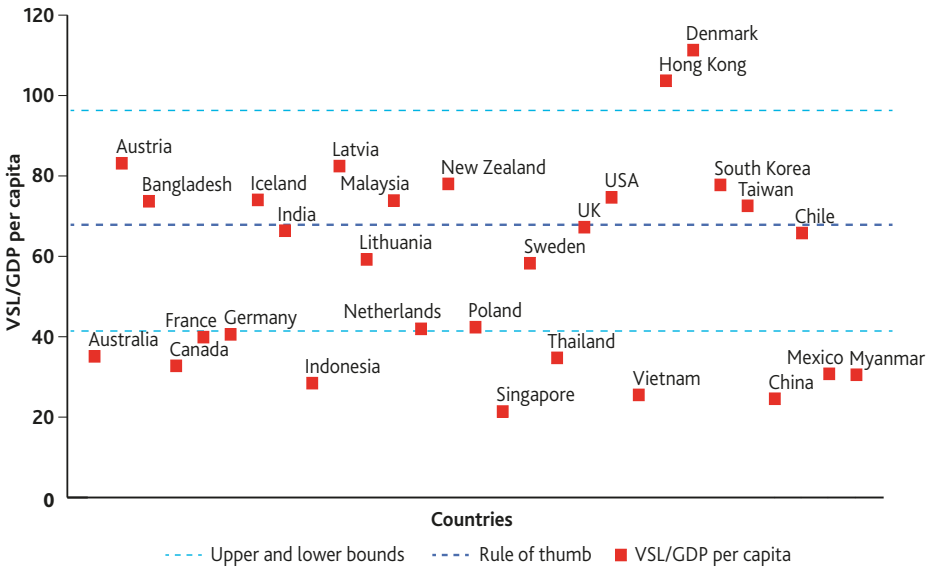
Key findings

The sample of 31 VSLs from the literature provides the basis for developing a rule of thumb. The analysis confirms the positive statistical relationship identified by iRAP that VSL is approximately 70 times greater than GDP per capita. This provides a basis for estimating VSL for countries based on their GDP per capita figure.

The analysis by the study team shows that there was significant variation in the ratio of VSL to GDP for different countries. This finding is consistent with previous research into this relationship and demonstrates the need to conduct sensitivity analysis of the finding, using the upper and lower bounds shown in figure 2.

Estimated VSLs were then price-adjusted to the latest year from which drowning mortality data was available.

Figure 2: Ratio of VSL to GDP per capita for different countries



A global estimate

Drowning fatality estimates were multiplied by the VSL to determine an estimated cost of drowning mortality on a country-by-country basis. This process used the output from the rule-of-thumb approach, as shown in figure 3.

Data for drowning mortality estimates were available for 188 out of 193 UN member states.

These estimates were then presented with caveats surrounding the confidence of the data used to determine them. There is a large degree of uncertainty surrounding drowning mortality estimates from countries where vital registration systems are weak. Many of these countries were also the subject of VSL estimates from the rule of thumb.

As the quality of each data source varied so widely, the study team created four tiers and categorised the countries in the sample from Tier 1 to 4 (with Tier 1 being the most robust). This categorisation is shown in figure 4.

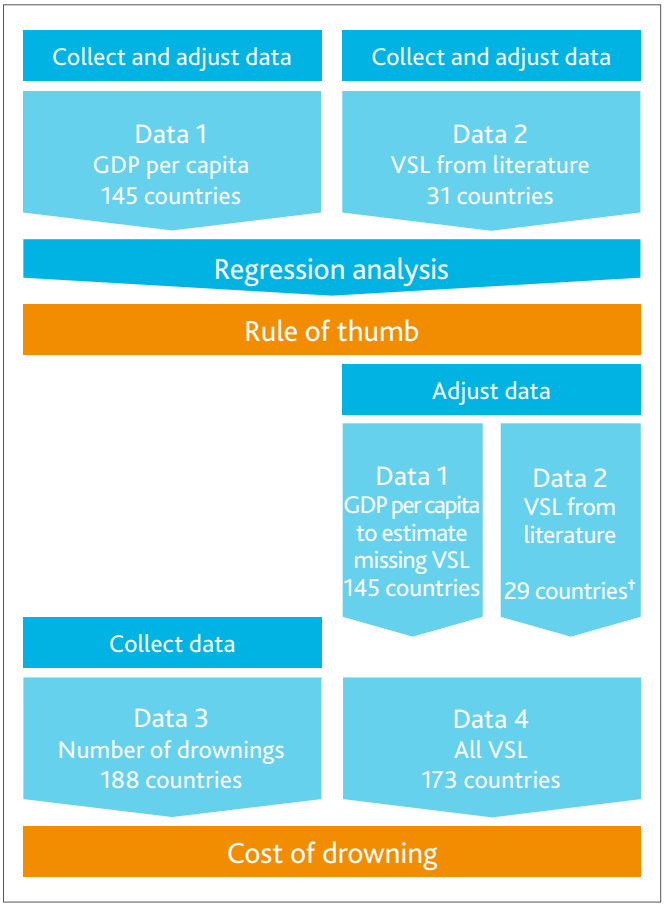
The most robust estimates are for countries with a VSL from the literature (rather than the rule of thumb) and for those with data on drowning from the WHO, rather than the Global Burden of Disease data.

