GLOBAL ESTIMATES OF OCCUPATIONAL INJURIES AND WORK-RELATED ILLNESSES 2017

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Global Estimates of Occupational Injuries and Work-related Illnesses 2017

CONTENT

EXECUTIVE SUMMARY

This report provides an update to the global estimates of occupational injuries and work-related illnesses that were presented during the XX World Congress on Safety and Health at Work 2014 at Frankfurt. These updated figures were released during the XXI World Congress held in Singapore from 3 to 6 September 2017, as agreed under the Memorandum of Understanding between the International Labour Organization (ILO) and the Workplace Safety and Health (WSH) Institute, Singapore. These estimates were worked out by a team comprising experts from the Ministry of Health and Social Affairs in Finland and Workplace Safety and Health Institute of the Ministry of Manpower in Singapore.

The methodology used in this update was the same as for the 2014 study so as to keep the estimated numbers comparable. In the 2014 study, estimates were made based on the World Health Organization (WHO) regions. In addition to the WHO classification, estimates were also made based on the United Nations (UN) geographical regions. As there was underestimation on the number of respiratory disease cases in 2014, new attributable fractions (AF) were used to estimate the number of respiratory cases caused by Chronic Obstructive Pulmonary Disease (COPD) and Asthma.

We estimated 2.78 million deaths occurring annually across the countries being attributed to work, higher than the 2.33 million deaths estimated in 2014. Work-related mortality accounted for 5% of the global total deaths (based on the Global Burden of Disease Study 2015). The biggest share of work-related mortality came from work-related illnesses which accounted for 2.40 million (86.3%) of the total estimated deaths. Fatal injuries accounted for the remaining 13.7%.

With the inclusion of COPD in our estimation, respiratory diseases (17%) had increased and was among the top three illnesses after circulatory diseases (31%) and malignant neoplasms (26%). Together, they contributed more than three-quarter of the total work-related mortality, followed by occupational injuries at 14% and communicable diseases (9%).

Asia was the highest contributor and constituted about two-thirds of the global work-related mortality, followed by Africa at 11.8% and Europe at 11.7%.

Similar to previous estimates, the number of estimated work-related illnesses far exceeds that of work injuries. The increase in the number of ill-health was due to previous underestimates of COPD, leading to the respiratory estimates climbing to the third spot among the work-related mortality. Asia emerges top and constitutes about two-thirds of the estimated work-related mortality, nearly 6 times that of Africa and Europe.

1   Background

This report is an update to the global estimates of occupational injuries and work-related illnesses that was shared during the XX World Congress at Frankfurt in 2014. A Memorandum of Understanding (MOU) was signed between the International Labour Organization (ILO) and Workplace Safety and Health (WSH) Institute, Singapore, to produce and release these estimates during the XXI World Congress in September 2017.

Tampere University of Technology (TUT) had been collaborating with ILO for over a decade to produce global estimates of fatal and non-fatal occupational injuries for 1998, 2001, 2003, 2008 and 2010.[1,2] Global estimates of the fatal work-related illnesses were also produced for the years 2000, 2002, 2008 and 2011. The latest scientific peer-reviewed report (Takala *et al.* 2014) was published by the *Journal of Occupational and Environmental Hygiene* in May 2014. For this latest report, the WSH Institute collaborated with the Ministry of Social Affairs and Health, Occupational Safety and Health Division of Finland, to produce the estimates for ILO.

For this project, estimates of the occupational injuries were compiled using 2014 data while the work-related illnesses were based on 2015 data. Besides presenting the findings based on the seven World Health Organization (WHO) regions, findings were also presented based on the geographical and sub-regional groupings of the United Nations (UN). As the number of respiratory diseases had been underestimated previously, new attributable fractions (AF) were thus used in the estimation of the work-related illnesses caused by Chronic Obstructive Pulmonary Disease (COPD) and Asthma.

2   Methodology

2.1   General

Sources of data on the burden of injuries and illnesses at work

We reviewed employment figures, mortality rates, occupational burden of diseases and injuries, reported accidents, surveys on self-reported occupational illnesses and injuries, attributable fractions, and the most recent information on the problems from published papers, documents, and electronic data sources of international and regional organizations, in particular ILO, WHO, the European Union (EU) and the Association of Southeast Asian Nations (ASEAN), institutions, agencies, and public websites.

Occupational injuries and work-related illnesses

While it is difficult to compare national data related to occupational injuries due to differences in legal and compensation criteria, the comparison between the number of fatal injuries (accidents) is easier and, although not completely, it is relatively comparable when the recording criteria, denominators and economic structures are well documented. Usually fatal injuries are expressed per 100,000 employed population in national statistics, or per 1 million working hours which may be converted to 100,000 full-time employed as indicated in the Chinese National statistics.[3]

Occupational disease is usually understood to be a disorder or illness included in the designated list of diseases at work where employment injury compensation is legally defined. Inclusion in such a list is influenced by both evidence of work-relatedness and by administrative, financial and political arguments by the government or region concerned. In reality, the number of illnesses covered depends on the countries' development, political commitment and financial capacity. A disease, such as musculoskeletal disorder may be included in a list of occupational diseases in a country while not included in the list for another country. The concept of occupational injuries is usually much better defined, compared to occupational diseases.

