

The new WHO/ILO Joint Estimates of the Work-related Burden of Disease & Injury



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Overview of the session

- Welcome and overview of the WHO/ILO Joint Estimates of the Workrelated Burden of Disease and Injury
- Data sources
- Methods applied
- Results
- Policy relevance and applicability for data users

The new WHO/ILO Joint Estimates of the Work-related Burden of Disease & Injury



Welcome and overview

Dr Frank Pega



Rationale, objectives, structure & timeline

Rationale

• WHO & ILO produced inconsistent estimates of work-related burden of disease in the past



- Member States requested that WHO & ILO harmonize their estimates
- WHO & ILO have agreements

 \circ to share data & exchange evidence (since 1948) \circ to co-produce burden of disease estimates (since 2019)

- UN reform requires agencies to work seamlessly as One UN
- The 2030 Agenda for Sustainable Development

 includes targets for environmental health & decent work
 calls for partnerships for development



Objectives

- To develop a methodology for estimating the numbers of workrelated deaths & disability-adjusted life years (DALYs)
- To adopt existing methods shared by WHO & ILO for established pairs of occupational risk factors & health outcomes
- To develop new methods for prioritized additional pairs of occupational risk factors & health outcomes
- To produce the first WHO/ILO Joint Estimates of the Work-related Burden of Disease & Injury



Organizational structure



230 individual experts in 35 countries

INAIL, Ministry of Labour & Social Policy, Italy Eurostat, European Commission, Europe NCPHA, Ministry of Health, Bulgaria

NRCWE, Ministry of Employment, Denmark

Ministry of Health, Welfare & Sport, Netherland

FIOH, Ministry of Social Affairs & Health, Finland



Fiocruz, Ministry of Health, Brazil

National Institute for Occupational Health, South Africa Country where individual expert is based Country without individual expert Not applicable

Timeline



2016 WHO & ILO agree to develop the WHO/ILO Joint Estimates

Photo credit: ILO

- 2016-21 WHO & ILO develop estimation strategy, systematically collect input data for modelling, develop statistical models & produce estimates
- 2019 WHO Assistant Director-General & ILO Deputy Director-General sign *Collaboration Agreement* for long-term joint monitoring programme
- 2019 WHO recognizes the WHO/ILO Joint Estimates as a Global Public Health Good
- 2020 WHO consults 194 countries & ILO consults workers' & employers' associations
- 2021 WHO & ILO Director-Generals co-launch first cycle of WHO/ILO Joint Estimates
- 2023 Planned release of second estimation cycle

The new WHO/ILO Joint Estimates of the Work-related Burden of Disease & Injury



Data sources

Dr Bálint Náfrádi



Data Sources used for the WHO/ILO Joint Estimates

Open access data:

• The 2019 Revision of World Population Prospects

Source: United Nations, Department of Economic and Social Affairs, Population Division

• Global Health Estimates 2016: Disease burden by Cause, Age, Sex, by Country and by Region, 2000-2016

Source: World Health Organization

• Population attributable fractions for 39 pairs

Source: Institute for Health Metrics Evaluation. Health Data Exchange

Data Sources used for the WHO/ILO Joint Estimates

WHO/ILO Global Working Hours Database (cross-sectional)

Source: ILO Microdata Collection

- 2324 large-scale national probability survey
- 467 million individual interviews
- 154 countries
- Data from 1976

The database disaggregates data on

- Sex (2 categories: Females, Males)
- Age (17 categories 15-19... ≥95)
- working hour bands (6 categories: outside labour force, 0-34, 35-40, 41-48, 49-54, and ≥ 55 hours/week)

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WHO/ILO Global Working Hours Database (longitudinal)

Source: ILO Microdata Collection and EUROSTAT

- 739 quarterly Labour Force Surveys
- 143 million individual interviews
- 15 countries
- Data from 2000

The database disaggregates data on

- Sex (2 categories: Females, Males)
- Age (17 categories 15-19... ≥95)
- Working hour band transitions (36 transitions, 30 independent)