Further, it is important to note that roughly 80% of fatal drownings fall within the lower confidence tiers (3 and 4), owing to a lack of robust vital registration systems to report drowning.

Notwithstanding these limitations, the estimated aggregate cost of drowning for these 173 countries was I$146.9B – equivalent to the economic output of New Zealand.

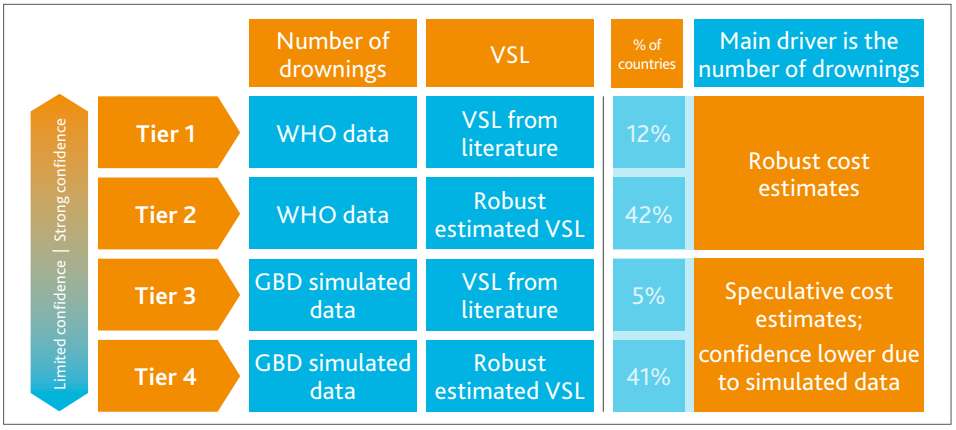
Despite the vast majority of deaths due to drowning occurring in low and middle income countries, the economic burden was split relatively evenly between these nations and the group of high income countries in the sample. This finding is driven by the substantially higher GDP, and therefore VSL, figures for high-income countries.

Figure 3: Data used to calculate the cost of drowning



†Japan and Switzerland were removed from the VSL dataset, owing to their estimates being considered outliers.