Work-relatedness is a gradual component that may vary between obvious and commonly agreed to barely detectable. Often the work-relatedness is measured by the population attributable fraction (AF).

Past studies on work-related illnesses, and often including injuries, have been carried out in several countries, and globally. These have been based on the attributable fraction method and cover a varying number of illnesses and diseases. The AF method is well described by Nurminen and Karjalainen.[4] Detailed information on the attributable fractions and general methodology are available in Hämäläinen.[5,6] This method has been used and applied including the AF values in Spain[7] and New Zealand[8] and with varied AF values in the United States[9] and United Kingdom[10]. In an earlier comparison of different estimation methods, the method used in this study was confirmed as the most realistic one.[11]

Methods and data sources for the estimates related to fatal outcomes

Methods used in collecting data for the ILO, WHO and Global Burden of Disease, (GBD) of the Institute of Health Metrics and Evaluation (IHME) are explained elsewhere.[5,12,13,14,15] The denominator in fatal injury rates is usually the number of employed persons. However in other cases, the full labour force or data on the total population by age groups had been used. In many developing countries, the number of those formally employed is a small fraction of all who work in the country as self-employed, subsistence farmers, and those working in the informal sectors were usually not captured in the statistics. Globally, the labour force size may also be an underestimate in some countries as large numbers of those below 15 years of age, starting from as young as under ten years old and a sizeable number of those beyond any retirement age must work for survival. The same applies to collecting data on injury incidents.

Table 1: Summary of ILO method and data sources[16]

Estimates of work-related deaths	Method/ Data Sources
a) Total number of deaths due to work injuries	Number of fatal injuries reported to the ILO and member States - Included fatal injuries, injury rates, work-related traffic fatalities, suicides, but excluded fatalities from commuting to work and back - As ILO data includes data from a limited number of countries, those countries where no information was available were grouped in specific regions, in particular, WHO regions and sub-regions, and fatal injury rates per 100,000 employed of one or several countries that had produced injury rates were used as proxy values - To increase the accuracy, separate injury rates were used for 1) agriculture and fishing, 2) industry including construction, and 3) service sector. This balances some of the potential differences between reporting proxy countries and non-reporting countries.
b) Total number of deaths due to work-related illnesses	All-cause mortality data from the World Health Organization - Breakdown by diseases and groups of diseases - Breakdown by gender and age groups Applied disease-specific AFs to the all-cause mortality data in 2015.

		The AFs were largely referenced from the Nurminen 2001 paper[4], with some replaced by more recent AFs. Related epidemiological studies for selected industries and occupations from which the AFs were derived, were also reviewed. When no systematic data existed from elsewhere on the number and share of exposed workers, figures for similar occupations from Nurminen were used. Certain conditions were applied to exclude non-work-related deaths. For instance, children were excluded by using only deaths between the specific age groups
c)	Total number of suicides due to work	Applied AF in Nurminen 2001 data to mortality data from WHO

2.2   Fatal occupational injuries

The number of fatal occupational injuries was estimated from the 2014 frequency rates of fatal injuries (fatalities per 100,000 workers) from selected ILO member States that reported their injury data in three economic sectors:

- Agriculture including farming, fishing and forestry
- Industry including mining, manufacturing, energy production and construction
- Services

For countries where fatal data was not available, the WHO regions were used, where countries of similar income structures were grouped into 7 regions:

- High Income countries (HIGH)
- Low- and middle-income countries of the African Region (AFRO)
- Low- and middle-income countries of the Americas (AMRO)
- Low- and middle-income countries of the Eastern Mediterranean Region (EMRO)
- Low- and middle-income countries of the European Region (EURO)
- Low- and middle-income countries of the South-East Asia Region (SEARO)
- Low- and middle-income countries of the Western Pacific Region (WPRO)

For each region, the available fatality rates of the three economic sectors are shown in Table 2 below.

Table 2: Fatal occupational injury rates per 100,000 employees

Region	Fatality Rates of each economic sector					
	Agriculture		Industry		Service	
	2010	2014	2010	2014	2010	2014
HIGH	7.8	7.8	3.8	3.8	1.5	1.5
AFRO	18.9	18.9	21.1	21.1	17.7	17.7
AMRO	9.3	8.7 ⬇	9.5	11.2 ⬆	6.0	5.7 ⬇
EMRO	13.0	13.0	14.9	14.9	12.3	12.3
EURO	15.7	17.0 ⬆	10.3	13.4 ⬆	5.5	3.5 ⬇
SEARO	24.0	27.5 ⬆	9.7	9.9 ⬆	5.1	4.4 ⬇
WPRO	24.0	27.5 ⬆	9.7	9.9 ⬆	5.1	4.4 ⬇

The previous rates of fatal occupational injuries are used for HIGH, AFRO and EMRO regions because of a lack of data. The percentage of labour force for each economic sector in each country was retrieved from the World Factbook of the Central Intelligence Agency (CIA). These percentages can also be obtained from ILOSTAT Database but they are percentages of the employed instead of the labour force. Together with the labour force, total employment (comprising both paid employment and self-employment) and the respective regions' fatality rates in 2014, the number of fatalities of each country was then computed.[6]

