Work today and in the future:
Part Three: Work-related deaths, diseases and costs in the Nordic countries

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Objective of the project

The project was requested by the Director Generals of the Nordic Labour Inspectorates. It's initial objective is to estimate the extent of work-related deaths in the Nordic countries. The recorded and approved numbers of **"occupational deaths"** depend on the legal definition of "occupational deaths/occupational diseases" in each country, whereas **"work-related deaths"** and work-related diseases covers a broader concept[1].

The number of work-related deaths represents only a part of the overall work-related burden of disease. Fatal cases alone do not account for illnesses and diseases conditions resulting from musculoskeletal disorders, or factors such as repetitive movements, and psychosocial issues, as these seldom lead to death. Additionally, the various stages of disability and loss of the quality of life are not considered in these calculations.

To provide a more detailed overview of health-related hazards, the project incorporates work-related diseases to better illustrate the loss of quality of life and economic consequences due to work-related deaths and disabilities., This is quantified in terms of **Disability Adjusted Life Years (DALYs)** estimated for the Nordic countries. The toll of deaths and injuries affecting young people significantly impact the working population, and this is well captured through the measurement of DALYs.

Numerous research reports are available on both of these issues.

[1] ILO criteria for including diseases as an occupational disease are listed in the ILO List on Occupational Diseases: https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_125137.pdf

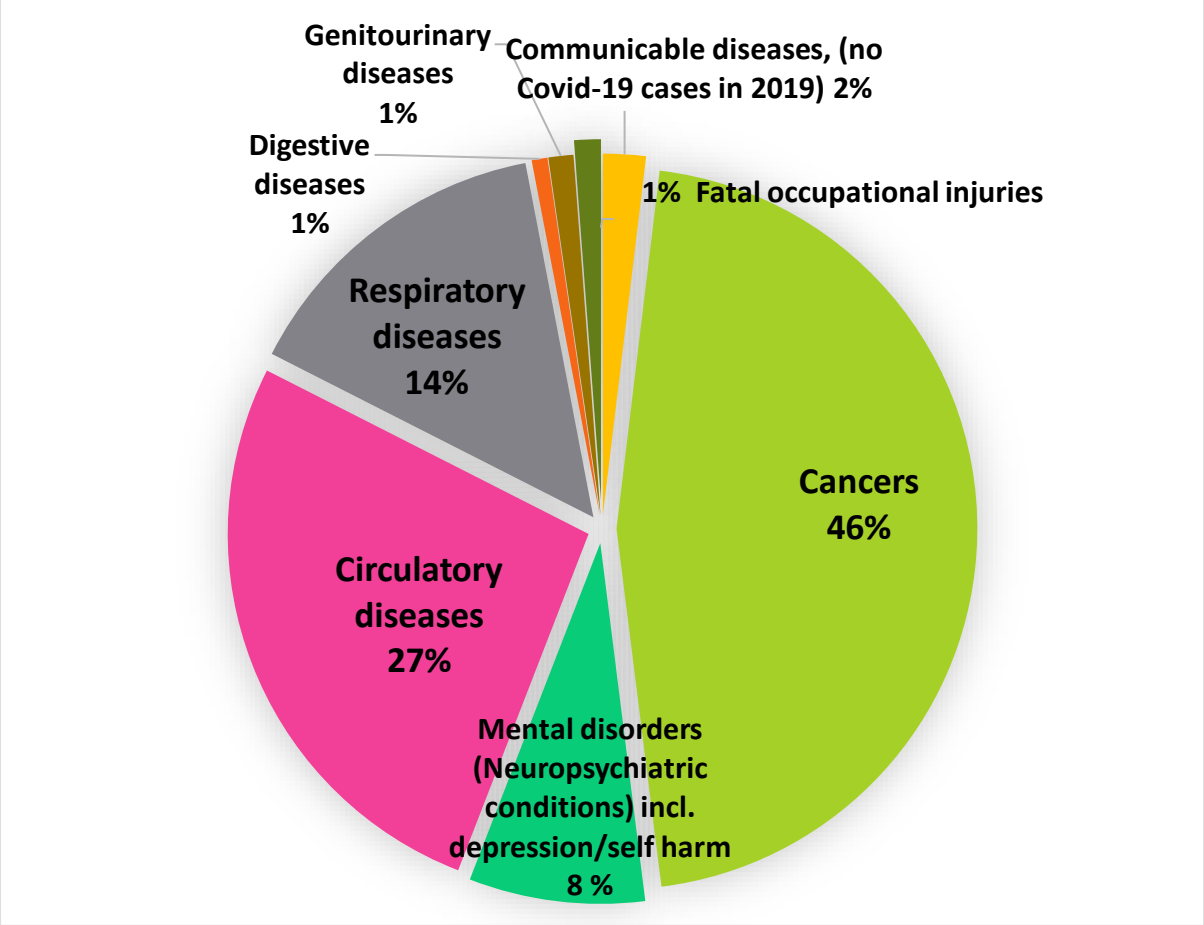
Background

The effectiveness of Occupational Safety and Health (OSH) preventive work and labour inspection is generally assessed through the reporting and recording of occupational accidents and diseases in both absolute numbers and rates.