WHO/ILO Global Working Hours Database



Data source: WHO/ILO Global Cross-Sectional Working Hours Database Map production: WHO GIS Centre for Health, DNA/DDI

WHO/ILO Global Working Hours Database

Bangladesh

Bhutan

Indonesia

Maldives

Myanmar

Srilanka

Thailand

Albania

Armenia

Belgium

Bulgaria

Croatia

Cyprus

Czechia

Denmark

Estonia

Finland

France

Georgia

Greece

Hungary

Iceland

Ireland

Israel

Italu

Latvia

Malta

Lithuania

Luxembourg

Montenegro

Netherlands

Norway

Poland

Portugal

Romania

Serbia

Spain

Sweden

Switzerland

Tajikistan

Turkey

Ukraine

Slovakia Slovenia

Kyrgyzstan

Austria

Timor-Leste

Nepal

India

African Region



Region of the Americas

Year



South-East Asian Region



European Region



Eastern Mediterranean Region



Western Pacific Region

Australia Brunei Darussalam Cambodia China China, Hong Kong Special Administrative Region Taiwan, China Cook Islands Japan Lao People's Democratic Republic Malausia Marshall Islands Micronesia (Federated States of) Mongolia Nauru New Zealand Papua New Guinea Philippines Republic of Korea Republic of Palau Samoa Singapore Solomon Islands Tonga Tuvalu Vanuatu Viet Nam

Afghanistan

Djibouti

Egypt

Jordan

Lebanon

Pakistan

Tunisia

Yemen

Iraq



Surveys (N) 1 📕 2 📕 3 📕 4 📕

WHO & ILO, 2021a

WHO/ILO Global Working Hours Database

	WHO region ^a				Global		
	African Region	Region of the Americas	South-East Asia Region	European Region	Eastern Mediterranean Region	Western Pacific Region	
No. countries, areas and territories	47	36	11	53	22	30	199
No. surveys	135	437	96	1435	66	155	2324
No. countries, areas and territories with ≥1 survey (% of countries, areas and territories)	37 (78.7%)	24 (66.7%)	10 (90.9%)	45 (84.9%)	11 (50.0%)	27 (90.0%)	154 (77.4%)

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Methods applied

Dr Frank Pega





TECHNICAL REPORT WITH DATA SOURCES AND METHODS

WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury, 2000–2016



Global comparative risk assessment

- Established & used by WHO & partners for over 20 years, incl for estimates & indicators
- Quantification of disease burden at the population level caused by risk factors
- Comparative
 - \circ same definitions & framework
 - \circ similar method for combining exposure & risk information
 - same metrics for expressing results (deaths & DALYs)
- Consistent
 - \circ linkage of disease burden by disease & by risk factor
- Estimation of attributable burden, that is current burden from past exposure
- Use of reported occupational cases where feasible

Exposure-based method



Slide credit: Annette Prüss-Üstün

WHO/ILO Joint Estimates for 39 established pairs of occupational risk factors & health outcomes (blue) & 2 additional pairs (red)

	Risk factor	Health outcome
1	Occupational exposure to asbestos	Larynx cancer
2	Occupational exposure to asbestos	Tracheal, bronchus & lung cancer
3	Occupational exposure to asbestos	Ovarian cancer
4	Occupational exposure to asbestos	Mesothelioma
5	Occupational exposure to arsenic	Tracheal, bronchus & lung cancer
6	Occupational exposure to benzene	Leukaemia
7	Occupational exposure to beryllium	Tracheal, bronchus & lung cancer
8	Occupational exposure to cadmium	Tracheal, bronchus & lung cancer
9	Occupational exposure to chromium	Tracheal, bronchus & lung cancer
10	Occupational exposure to diesel engine exhaust	Tracheal, bronchus & lung cancer
11	Occupational exposure to second-hand smoke	Tracheal, bronchus & lung cancer
12	Occupational exposure to formaldehyde	Nasopharynx cancer
13	Occupational exposure to formaldehyde	Leukaemia
14	Occupational exposure to nickel	Tracheal, bronchus & lung cancer
15	Occupational exposure to polycyclic aromatic hydrocarbons	Tracheal, bronchus & lung cancer
16	Occupational exposure to silica	Tracheal, bronchus & lung cancer
17	Occupational exposure to sulfuric acid	Larynx cancer
18	Occupational exposure to trichloroethylene	Kidney cancer