2.3   Non-fatal occupational injuries

As non-fatal (causing at least 4 days of absence) occupational injuries are not usually reported by most countries, they were estimated by using lower and upper limit estimates.[6] The lower limit of 0.14% was obtained by averaging the proportion of fatal and non-fatal injuries of the European Union (EU) 15 countries except Greece. The upper limit of 0.08% was obtained similarly from Finland, France and Germany. The lower and upper limits used for 2010 were 0.13% and 0.10% respectively. The lower and upper limit estimates of the number of non-fatal injuries of each country in 2014 are then calculated as follows:

$$Estimated\ number\ of\ non\ fatal\ injuries\ (Lower\ Limit) = \frac{No.\ of\ fatalities \times 100\%}{0.14}$$

$$Estimated\ number\ of\ non\ fatal\ injuries\ (Upper\ Limit) = \frac{No.\ of\ fatalities \times 100\%}{0.08}$$

The estimated non-fatal injury is then finally obtained by taking the mean of the two limits.

2.4   Fatal work-related illnesses

The WHO Global Burden of Disease (GBD) is the only data source that covers all the diseases in the world. It categorises all the diseases into seven categories:

- communicable diseases
- malignant neoplasms
- circulatory diseases
- neuropsychiatric conditions
- respiratory diseases
- digestive diseases
- genitourinary diseases.

Since fatal diseases that are work-related are not listed separately in the GBD data, they are estimated by attributable fractions (AF) taken from Nurminen & Karjalainen, 2001.[4] An attributable fraction can be interpreted as "the fraction of a disease [or injury] which would not have occurred had the exposure factor been non-existent in the population in question".[5] The attributable fractions used to calculate the fatal work-related illnesses are shown in Table 3. As the attributable fraction for communicable diseases was obtained from industrialized countries in the HIGH region, the attributable fraction was thus reduced for countries that do not belong to this high income group.[5]

Table 3: Attributable fractions (AF) used in the estimation of fatal work-related illnesses

Causes of Death	HIGH Region[a]		OTHER Regions[b]	
	Men	**Women**	**Men**	**Women**
Communicable diseases	4.80	32.50	3.05	20.68
Malignant neoplasms	13.80	2.20	13.80	2.20
Neuropsychiatric conditions	6.60	1.80	6.60	1.80
Circulatory diseases	14.40	6.70	14.40	6.70
Respiratory diseases • COPD • Asthma • Others	 18.00 21.00 1.00	 6.00 13.00 1.00	 18.00 21.00 1.00	 6.00 13.00 1.00
Digestive diseases	2.30	1.50	2.30	1.50
Genitourinary system	3.00	0.40	3.00	0.40

[a] Attributable fractions from Nurminen & Karjalainen, 2001[4]
[b] Revised attributable fractions

The Collegium Ramazzini released its 19th Statement containing a comprehensive analysis of Chronic Obstructive Pulmonary Disease (COPD) in occupational settings in 2016: A New Approach to the Control of COPD.[17] As a result, AF for COPD were used to estimate the number of deaths due to respiratory diseases. The AF for COPD was 18% for males and 6% for females.

The estimate of fatal work-related illnesses of each WHO region was calculated by selecting the 7 main disease categories with the appropriate AF. The fatal work-related illnesses of each country was obtained by multiplying the WHO region's estimate with the proportion of its labour force.

3   Results

3.1   Overview

There was an estimated 2.78 million fatalities compared to 2.33 million estimated in 2011. For fatal occupational injuries, there were 380,500 deaths, an increase of 8% in 2014 compared to 2010. Fatal work-related illnesses had been a concern since 1998 and were at least five times higher than fatalities due to occupational injuries. In 2015, there were 2.40 million deaths due to fatal work-related illnesses, an increase of 0.4 million compared to 2011.

In total, it is estimated that more than 7,500 people die every day; 1,000 from occupational injuries and 6,500 from work-related illnesses. The rate of fatal occupational injuries increased slightly. The number of non-fatal occupational injuries was estimated to be 374 million, increasing significantly from 2010. The main reason was that a higher under-reporting estimate was used compared to the previous estimates.

Table 4: Global trend of fatal occupational injuries and fatal work-related illnesses (1998-2015)

Year	Fatal Occupational Injuries		Non-fatal occupational injuries at least 4 days absence		Fatal work-related illnesses
	Number	**Rate[a]**	**Number**	**Rate[a]**	
1998	345,436	16.4	263,621,966	12,534	
2000					2,028,003
2001	351,203	15.2	268,023,272	12,218	
2002					1,945,115
2003	357,948	13.8	336,532,471	12,966	
2008	320,580	10.7	317,421,473	10,612	2,022,570
2010	352,769	11.0	313,206,348	9,786	
2011					1,976,021
2014	380,500	11.3	373,986,418	11,096	
2015					2,403,965

[a] Number of fatal occupational injuries per 100,000 persons in the labour force