In Nordic countries, fatal occupational accidents are well-documented and closely align with the overall estimates of the International Labour Organization (ILO). However, in most countries, the reporting and recording of occupational accidents are unreliable, with the Nordic countries being an exception. Consequently, the ILO has employed scientific estimation methods for occupational accidents and work-related diseases over the past decade.

Causes of work-related deaths

In 2019, an estimated total of 11 730 work-related fatalities occurred in the Nordic countries, with **only 143 (1 %) were attributed to accidents at work**. The leading causes of work-related deaths were cancers and circulatory diseases, the latter encompassing cardiovascular diseases caused by stress and prolonged working hours.



Fatal work-related diseases and injuries in all Nordic countries (2019). Fatal occupational injuries per country and work-related diseases per Nordic country, see annex. Source ICOH Global Estimates 2019.

The estimate indicates that fatal occupational accidents accounts for just 1 % of the total, with chemical, physical and biological exposures being the predominant contributors. Notably, these exposures are responsible for a significant number of cancer deaths (46 %), followed by circulatory and respiratory diseases.

Despite the substantial percentage of work-related (non-accident) deaths, labour inspections and media attention primarily focuses on occupational accidents and fatalities. While attention to occupational injuries is valid and necessary due to their immediacy and preventability, exposures with long latency periods necessitate sustained, long-term efforts and strategies. Drawing from inspection practices in Finland, the majority of inspections (57%) concentrate on preventing accidents, followed by 24% on chemical agents, 12% on biological agents, and 7% on physical workload (see chapter Focus of inspections: Case Finland and details in Annex 2).

As these diseases also occur in the general population without work exposure, research[2,3] has been conducted to estimate the fraction of diseases attributable to workplace exposures. Generally, 5-20 % of such diseases can be related to exposures at work (see also references at the end of the text). Mesothelioma is an exception with an attributable fraction of 80-95 %. Mesothelioma incidence and mortality can therefore be used as a proxy for asbestos exposure and consequently other asbestos-related cancers.

These attributable fractions are determined through numerous scientific studies comparing two similar working populations - one exposed to risk factors and the other not. The fraction represents the percentage of negative outcomes, such as deaths or diseases, that could have been prevented by eliminating or reducing the exposure.

Validity of cancer estimate

The largest proportion of work-related deaths is linked to cancer. Most cancers have a relatively long latency period, meaning that the exposures leading to the development of cancer occurred many years ago. While it is impossible to prevent past exposures, some exposure still occurs today, others have decreased, and new potential carcinogen exposures are emerging. The responsibility for monitoring retired workers with past exposures has shifted from labour inspectors to the healthcare service, where the exposure history should be taken seriously, especially considering the expected 20% increase in cancer fatalities from 2020 to 2035 in Finland. Additionally, new suspected carcinogenic chemical and biological agents have replaced old known carcinogens among the thousands of new chemicals in use. The impact of these substances on workers is not fully understood.

While reduced exposure in some cases (such as smoking and passive smoking) is decreasing the risk, longer life expectance is expected to result in higher proportional cancer fatalities in the short term. Research suggests[3] that the number of work-related deaths caused by cancer is likely to continue increasing in the next ten to twenty years, with a slow decrease over a longer period.

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[2] Nurminen M, Karjalainen A. Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. Scand J Work Environ Health 2001;27(3):161—213.

[3] Takala J, etc. Global-, regional- and country-level estimates of the work-related burden of diseases and accidents in 2019, Scand J Work Environ Health, 2023. *https://doi.org/10.5271/sjweh.4132* , Supplementary pdf-files and excel-files have the latest death and disability data on all work-related diseases and injuries of all Nordic countries – including also EU Member States, and 181 countries and regions.

Cancer prevention requires a long-term approach, and the current degree of chemical exposure is more diverse. Workers are now exposed to a wider array of chemicals, both at work and leisure time, making the exposure more complex than in the past. For example, asbestos is still present in infrastructure (see the next paragraph) and will be released during demolition and repair work. Although asbestos exposure will be lower, more people will be exposed in urban surroundings. Airborne particles from burning wood, long-term exposure to silica dust for workers, and the confirmed carcinogenicity of diesel exhaust fumes, established only a decade ago despite over a century of use, highlight the ongoing importance of labour inspectors focusing on occupational exposures.

Moreover, there is insufficient information about the joint effects of multiple chemical exposures, but often different exposures can reinforce each other.