WHO/ILO Joint Estimates for 39 established pairs of occupational risk factors & health outcomes (blue) & 2 additional pairs (red)

	Risk factor	Health outcome
19	Occupational asthmagens	Asthma
20	Occupational particulate matter, gases & fumes	Chronic obstructive pulmonary disease
21	Occupational noise	Age-related & other hearing loss
22	Occupational ergonomic factors	Low back pain
27	Occupational injuries	Other road injuries
28	Occupational injuries	Other transport injuries
29	Occupational injuries	Falls
30	Occupational injuries	Drowning
31	Occupational injuries	Fire, heat & hot substances
32	Occupational injuries	Poisonings
33	Occupational injuries	Unintentional firearm injuries
34	Occupational injuries	Unintentional suffocation
35	Occupational injuries	Other exposure to mechanical forces
36	Occupational injuries	Animal contact
37	Occupational injuries	Pulmonary aspiration & foreign body in airway
38	Occupational injuries	Foreign body in other body part
39	Occupational injuries	Other unintentional injuries
40	Long working hours	Ischaemic heart disease
41	Long working hours	Stroke

WHO/ILO databases of risk factor distribution

Variable	Countries (N)	Surveys (N)	Source
Industrial sector (proxy for exposure to risk factors)	154	1,956	National statistics offices
Occupation (proxy for exposure to risk factors)	97	804	National statistics offices
Exposure to long working hours	146	2,324	National statistics offices, Gallup Surveys
 Occupational exposure to ergonomic risk factors dusts & fibres solar ultraviolet radiation occupational noise 	Diverse	Diverse	WHO/ILO systematic reviews

Leaving no one behind: trends & disaggregation

- Produced for the years 2000, 2010 & 2016
- Reported at the country, region & global levels
- Disaggregated by
 - \odot Occupational risk factor
 - \circ Disease
 - \circ Sex
 - Age group (5-year age bands)

Quality assurance for WHO health estimates

- WHO ethics management of interests
- WHO statistical clearance

 \circ WHO must have assessed evidence base as sufficient

 Estimates must comply with Guidelines for Accurate & Transparent Health Estimates Reporting (GATHER), incl systematic review of input data; documentation of input data, incl meta-data; & description of statistical models, incl uncertainty ranges

• Statistical clearance by WHO Department of Data, Analysis & Delivery

- WHO country consultation
 - \circ WHO consults the Ministries of Health of all 194 Member States on its estimates
 - \circ Ministers of Health & Permanent Missions are contacted & their feedback is invited
 - This strengthens countries' participation, support & use of WHO/ILO Joint Estimates

Systematic reviews & meta-analyses



Input data & their sources

- 39 established pairs
 - 1. Population-attributable fractions: 2017 Global Burden of Disease Study
 - 2. Total deaths or DALYs from health outcome: WHO burden of disease estimates 2000-2016, based on WHO collections from Member States
- 2 additional pairs
 - 1. Distribution of the risk factor in the population: ILO, Eurostat & WHO collections from Member States
 - 2. The effect of the risk factor on the health outcome: systematic reviews
 - 3. Total deaths or DALYs from health outcome: WHO burden of disease estimates 2000-2016



Systematic reviews of input data



Photo credit: EU-OSHA

- 15 systematic reviews conducted to establish evidence base for additional pairs of occupational risk factors & health outcome
- Conducted by WHO & ILO with 200 individual experts in 35 countries
- National systematic reviews conducted by Governments of Peoples' Republic of China & Thailand (Kunpeuk et al, 2021)
- Published open-access in Special Issue in *Environment International*, edited by Paul Whaley & Tim Driscoll, or on the WHO website