3.2   Occupational injuries

3.2.1   By WHO region

Table 5: Breakdown of 2014 occupational Injuries by WHO region

| | | | Occupational injuries reported to ILO in 2014 | | Global estimates of occupational accidents 2014 | | | |
| | | | | | Fatal | Non-fatal (at least four days absence) | | |
Region	Labour force	Total employment	Fatal	Non-fatal		Lower limit (0.14)	Upper limit (0.08)	Average
HIGH	521,662,897	476,238,830	4,064	1,991,628	10,757	7,683,291	13,193,091	10,845,213
AFRO	350,749,965	345,598,985	110	8,742	65,145	46,532,038	81,431,066	63,981,552
AMRO	297,081,063	269,154,947	1,916	966,221	19,388	13,848,697	24,235,220	19,041,958
EMRO	195,451,073	160,588,073	210	16,692	21,113	15,081,021	26,391,787	20,736,404
EURO	227,406,974	204,171,210	2,598	98,904	14,159	10,113,353	17,698,368	13,905,861
SEARO	824,496,607	763,156,900	77	6,710	124,404	88,859,942	155,504,898	122,182,420
WPRO	953,638,990	909,608,518	222	44,638	125,535	89,667,644	156,918,377	123,293,011
TOTAL	**3,370,487,570**	**3,128,517,463**	**9,197**	**3,133,535**	**380,500**	**271,785,986**	**475,372,807**	**373,986,418**

Similar to 2010, most of the occupational injuries in 2014 had occurred in the SEARO and WPRO regions as shown in Table 5. About two-thirds of the occupational injuries fell almost equally under these two regions. Compared to the 2010 figures, there was a rise in the number of occupational injuries for all the WHO regions except for the HIGH and EURO regions.

3.2.2   By geographical region

The number of fatal and non-fatal occupational injuries of the 5 geographical regions are presented in Table 6. Asia had the highest number of fatalities among the 5 regions and constituted more than 70% globally. The Asian fatal occupational rate was 12.99 per 100,000 persons in the labour force which was lower than Africa which had the highest fatality rate of 17.39 per 100,000 persons in the labour force. Europe had the lowest fatality rate among the 5 regions, with a rate of 3.02.

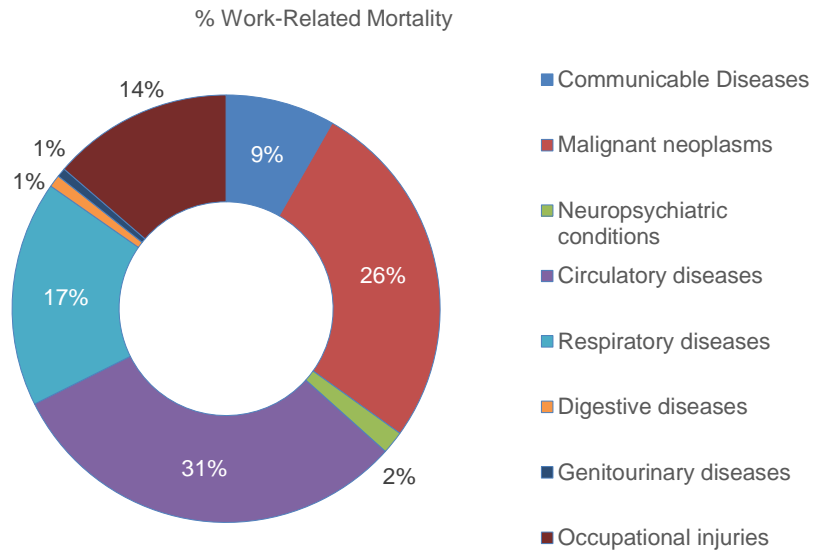**Table 6: Breakdown of 2014 occupational injuries by geographical region**

| | | | Occupational injuries reported to ILO 2014 | | Global estimates of occupational injuries 2014 | | | | |
| | | | | | Fatal | * Fatality Rate | Non-fatal (at least four days absence) | | |
Region	Labour force	Total employment	Fatal	Non-fatal			Lower limit (0.14)	Upper limit (0.08)	Average
Africa	413,329,046	397,013,885	320	25,434	71,882	17.39	51,343,960	89,851,931	70,597,946
America	479,990,599	433,527,137	1,916	966,221	24,579	5.12	17,556,317	30,672,033	24,114,175
Asia	2,093,134,505	1,953,718,973	2,694	121,256	271,949	12.99	194,249,063	339,932,172	267,097,755
Europe	364,546,703	326,139,450	4,079	1,921,644	11,017	3.02	7,869,606	13,600,463	11,134,918
Oceania	19,486,718	18,118,018	188	98,980	1,074	5.51	767,040	1,316,209	1,041,625
Total	**3,370,487,570**	**3,128,517,463**	**9,197**	**3,133,535**	**380,500**	**11.29**	**271,785,986**	**475,372,807**	**373,986,418**

* Number of occupational injuries per 100,000 persons in the labour force

3.3 Work-related illnesses

3.3.1 Work-related mortality by cause

Figure 1: Breakdown of the estimated work-related mortality by cause in 2015

% Work-Related Mortality

Legend:
- Communicable Diseases
- Malignant neoplasms
- Neuropsychiatric conditions
- Circulatory diseases
- Respiratory diseases
- Digestive diseases
- Genitourinary diseases
- Occupational injuries

In Figure 1, the main causes of death from all work-related illnesses were circulatory diseases (31%), malignant neoplasms (26%), respiratory diseases (17%) and occupational injuries (14%). They formed about 90% of all fatal work-related deaths. Communicable diseases were still a common problem in developing countries. The current burden of communicable diseases at 9% had decreased slightly from 10% in 2011 probably due to better estimates since the estimate in 2008 was 25% which was conservative.