Asbestos exposure

Asbestos exposure has been and remains the highest single factor causing work-related deaths. Despite public belief that past bans on asbestos have resolved the problem, this is not the case. For instance, Sweden banned the use of new asbestos products approximately 40 years ago. However, recent data from the Global Burden of Disease 2019 (published in *The Lancet* and available at https://vizhub.healthdata.org/gbd-compare/) shows that the total number of asbestos-related deaths in Sweden, particularly in the Stockholm area, continues to rise. Although the number of younger victims is decreasing, this positive trend is overshadowed by the massive exposure caused by asbestos during infrastructure activities, especially in renovations and demolitions related to housing, piping, and roofing materials.

The continuous need for building renovation releases asbestos fibres into the air. While installation workers in the 1970s faced heavy exposures to asbestos, today a vast number of workers and the general population are exposed to relatively low levels. In many European cities, the number of fibres often exceeds the new EU occupational exposure limit of 2000 fibres/m^3 (cubic metre) inhaled in an hour[4]. The risk of cancer caused by asbestos is linear without a lower limit. Therefore, the resulting exposure of 2000 fibres/m^3 by 100 persons equals the risk of one person exposed to 200 000 fibres/m^3, as was the case in the 1970s. This trend in Sweden is likely to be mirrored by countries that banned asbestos later.

WHO's latest estimates were 25,372 mesothelioma deaths in 2022 and according to WHO this estimate will go up to 52,961 or 108% by the year 2050. Mesothelioma mortality has a strong link to asbestos exposure – up to 95% of mesothelioma cases are caused by asbestos. IARC/WHO researchers have shown that mesothelioma mortality can be a proxy for asbestos exposures which also causes other very common cancers such as lung cancer. Consequently, present asbestos mortality will increase all other asbestos-related cancers. Present exposures in the Nordic countries come mainly from existing asbestos in infrastructure and the renovation and removal processes.

[4] The new EU Directive was adopted on 22.11.2023 and came into force 20 days later. There is a long implementation period until 2029 for the OEL of 2000 fibres/m^3 or 0.002 fibres/cm^3. The occupational exposure limit before 2029 is 10 000 fibres/m^3 or 0.01 fibres/cm^3, see the new EU Directive: *https://www.europeansources.info/record/proposal-for-a-directive-amending-directive-2009-148-ec-on-the-protection-of-workers-from-the-risks-related-to-exposure-to-asbestos-at-work/*

Source:
https://gco.iarc.who.int/tomorrow/en/dataviz/tables?multiple_populations=1&mode=population&multiple_cancers=0&types=1&cancers=18&populations=900&years=2050

