

METHODOLOGY

COST ESTIMATES BASED ON ILO GLOBAL ESTIMATES ON THE BURDEN OF INJURIES AND ILLNESSES AT WORK AND DISABILITY ADJUSTED LIFE YEARS

Background

ILO has made “Global Estimates of Occupational Injuries and Diseases” for the last 20 years and the method and results have progressed with timeⁱ. These have been based on two distinct processes, one for occupational injuries (accidents) and the other on work-related diseases. The ILO’s statistics contain collected data from Member States for injuries. However, these are covering about 30 Member States only and these are mostly from the highly developed parts of the world. No data have been available for work-related diseases. The two distinctive processes have been explained by a number of reports and scientific peer reviewed papers elsewhereⁱⁱ.

Essentially injuries were estimated using several countries as “proxy” countries for each WHO Region to cover the missing dataⁱⁱⁱ. This was done by three major sectors: 1) agriculture including fishing and forestry, 2) industry including the construction sector and 3) services^{iv}. Starting point was to obtain fatal accident rates through ILO statistical reports from these representative proxy countries for the above mentioned three economic sectors, and for each WHO Region. These proxy countries are those that reported reliably and systematically their injury outcomes. The fatal numbers and rates were the primary source for a region/country estimate by the sectors and the country or region as whole. Secondary estimates were made for non-fatal injuries based on the relatively stable rate between fatal and non-fatal injuries.

Fatal work-related diseases were estimated using latest WHO mortality data by WHO regions and by diseases and for each major disease group. A set of attributable fractions^v – a percentage – of fatal diseases that are attributed to work were adjusted from available scientific sources and used for each major disease group and relevant age groups^{vi}.

Based on the initiative of the European Agency for Safety and Health at Work a number of expert meetings were held in order to better estimate the economic costs of not or poorly taking care of safety and health at work. As a result this method was designed to establish relatively quickly but still reliably these economic costs estimates. The method was developed for the European Union and based on ILO interest globally. Data shortages in most countries in the world limit seriously such efforts so the ILO Global Estimates – based on WHO data on diseases – are the only reasonable alternative for comparable outcomes. The best data sources, for example using those of EUROSTAT, produce more realistic and supposedly more accurate cost estimates but are available only for the EU. The ground work of the method development was done in collaboration with ICOH and the Workplace Safety and Health Institute, Ministry of Manpower, in Singapore and in collaboration with the Occupational Safety and Health Department of the Ministry of Social Affairs and Health in Finland providing the Global Estimates 2017 as a baseline. The detailed calculations were done by the Finnish Institute of Occupational Health in collaboration with ICOH and the WSH Institute. EU-OSHA and their contractor PwC have proposed a number of additional items to be covered and checked systematically and continuously the integrity of the draft estimates. A list of contributors is at the end of this paper.

The individual cost estimates for selected diseases/injuries covered occupational cancer, work-related circulatory diseases – cardiovascular and stroke -, musculoskeletal disorders, injuries and others.

Objective

The target was to identify the economic costs of poor or non-existing measures on safety and health in order to provide further incentives to reduce exposures and hazardous factors and conditions at work. This would contribute also to a more balanced public and private policies and on the urgency of measures to be taken. Ideally it would support in setting priorities in our quest for zero harm at work. The outcome was expected to be a percentage of Gross Domestic Product (GDP) and monetary values originating from neglected safety and health measure by region, country, and by selected injuries, illnesses or disorders at work. Additional factors may be further analysed, such as gender, age and economic sector differences as long as data could be identified.

The method, in principle, is based on best estimates of Disability Adjusted Life Years, DALYs obtained for each disease group and injuries. This is compared to the ideal case in the country or region where no DALYs would be lost: no fatal diseases or injuries, no absence from work from any non-fatal disease/injury. The share (percentage) of annual DALY's caused by occupational risks from the total number of work years carried out in the same year is then applied to the GDP – nominal gross domestic product - of the country/region in question.

Method

In principle, the method is based on the number of problems identified at work: injuries, illnesses, and disorders including fatal or no-fatal cases. This was implemented by calculating the deaths, Years of Life Lost (YLL), Years Lived with Disability (YLD) and their combination Disability Adjusted Life Years (DALY) based on primarily ILO numbers as adjusted by the Institute of Health Metrics and Evaluation (IHME) Global Burden of Disease and Injury (GBD) process outcomes^{vii}. While there are existing estimates updated annually by the GBD process, latest for the year 2015, these cover only a selected group of occupational risks. Therefore, the GBD 2015 outcomes would not be comparable to ILO Estimates and – if directly used – would end up in clear underestimates of the size of the problem. The differences between ILO and GBD2015 outcomes are reported elsewhere^{viii}.

All injuries and illnesses

Fatal cases: obtained directly from ILO Global Estimates and EU Eurostat data.