Figure 2: Work-related mortality by WHO regions by cause in 2015

Legend:
- Occupational injuries
- Genitourinary diseases
- Digestive diseases
- Respiratory diseases
- Circulatory diseases
- Neuropsychiatric conditions
- Malignant neoplasms
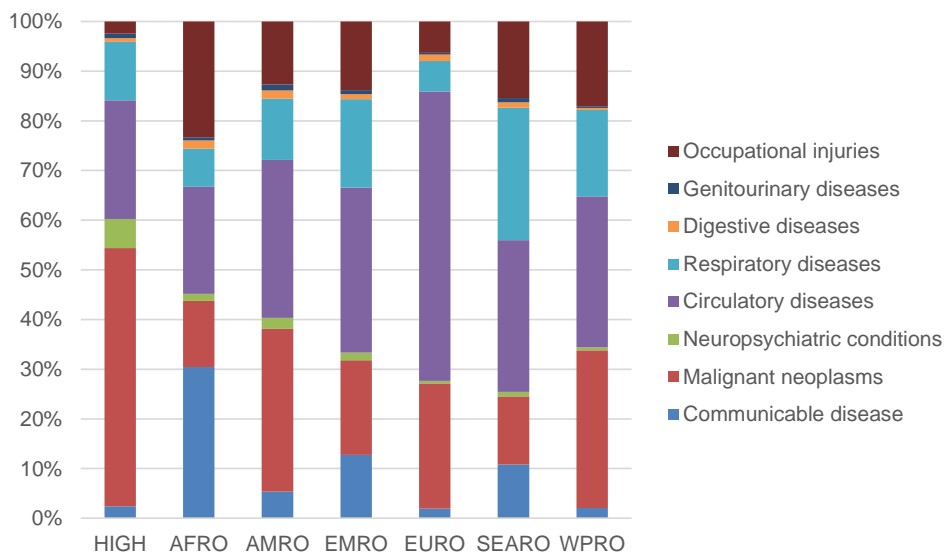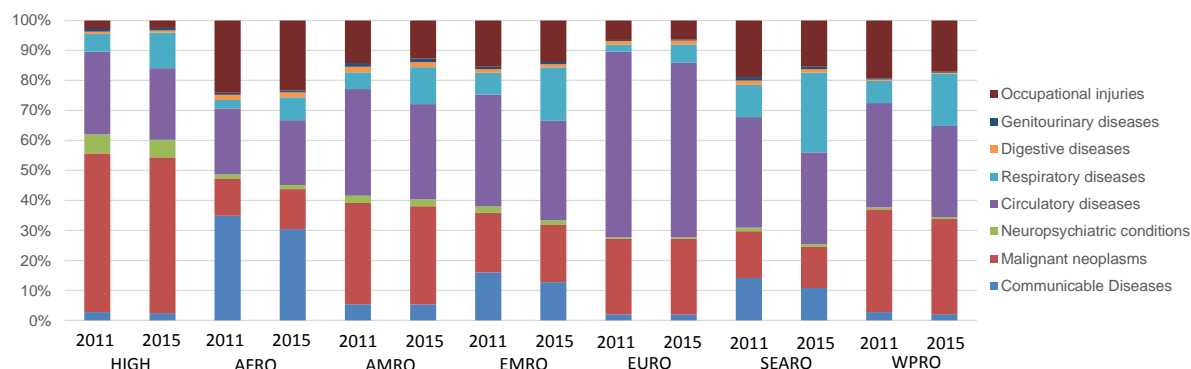- Communicable disease

Figure 3: Comparison of work-related mortality by WHO region between 2011 and 2015

In Figure 3, communicable diseases constituted slightly more than 30% in AFRO in 2015 among the work-related deaths but less than 5% in HIGH. The proportion of the cause of fatal work-related illnesses had remained almost the same except for an increased proportion of respiratory diseases occurring in all the regions. Previous respiratory disease estimates were clearly underestimates as they were lower than respiratory deaths attributed to hazardous substances. On the other hand, circulatory diseases had increased in all regions except for HIGH and EURO.

Although the number of deaths due to neuropsychiatric conditions was low (2%), it had increased slightly in 2015. It could be assumed that the number of deaths due to neuropsychiatric conditions will increase in the future. These diseases, together with musculoskeletal disorders, are usually non-fatal and are relatively more prevalent in developed countries.

The proportion of malignant neoplasm dominated the fatal work-related illnesses in high income countries (Figure 2), with the breakdown of the estimated mortality demonstrated in Table 7. This is a continuously growing problem that needs better preventive measures. Practically, all such cancers can be avoided by eliminating the exposures to carcinogenic agents and minimizing exposures at related jobs, settings and procedures.