Figure 4: Data quality tiers for the 173 countries in the study



GBD = Global Burden of Disease

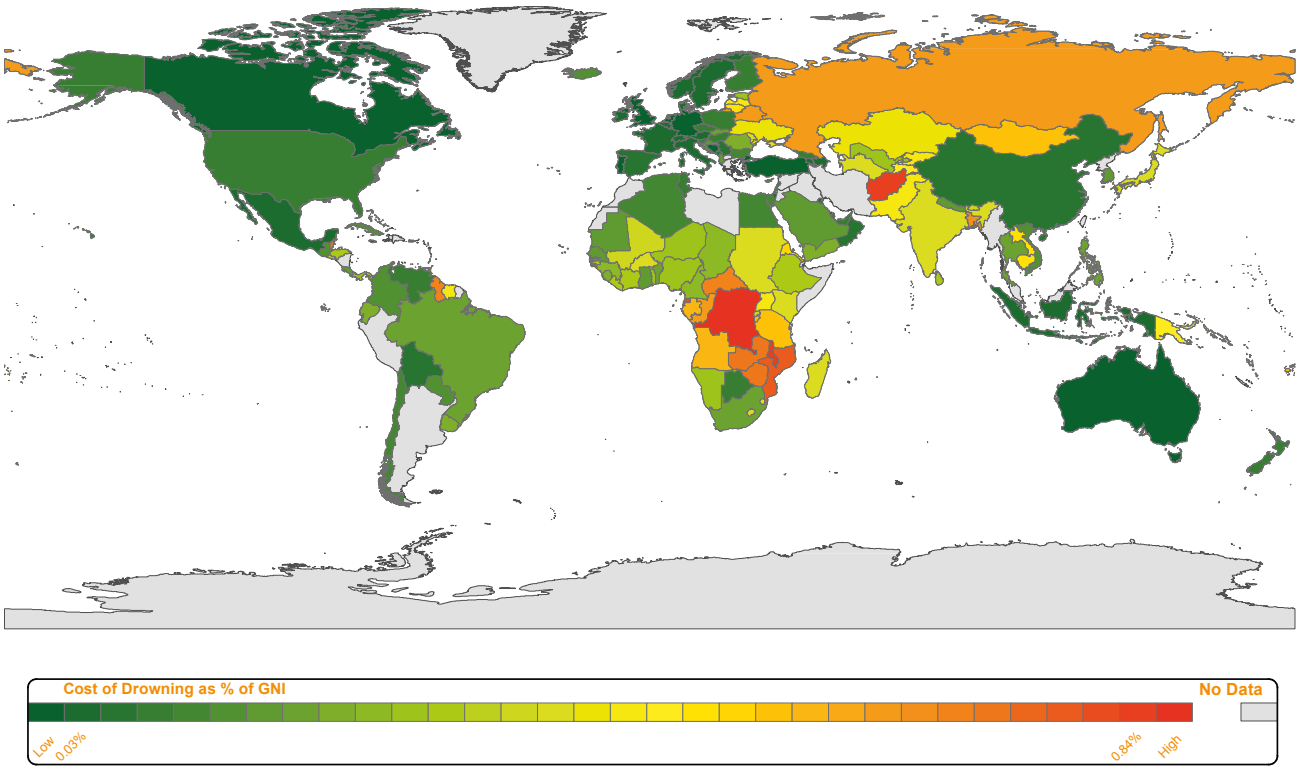
Costs for individual countries

Unsurprisingly, countries with large populations and industrialised economies such as India, China and the United States bear the largest costs, primarily due to their relatively large populations and as a by-product of high GDP and high VSL.

In order to show where drowning has a disproportionately high cost, the cost of drowning mortality is expressed as a percentage of gross national income (GNI). In doing so, we see particularly high costs in many countries from central and southern Africa and south Asia (figure 5).

These results provide a conservative initial estimate that supports the hypothesis that the epidemic scale of global drowning creates tangible costs. Accepting that the global health impact of drowning is significant, and that good health and a long life are valued by society, the benefits to preventing drowning are potentially large.

Figure 5: Estimated cost of drowning as a % of GNI (2014)



Limitations and sensitivity analysis

The findings in this summary are thought by the study team to be underestimates of the global cost of drowning, for the following reasons:

- Drowning is under-recorded in many countries[4].
- This analysis only considered deaths from drowning; there are also many more serious injuries each year.
- Mortality data classifications of external causes of injury other than 'unintentional drowning' were excluded. Codes relating to water transport, victims of flooding and intentional harm may have relevance and their inclusion would increase our estimates.
- All of the technical assumptions are deliberately conservative (see technical annex for more detail).
- Value of a statistical life cannot fully capture the social and psychological costs associated with drowning.
- In many countries, drowning disproportionately affects children, for whom the value of life lost may arguably be higher. Our analysis did not attempt to adjust VSL estimates to account for the profile of drowning deaths.

The team conducted detailed sensitivity analysis on some of the assumptions and in relation to some of the findings from the initiation stages of the work (such as the rule of thumb). The full sensitivity analysis is reported in the technical annex to the project, which is published alongside this summary.

Finally, these results provide us with a global estimate. However, there is great scope to improve the understanding of the cost of drowning. Further research to reduce the uncertainties surrounding the data and country-level primary research may provide greater detail about how drowning impacts society.

The RNLI welcomes dialogue with parties interested in further research into the cost of drowning, particularly efforts to deriving estimates for better data sources for specific countries, or conducting further analysis to tailor the rule-of-thumb approach for drowning.

[4]Linnan, Michael, et al, 2012. *Child Drowning: Evidence for a Newly Recognized Cause of Child Mortality in Low and Middle Income Countries in Asia*, Working Paper 2012–07, Special Series on Child Injury No 2. Florence: UNICEF Office of Research

How the RNLI is using the evidence

The evidence collected may be beneficial as we seek to raise awareness of the issue of drowning and advocate for action to prevent it.

The costs estimated here can be used by advocates for drowning prevention to highlight the financial costs incurred due to drowning. The full analysis could also prove useful for analysts and policy makers who need to assess the costs and benefits of proposed drowning reduction programmes.

If you are interested in finding out more about the study, please contact Dan Ryan, International Research Manager for the RNLI, at Dan_Ryan@rnli.org.uk.

Further reading

Dahdah S and MacMahon, K . *The True Cost of Road Crashes: Valuing Life and the Cost of a Serious Injury*, International Road Assessment Programme, March, 2008.

WHO. *Global Report on Drowning: Preventing a Leading Killer* World Health Organization, Geneva, November, 2014

Acknowledgements

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Photo: RNLI/Nigel Millard


Photo: RNLI/Nathan Williams