Systematic reviews of input data

	Title	Protocol	Systematic review
1	The prevalence of occupational exposure to ergonomic risk factors	Hulshof et al, 2019	Hulshof et al, 2021a
2	The effect of occupational exposure to ergonomic risk factors on osteoarthritis & other	Hulshof et al, 2019	Hulshof et al, 2021b
	musculoskeletal diseases		
3	The prevalence & level of occupational exposure to dusts and/or fibres	Mandrioli et al, 2018	Schlünssen et al, Under review
4	The effect of occupational exposure to dusts and/or fibres on pneumoconiosis	Mandrioli et al, 2018	Ongoing
5	The prevalence of occupational exposure to solar ultraviolet radiation	Paulo et al, 2019	Ongoing
6	The effect of occupational exposure to solar ultraviolet radiation on cataract	Tenkate et al, 2019	Ongoing
7	The effect of occupational exposure to solar ultraviolet radiation on malignant skin	Paulo et al, 2019	WHO, 2021
	melanoma & non-melanoma skin cancer		
8	The prevalence of occupational exposure to noise	Teixeira et al, 2019	Teixeira et al, 2021a
9	The effect of occupational exposure to noise on cardiovascular disease	Teixeira et al, 2019	Teixeira et al, 2021b
10	The prevalence of occupational exposure to long working hours	Descatha et al, 2018	Ongoing
11	The effect of occupational exposure to long working hours on ischaemic heart disease	Li et al, 2018	Li et al, 2020
12	The effect of occupational exposure to long working hours on stroke	Descatha et al, 2018	Descatha et al, 2020
13	The effect of occupational exposure to long working hours on depressive disorder	Rugulies et al, 2019	Rugulies et al, 2021
14	The effect of occupational exposure to long working hours on alcohol use disorders	Godderis et al, 2018	Pachito et al, 2021
15	The effect of occupational exposure to welding fumes on tracheal, bronchus & lung cancer	Pega et al, 2020	Ongoing

The effect of occupational exposure to solar ultraviolet radiation on malignant skin melanoma and nonmelanoma skin cancer:

a systematic review and meta-analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury

Innovations in evidence synthesis

- Systematic reviews for occupational burden of disease study, incl protocols
- Systematic reviews of occupational exposure prevalence studies, incl new methods
 - RoB-SPEO tool for assessing risk of bias (Pega et al, Environ Int, 2019; Momen et al, Environ Int, 2021)
 - QoE-SPEO approach for assessing quality of evidence (Pega et al, Environ Int, 2022)

The new WHO/ILO Joint Estimates of the Work-related Burden of Disease & Injury

Results

Dr Natalie Momen

Estimates – Burden of disease attributable to exposure to long working hours

Systematic reviews & meta-analyses

Systematic review evidence

Health	Long working	Number of studies in	Relative risk	Navigation	Navigation Guide	Evidence judged
outcome	hours	meta-analysis	(95%	Guide rating	rating of strength of	as sufficient to
	category	(participants)	confidence	of quality of	evidence for human	proceed to
			interval)	evidence	data	estimation
Ischemic	41–48	20 studies	0.99	Low quality	Inadequate evidence	No
heart	hours/week	(312,209 participants)	(0.88–1.12)		for harmfulness	
disease	49–54	18 studies	1.01	Low quality	Inadequate evidence	No
	hours/week	(308,405 participants)	(0.82–1.25)		for harmfulness	
	≥55	22 studies	1.17	Moderate	Sufficient evidence	Yes
	hours/week	(339,680 participants)	(1.05–1.31)	quality	for harmfulness	
Stroke	41–48	12 studies	1.04	Low quality	Inadequate evidence	No
	hours/week	(265,937 participants)	(0.94–1.14)		for harmfulness	
	49–54	17 studies	1.13	Moderate	Limited evidence for	No
	hours/week	(275,181 participants)	(1.00–1.28)	quality	harmfulness	
	≥55	7 studies	1.35	Moderate	Sufficient evidence	Yes
	hours/week	(162,644 participants)	(1.13–1.61)	quality	for harmfulness	

attributable to exposure to long working hours for 194 countries, 2000–2016: A systematic analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury

Frank Pega^{a,*}, Bálint Náfrádi^b, Natalie C. Momen^a, Yuka Ujita^b, Kai N. Streicher^a, Annette M. Prüss-Üstün^a, Technical Advisory Group: Alexis Descatha^{c,d,e,f}, Tim Driscoll^g, Frida M. Fischer^h, Lode Godderisⁱ, Hannah M. Kiiver^j, Jian Li^k, Linda L. Magnusson Hanson¹, Reiner Rugulies^{m,n,o}, Kathrine Sørensen^m, Tracey J. Woodruff^p Burden of disease attributable to exposure to long working hours

- 488 million or 8.9% of working-age people work ≥55 hours per week
- 745,194 attributable deaths (UR 705,786–784,601)
- 23.3 million DALYs lost (UR 22.2–24.4 million)

Burden of disease attributable to exposure to long working hours

- Upwards trend in both exposure & burden between 2000 & 2016; deaths from heart disease up by 42% & from stroke by 19%
- Larger burden among Africa, South-East Asia, Western Pacific, males & older people
- Occupational risk factor with the largest mortality burden identified!

Rate of deaths from stroke & ischemic heart disease (per 100,000 working-age population) attributable to exposure to long working hours, 2016

Adapted from: Pega, Náfrádi et al, Environ Int, 2021

Estimates – Burden of disease attributable to 19 occupational risk factors

GLOBAL MONITORING REPORT

WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury, 2000–2016

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Scand J Work Environ Health – online first: 22 November 2021. doi:10.5271/sjweh.4001

Global, regional and national burden of disease attributable to 19 selected occupational risk factors for 183 countries, 2000–2016: A systematic analysis from the WHO/ILO Joint Estimates of the Work-related Burden of Disease and Injury

by Frank Pega, PhD,¹ Halim Hamzaoui, MD,² Bálint Náfrádi, PhD,² Natalie C Momen, PhD¹

Burden of disease attributable to 19 occupational risk factors

- 1.9 million deaths (95% UR 1.8-1.9 million)
- 89.7 million DALYs (95% UR 88.6-90.8 million)
- Larger burden among Africa, South-East Asia, Western Pacific, men & older people

Globally, exposure to **risk factors at work** results in almost **2 million premature deaths per year**

Number of deaths, by occupational risk factor, 183 countries, 2016

Occupational risk factors

Occupational exposure to asbestos					
Occupational exposure to arsenic					
Occupational exposure to benzene					
Occupational exposure to beryllium					
Occupational exposure to cadmium					
Occupational exposure to chromium					
Occupational exposure to diesel engine exhaust					
Occupational exposure to formaldehyde					
Occupational exposure to nickel					
Occupational exposure to polycyclic aromatic hydrocarbons					
Occupational exposure to silica					
Occupational exposure to sulfuric acid					
Occupational exposure to trichloroethylene					
Occupational asthmagens					
Occupational particulate matter, gases and fumes					
Occupational noise					
Occupational injuries					
Occupational ergonomic factors					
Exposure to long working hours					
۵	2000	00 400	000 6	00 000	800 000

Number of deaths

Number of deaths, by health outcome, 183 countries, 2016

Health outcomes

Number of deaths

WHO & ILO, 2021b

Rate of work-related deaths (per 100,000 working-age population), 2016

Adapted from: Pega et al, Scand J Work Environ Health, 2021

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Policy relevance and applicability for data users

Dr Frank Pega & Dr Halim Hamzaoui

Policy relevance

Importance of OSH data in occupational health

Identification of priorities

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Assessment of achievements

Implementation of adequate actions

WHO/ILO Joint Estimates added value

Notification and recording of occupational injuries and diseases

- Access to rights
- Underdiagnosis mainly on occupational diseases

Complementary surveys associated to Labour Force Surveys or establishment surveys

- Explore exposure to occupational hazards
- Subjective responses specifically for workrelated diseases