Table 7: Breakdown of the estimated work-related mortality by WHO region in 2015

	HIGH	AFRO	AMRO	EMRO	EURO	SEARO	WPRO	TOTAL
Communicable disease	10,435	84,948	8,152	19,396	4,373	87,511	15,168	**229,983**
Malignant neoplasms	225,939	37,198	50,038	29,036	56,277	110,662	233,085	**742,235**
Neuropsychiatric conditions	25,512	3,927	3,390	2,396	1,101	7,280	4,510	**48,116**
Circulatory diseases	103,863	60,151	48,580	50,597	129,992	246,885	223,105	**863,173**
Respiratory diseases	51,363	21,419	18,834	27,123	13,714	215,118	128,018	**475,589**
Digestive diseases	3,132	4,505	2,535	1,546	2,910	8,631	2,655	**25,914**
Genitourinary diseases	3,840	1,750	1,835	1,167	729	7,214	2,420	**18,955**
Occupational injuries	10,757	65,145	19,388	21,113	14,159	124,404	125,535	**380,500**
TOTAL	**434,840**	**279,042**	**152,754**	**152,375**	**223,253**	**807,705**	**734,497**	**2,784,465**

3.3.2 Number of work-related mortality by United Nations geographical regions

Table 8 showed the estimated work-related mortality by the United Nations geographical regions. Asia had the highest number of work-related mortality among the five regions. About two-thirds of the work-related mortalities came from Asia (Figure 4). In fact, Asia had in absolute numbers, the highest number of work-related deaths in each disease category, including occupational injuries.

Table 8: Breakdown of Work-Related Mortality by United Nations geographical regions in 2015

	AFRICA	AMERICA	ASIA	EUROPE	OCEANIA	* TOTAL
Communicable Diseases	91,158	11,754	119,397	7,075	374	229,758
Malignant neoplasms	46,494	128,020	430,472	126,127	7,645	738,759
Neuropsychiatric conditions	4,694	12,195	19,856	10,540	762	48,048
Circulatory diseases	76,350	84,428	563,687	131,335	4,052	859,853
Respiratory diseases	30,103	36,562	375,611	29,322	2,086	473,683
Digestive diseases	5,000	3,616	13,906	3,249	103	25,874
Genitourinary diseases	2,123	3,161	11,529	1,983	123	18,919
Occupational injuries	71,905	23,101	268,641	14,094	895	378,634
Total	**327,827**	**302,837**	**1,803,098**	**323,726**	**16,040**	**2,773,528**

* The numbers did not tally with Table 6 due to rounding off errors.

Figure 4: Distribution of work-related mortality by UN geograpical region

EUROPE
11.7%

OCEANIA
0.6%

AFRICA
11.8%

AMERICA
10.9%

ASIA
65.0%
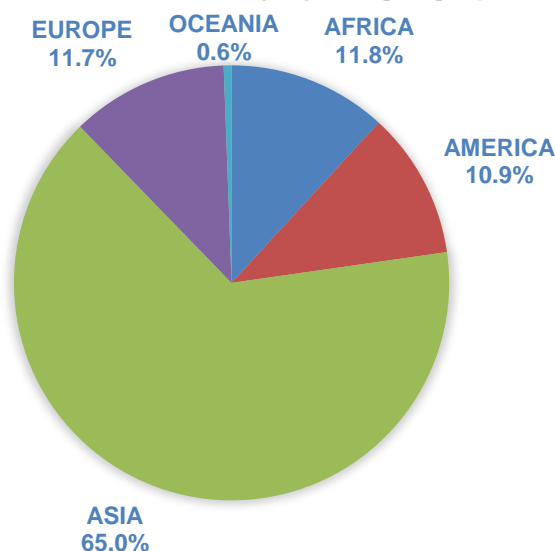
3.3.3 Deaths attributed to hazardous substances including dusts, vapours and fumes

In 2015, nearly one million workers died at work due to hazardous substances (Table 9), an increase of more than 90,000 workers when compared to 2011.

Table 9: Estimated deaths attributed to hazardous substances (including dusts, vapours and fumes)

	No. of deaths		Estimated % attributed to hazardous substances		No. of deaths attributed to hazardous substances		
	Men	**Women**	**Men**	**Women**	**Men**	**Women**	**Total**
Cancers	**4,779,542**	**3,754,270**	-	-	**343,646**	**71,976**	**415,622**
Mouth and oropharynx cancers	242,334	96,859	1.0	0.5	2,423	484	2,908
Oesophagus cancer	321,263	136,534	3.3	1.1	10,602	1,502	12,104
Stomach cancer	499,852	292,749	3.0	0.3	14,996	878	15,874
Colon and rectum cancers	396,370	349,958	1.0	0.5	3,964	1,750	5,713
Liver cancer	559,329	255,598	0.2	0.1	1,119	256	1,374
Pancreas cancer	169,105	161,678	0.02	0.01	34	16	50
Trachea, bronchus, lung cancers	1,113,475	520,462	21.1	5.3	234,943	27,585	262,528
Melanoma and other skin cancers	54,769	40,412	10.0	2.0	5,477	808	6,285
Breast cancer	0	558,514	-	4.6	0	25,692	25,692
Cervix uteri cancer	0	306,319	-	0.7	0	2,144	2,144
Ovary cancer	0	161,181	-	0.5	0	806	806
Prostate cancer	328,131	0	1.0	-	3,281	0	3,281
Bladder cancer	143,275	47,731	7.1	1.9	10,173	907	11,079
Leukaemia	136,879	109,581	0.9	0.5	1,232	548	1,780
Other malignant neoplasms	814,759	716,693	6.8	1.2	55,404	8,600	64,004
Neuropsychiatric conditions	**82,630**	**75,083**	1.0	1.0	**826**	**751**	**1,577**
Cardiovascular diseases	**4,366,727**	**3,497,981**	1.0	1.0	**43,667**	**34,980**	**78,647**
Respiratory Diseases	**2,259,742**	**1,867,406**	-	-	**362,910**	**112,679**	**475,589**
Chronic obstructive pulmonary disease	1,740,463	1,443,292	18.0	6.0	313,283	86,598	399,881
Asthma	222,168	182,004	21.0	13.0	46,655	23,660	70,316
Other respiratory diseases	297,112	242,110	1.0	1.0	2,971	2,421	5,392
Genitourinary diseases	**561,351**	**526,893**	1.0	1.0	5,614	5,269	10,882
Total					**756,663**	**225,654**	**982,317**