YLL's: obtained from the ILO death estimates by country and region multiplied by the average years of lives lost by one death from GBD2015 for that country or region, this was done separately for fatal injuries (much more years lost/death) and illnesses (less years lost/death) by each country and region;

YLD's: ILO estimates based on WHO mortality data do not have any data of non-fatal cases, ILO non-fatal injury reporting tends to be much less reliable than fatal number and rate reporting. We decided to use the only reasonable YLD source as a baseline: GBD2015. This takes already into account the severity of both injuries and illnesses and these are adjusted so that comparable YLD's can be used with YLL's. To compensate for the lower selected risks covered by GBD2015 an adjustment process was created to match the ILO estimates covering wider occupational risks:

$YLD_{GBD2015}$ was multiplied by the factor obtained by the ratio of $YLL_{ILO} / YLL_{GBD2015}$ as follows:
 $YLD_{GBD2015} * (YLL_{ILO2017} / YLL_{GBD2015})$. Both ILO fatal injury numbers and ILO fatal disease numbers were covering wider selection of occupational risks. Once there are more fatal cases we expect more non-fatal cases as well both for injuries and illnesses. This process was done for injuries and diseases separately:

$$\begin{aligned} & \text{YLD}_{\text{GBD2017injuries}} * (\text{YLL}_{\text{ILO2017injuries}} / \text{YLL}_{\text{GBD2015injuries}}) \text{ and} \\ & \text{YLD}_{\text{GBD2017diseases}} * (\text{YLL}_{\text{ILO2017diseases}} / \text{YLL}_{\text{GBD2015diseases}}) \end{aligned}$$

DALY's: = YLL + YLD for different categories

Costs in monetary terms have been calculated by multiplying the number of DALY's for each country and region (and category) by GDP/employed in the same country/ region. Costs in percentage of GDP have been obtained through dividing DALY (years) value for country/region by the maximum hypothetical number of years that could have been produced if no-one died, or had temporary or permanent disability obtained through the number of years worked by those employed or full employment number.

Work-related cancer costs

Country/region work-related cancer deaths were obtained through dividing the reference WHO region all work-related cancers by the country's share of labour force. This number was used as the baseline exactly as above and counting YLL_{cancer}'s, adjusted YLD_{cancer}'s and DALY_{cancer} and costs.

For EU numbers these were made through two reference WHO regions, for Western EU through High Income Region and for WHO Euro Region separately for remaining EU countries.

Work-related musculoskeletal (MSD) disorders

No direct deaths were assumed resulting in no YLL's. The YLD estimates are the same as DALY estimates. These have been taken directly from GBD2015 as no other data exist for MSDs. These cover only low-back pain and neck pain disorders. Other MSD data may be obtained in future GBD releases.

Work-related circulatory diseases

All circulatory disease deaths by country were obtained as above for work-related cancer. Details of various age groups are taken from the files on ILO Global estimated work-related diseases. In order to get DALY_{ILO2017} corresponding to ILO deaths due to different age groups by ILO and GBD an adjustment was done as follows:

- Compare the two different sources in each age group and males/females separately. Establish correction factor for deaths for each country, region, males, females separately;
- Apply the correction factor to GBD2015 corresponding DALY numbers obtaining new overall DALY_{ILObycountryandsex} values for selected ILO age groups, sexes covering all risk factors, not just occupational risk factors;
- Apply attributable fractions for each country, region, and age group for males: 14.4% which has been selected for circulatory diseases by ILO Global Estimates and, apply attributable fractions for each country, region, and age group for females: 6.7% which has been selected for circulatory diseases by ILO Global Estimates.

Use male and female work-related DALY values exactly as for all diseases to obtain costs as % - value and monetary value.

Injuries

Injury values of GBD2015 are largely based on EUROSTAT numbers so injury DALY's and can be directly used from GBD2015. Costs have been estimated exactly as above for other disease/injury groups

Sources

World Health Organisation mortality data

ILO Statistics, employment, labour force and occupational injuries

ILO Global Estimates, based on ILO statistics for injuries and WHO mortality data for diseases.

GBD website: <https://vizhub.healthdata.org/gbd-compare>

GDP nominal from Wikipedia World Bank and IMF columns:

[https://en.wikipedia.org/wiki/List_of_countries_by_GDP_\(nominal\)](https://en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal))

Eurostat Fatal cases

Institute of Health Metrics and Evaluation, YLD, YLL and DALY data

Published reports and scientific papers

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Discussion

Some improvements will be obtained if/when the GBD process starts covering further diseases and disorders. In principle, the major sources of burden may be further elaborated, such as the differences visible and caused by ageing, modifiable factors causing cancers (asbestos, silica, shift work), circulatory disorders and MSD's, COPD, and psychosocial factors, such as stress, strain and long working hours. Work has been started under ILO/WHO/ICOH collaboration.

Musculoskeletal disorders are based on GBD numbers, which may be an underestimate. However, no other useful information sources exist for MSD's.

Psychosocial factors and individual major diseases, such as those caused by asbestos can be obtained for countries and regions.

Lots of further data could be worked out. We have not had further thoughts e.g. on the sharing of the burden, but in most countries the workers themselves have the heaviest burden. Compensation data are not available on global scale but e.g. the Australian model could be used as guidance and source of rough estimates.

References

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- ^v Nurminen M & Karjalainen A (2001). Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. Scandinavian Journal of Work, Environment & Health 27, 161–213. http://www.sjweh.fi/show_abstract.php?abstract_id=605 (accessed on 26 March 2014)
- ^{vi} Hämäläinen P. Global Estimates of Occupational Accidents and Fatal Work-Related Diseases. Doctoral dissertation, Publication 917, Tampere University of Technology, Finland, 2010. Accessed on 11 September 2014 and available at <http://dspace.cc.tut.fi/dpub/bitstream/handle/123456789/6818/hamalainen.pdf?sequence=1>
- ^{vii} GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016;388:1459-544. See details from <http://vizhub.healthdata.org/gbd-compare/> ICOH contributors included Tim Driscoll (GBD occupational risks coordinator), Ken Takahashi, Odgerel Chimed-Ochir, Jukka Takala
- ^{viii} Takala J, Hämäläinen P, Nenonen N, Takahashi K, Chimed-Ochir O, Rantanen J: Comparative analysis of the burden of injury and illness at work in selected countries and regions (published on-line, 2017, Central Europ J.on Occ.&Env.Med, print version in press in July 2017)