WHO/ILO Joint Estimates

- Evidence-based data based on validated methodology
- Reliable data available by country, gender and age: target specific populations

Products for users

Data products & publications

Online app

https://www.who.int/teams/environment-climate-change-andhealth/monitoring/who-ilo-joint-estimates

Indicators for monitoring systems

- WHO Global Health Observatory
- WHO Environmental Health Profiles
- ILOSTAT
- EC (DG Employment, EU-OSHA)
- Proposed additional SDG indicator

Three reports

- Global monitoring report
- Technical report
- Systematic review

22 journal articles

- Two estimates articles
- Ten systematic review protocols
- Seven systematic reviews
- Four methods articles

Communication & advocacy products

Website (entry point)

Press Conferences

Infographics

Social media tiles

Breaking news

	the		Inti NT VOICE IN AS	mes	
OPINION	LIFE		сомми	UNITY	
NATIONAL	ASIA PACIFIC	BUSINESS	WORLD	REFERENCE	M
	OPINION	OPINION LIFE	OPINION LIFE NATIONAL ASIA PACIFIC BUSINESS	OPINION LIFE COMMU NATIONAL ASIA PACIFIC BUSINESS WORLD	OPINION LIFE COMMUNITY NATIONAL ASIA PACIFIC BUSINESS WORLD REFERENCE

World Health Organization chief Tedros Adhanom Ghebreyesus says he and other WHO staff have been working long urs during the pandemic I REUTERS

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Global capacity building

• Evidence synthesis in occupational health

200 individual experts in 35 countries trained in systematic review
 Working Group of systematic review methodologists
 New methods developed & tested for synthesising evidence from occupational exposure prevalence studies

• Estimation of work-related exposures & burden of disease

 \odot Participation & consultation of countries

 \odot Technical Advisory Groups

Next & future steps

Looking into the future

- Second estimation cycle (2021-2023), incl additional pairs
- Estimates of economic costs of work-related burden of disease
- - Exposures & disease burden linked to geo-locations (e.g., heat stress)
- Projected reductions of disease burden from policies & interventions

Conclusions

Conclusions

- WHO & ILO, supported by governments, organizations & individual experts, have launched the first WHO/ILO Joint Estimates, available for use in countries
- The estimates are based on long-established statistical modelling methods, systematic reviews of evidence, large databases of official data & country consultation & collaboration
- Our world-first estimates of disease burden from exposure to long working hours identified the largest occupational risk factor, causing 745,000 deaths per year globally
- Second estimation cycle has started, adding pairs to further expand estimates' scope
- In the future, additional data & analytical products can be added (costs, geo-spatial disaggregation & intervention effects) & the estimates can be updated regularly
- Continued opportunities for governments, supporting organizations & individual experts to participate in WHO/ILO occupational health research & monitoring

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- European Commission, DG Employment

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- Editors & academic journals: Paul Whaley, Tim Driscoll, Adrian Covaci, *Environ Int;* Reiner Rugulies, Alex Burdorf, *Scand J Work, Environ & Health*
- WHO & ILO secretariats: Maria Neira & Vera Paquete-Perdigão; Rola Al-Elmam, Mathieu Boniol, Richard Brown, Bochen Cao, Bayan Hosseini, Ahmadreza Hosseinpoor, Ivan Ivanov, Kathleen Krupinski, Maria Leon-Roux, Marion McFeedy, Franklin Muchiri, Subas Neupane, Joaquim Pintado Nunes, Ann Olsson, Felix Onyije, Lesley Onyon, Annette Prüss-Üstün, Joachim Schüz, Mary Schubauer-Berigan, Kai Streicher, Yuka Ujita, Emilie van Deventer & Jennyfer Wolf

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The new WHO/ILO Joint Estimates of the Work-related Burden of Disease & Injury

Number of DALYs, by occupational risk factor, 183 countries, 2016

Occupational risk factors

Number of DALYs (in thousands)

WHO & ILO, 2021b

Rate of work-related DALYs (per 100,000 working-age population), by country, 183 countries, 2016

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