4   Discussion

The methodology used to calculate the estimates was similar to the previous global estimates. The 2014 total employment was collected from ILOSTAT. Total employment is defined to be the number of persons employed including paid employment and self-employment. If total employment numbers were not available, the 2010 numbers were used instead. If neither were available, labour force numbers were used. Since the affected countries are usually small, there would be minimal impact on the global figures.

Labour Force data was collected from ILOSTAT. For ILO countries where ILOSTAT was not available, it was obtained from the earlier LABORSTA data also from ILO. For non-ILO countries, the figures were obtained from CIA World Factbook. For countries where such data was not available, 2010 estimates were used instead.

The percentage of the total employment by sector of economic activity was collected from CIA World Factbook. For countries where such data was not available, previous estimates were used instead. When the fatal occupational injury rate of each economic sector in Section 2.2 was known, the fatal occupational injuries could then be calculated. As new fatal occupational injury rates were only available for AMRO, EURO and WPRO from ILOSTAT, 2010 estimates were then used for HIGH, AFRO and EMRO. For AMRO, Chile (2011-2013) and Colombia (2015) were used to formulate the fatal occupational injury rates for agriculture, industry and service. For EURO, Russia (2015) and Ukraine (2012) were used. For WPRO, Macau (2015) and Malaysia (year 2015) were used. Though these representative countries were not used during the previous estimates, the calculated rates did not differ too much from the previous rates as shown in Table 1. For SEARO, the rates for WPRO were used.

There was an increase in employment for the seven WHO regions. Though the total employment in 2014 for all countries increased by 4% compared to 2010, the number of estimated fatal occupational injuries increased by about 8% to 380,500. However, the number of fatal occupational injuries decreased in two of the WHO regions despite an increase in the total employment. There was an estimated 6% decrease in occupational injuries for HIGH Region despite a 5% increase in total employment. For EURO, occupational injuries decreased by 3% with a 2% increase in employment. However for WPRO and SEARO, though employment increased by 2-3%, the number of fatal occupational injuries was estimated to increase by 8-9%. As such, the estimated fatal and non-fatal occupational injury rates in 2014 had increased and was higher than the global crisis year in 2008 (Table 3).

Chronic Obstructive Pulmonary Disease (COPD) is a growing disease world-wide. It has become an important work-related problem but is often not well-recognized and is thus under-diagnosed. It is caused by exposures to a multitude of vapours, gases, dusts and fumes which are collectively known as VGDF (vapours, gases, dusts and fumes). Many VGDF exposures pose serious risks in workplaces and are often under-regulated. Besides VGDF, COPD is known to be associated with specific occupational exposure agents including coal mine dust, asbestos, silica, welding and cutting gases and fumes, cement dust, diesel exhausts, spray painting, organic solvents and possibly man-made mineral fibres.[17]

The American Thoracic Society estimated that occupational exposures were responsible for 15-20% of COPD in 2004 and this had since been supported by many publications that

occupational exposures were an important contribution to COPD. In light of this, the previous respiratory death numbers were clearly underestimates as also evidenced in Table 9 for hazardous substances. For example, in the previous estimate, the estimated deaths due to COPD was 374,128 which was more than twice the number of work-related illnesses due to respiratory diseases at 162,260. For the computation of the respiratory estimates, AF values were used to calculate the number of deaths due to COPD. They were 18% for males and 6% for females. Deaths due to COPD constituted more than 80% of the respiratory estimates.

Among the more than 400,000 increase in fatal work-related illnesses in 2015, more than 70% were due to respiratory diseases. Estimates of fatal work-related illnesses due to respiratory diseases is now the third largest after circulatory diseases and malignant neoplasms. A new paradigm has to be adopted to recognise that occupational exposures to VGDF cause COPD and preventive measures should be taken to reduce such exposures to workers.

References

[1] Takala, J. 2005. *Introductory Report: Decent Work – Safework*, Report, XVII World Congress on Safety and Health at Work, Orlando, 2005 [Online]. Available at http://ohsa.org.mt/Portals/0/docs/intrep_05.pdf

[2] International Labour Office (ILO). 2014. *Safety and Health at Work: a vision for sustainable prevention*, Report, XX World Congress on Safety and Health at Work 2014: Global Forum for Prevention, Frankfurt, 2014 [Online]. Available at http://www.ilo.org/safework/info/publications/WCMS_301214/lang--en/index.htm

[3] *Statistical Communiqué of the People's Republic of China on the 2013 National Economic and Social Development*, National Bureau of Statistics of China, 2014, http://www.stats.gov.cn/english/PressRelease/201402/t20140224_515103.html

[4] Nurminen, M.; Karjalainen, A. 2001. "Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland" in *Scand. J. Work Environ. Health*, Vol. 27, pp 161–213 [Online]. Available at http://www.sjweh.fi/show_abstract.php?abstract_id=605

[5] Hämäläinen, P. 2010. "Global Estimates of Occupational Accidents and Fatal Work-Related Diseases". Doctoral dissertation, Publication 917, Tampere University of Technology, Finland [Online].

[6] Hämäläinen, P.; Takala, J.; Saarela, K. L. 2006. "Global estimates of occupational accidents" in *Safety Science*, Vol. 44, pp. 137–156 [Online]. Available at http://www.bvsde.paho.org/bvsacd/cd63/global_estimates.pdf

[7] García, A. M.; Merino, R. G.; Martínez, V. L. 2007. "Estimación de la mortalidad atribuible a enfermedades laborales en España 2004" in *Rev Esp Salud Pública,* Vol. 81, pp 261–270 [Online]. Available at http://scielo.isciii.es/scielo.php?pid=S1135-57272007000300003&script=sci_arttext

[8] 't Mannetje, A.; Pearce, N. 2005. "Quantitative estimates of work-related deaths, diseases and injury in New Zealand" in *Scand J Work Environ Health*, Vol. 31, No. 4, pp 266–276, doi:10.5271/sjweh.882 [Online]. Available at www.sjweh.fi/download.php?abstract_id=882&file_nro=1

[9] Steenland K.: *Attributable fraction: example, cancers due to occupation in the US*, Presentation at OCRC Research Day: Assessing the Human and Economic Burden of Occupational Cancer, Toronto, Ontario, 23 March 2011 [Online]. Available at http://www.occupationalcancer.ca/wp-content/uploads/2011/03/Steenland.pdf

[10] Rushton, L.; Hutchings, S. J.; Fortunato, L.; Young, C.; Evans, G. S.; Brown, T.; Bevan, R.; Slack, R.; Holmes, P.; Bagga, S.; Cherrie, J. W.; Van Tongeren, M. 2012. "Occupational

cancer burden in Great Britain" in *Br J Cancer,* Vol. 107, pp S3–S7, doi:10.1038/bjc.2012.112 [Online]. Available at https://www.nature.com/articles/bjc2012112

[11] Driscoll, T.; Takala, J.; Steenland, K.; Corvalan, C.; Fingerhut. M. 2005. "Review of estimates of the global burden of injury and illness due to occupational exposures" in *Am. J. Ind. Med.,* Vol. 48, pp 491–502, doi: 10.1002/ajim.20194.

[12] Takala, J.; Hämäläinen P.; Saarela K. L.; Loke, Y. Y.; Manickam, K.; Tan, W. J.; Heng, P.; Tjong, C.; Lim, G. K.; Lim, S.; Gan S. L. 2014. "Global Estimates of the Burden of Injury and Illness at Work in 2012" in *J. Occup. Environ. Health*, Vol. 11, pp 326–337 [Online]. Available at http://www.tandfonline.com/doi/pdf/10.1080/15459624.2013.863131

[13] Nenonen, N.; Hämäläinen, P.; Takala, J.; Saarela, K. L.; Yong, E.; Lim, S. L.; Lim, G. K.; Manickam, K. 2014. *Global Estimates of Occupational Accidents and Work-related Illnesses 2014, made for the ILO report at XX World Congress, Frankfurt.* Report, XX World Congress, Frankfurt, 2014, doi: 10.13140/2.1.2864.0647 [Online].

[14] Lim, S. S.; Vos, T.; Flaxman A. D. *et al*. 2012. "A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010" in *Lancet,* Vol. 380, No. 9856, pp 2224–2260, doi: 10.1016/S0140-6736(12)61766-8 [Online]. Available at http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(12)61766-8.pdf

[15] GBD 2015 Mortality and Causes of Death Collaborators. 2016. "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" in *Lancet,* Vol. 388, No. 10053, pp 1459–1544, doi: 10.1016/S0140-6736(16)31012-1 [Online].

Available at http://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(16)31012-1.pdf

[16] Takala, J.; Yong, E.: *Mortality estimates of occupational injuries and ill health in Singapore*, paper for Public Health and Occupational Medicine Conference, Singapore, 2014 [Online].

[17] Collegium Ramazzini*: A New Approach to the Control of Chronic Obstructive Pulmonary Disease (COPD)*, 19th statement, published on 19 July 2016 [Online]. Available at http://www.collegiumramazzini.org/news1.asp?id=144 and http://www.collegiumramazzini.org/download/19_NineteenthCRStatement(2016).pdf