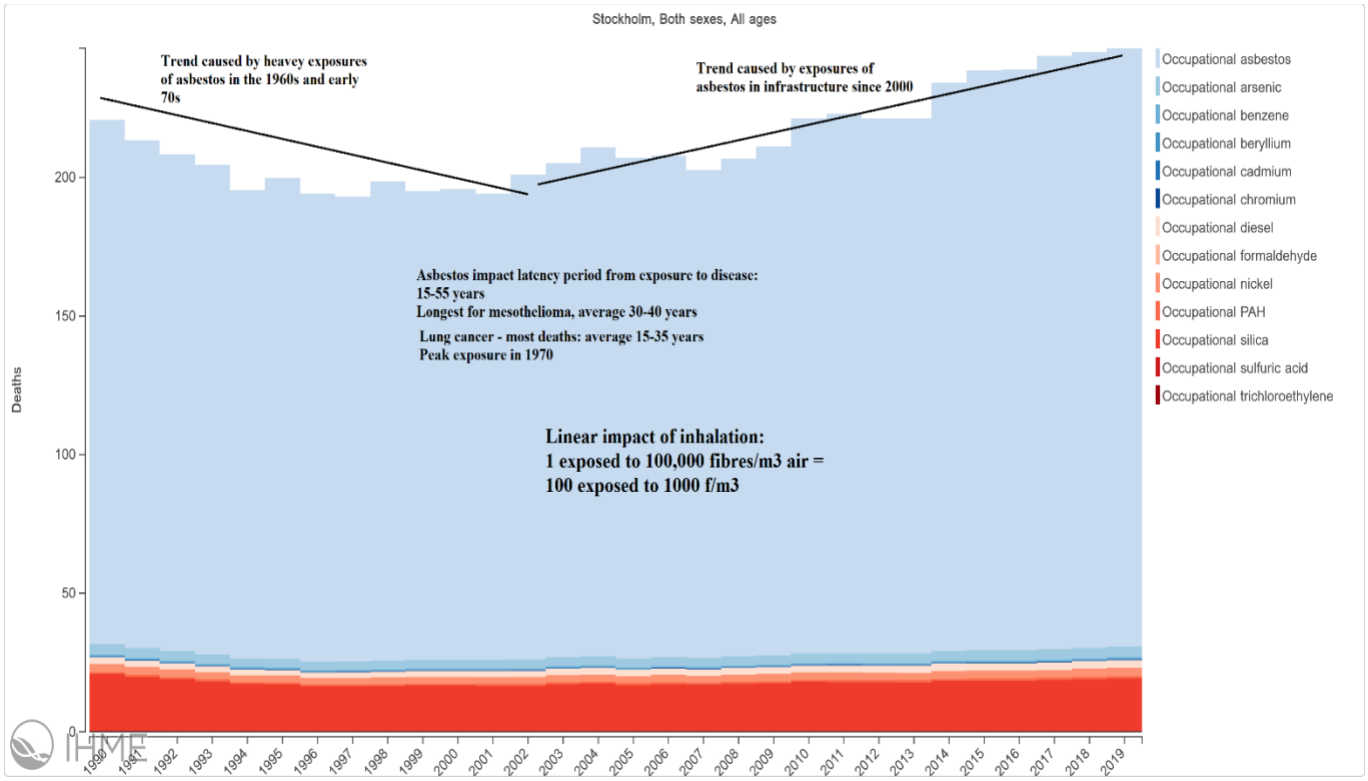

Figure 1. Trend of Asbestos-related death risk among male and female of all age in Stockholm from 1990 to 2019. A massive amount of asbestos in infrastructure is a major factor.

Psychosocial risks

Psychosocial risks arise from poor work design, organisation and management, as well as a poor social context of work. These risks may lead to negative psychological, physical and social outcomes, such as work-related stress, burnout, or depression. In addition to psychological and mental disorders, psychosocial risks are associated with cardiovascular diseases that may have lethal consequences, such as myocardial infarction or stroke.

Excessive stress can adversely affect the cardiovascular system by accelerating harmful cardiovascular processes, including atherosclerosis, and by contributing to triggering a cardiovascular event. The mechanisms underlying the increased risk of developing cardiovascular disease among individuals experiencing stress can also be indirect, via adverse lifestyle or lifestyle changes that speed up atherosclerosis and metabolic dysregulation.

The primary negative outcome of psychosocial risks is long term disability, including lost workability that may extend throughout one's life. Fatal cases caused by self-harm and suicides have been reported. In addition to ischemic heart disease and stroke, psychosocial factors contribute to an average population attributable fraction of 16.6 % for depression. The range of attributable fraction is 9 – 25 %, with the Nordic countries situated at the lower end.

References:
EU-OSHA – European Agency for Safety and Health at Work, The links between exposure to work-related psychosocial risk factors and cardiovascular disease, 2023. https://osha.europa.eu/en/publications/links-between-exposure-work-related-
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Kivimäki, M., Bartolomucci, A., & Kawachi, I. (2022). The multiple roles of life stress in metabolic disorders. Nature Reviews Endocrinology. Advance online publication. doi:10.1038/s41574-022-00746-8
Kivimäki, M., & Steptoe, A. (2018). Effects of stress on the development and progression of cardiovascular disease. Nature Reviews Cardiology, 15(4), 215-229.
doi:10.1038/nrcardio.2017.189

Fatalities due to mental and neuropsychiatric disorders

These diseases and deaths may arise from mental disorders covering diseases related to "Vascular and unspecified dementia" and "Depressive episodes",

The exposures vary from

a) Job strain including high levels of psychological demands, low levels of decision latitude, and low levels of social support for mental disorders at work . Suicides caused or contributed by job strain are included here.

b) Pesticides (herbicides and insecticides) and fertilizers for vascular dementia.

Neuropsychiatric disorders at work are caused by diseases of the nervous system and spinal muscular atrophy, Parkinson's disease and Alzheimer's disease. The exposures are mainly due to pesticides (herbicides and insecticides), see further
https://www.sjweh.fi/article/4132 and related Supplementary materials 1- 2
https://www.sjweh.fi/article/download_online.php?abstract_id=4132&file_nro=1

Work-related deaths: Case Sweden[5]

In 2019, Swedish authorities released a report detailing the number of work-related deaths attributed to selected exposures (see the table). This report encompasses noise and long term heavy physical work, where the relationship to work and associated risks is less reliable. Some individuals may have been exposed to more than one factor, preventing the direct addition of numbers to estimate the total work-related cases in Sweden. However, the order of magnitude is roughly similar to the estimates provided by the ICOH.

Factor	Number of work-related deaths per year		
	Women	Men	Total
Accidents	4,0	33,0	37,0
Stress	360,3	412,2	772,4
Shift work	280,9	446,8	727,7
Dust (COPD)	246,6	174,8	421,4
Asbestos	45,0	222,5	267,5
Quartz	9,0	116,2	125,2
Engine exhaust	222,7	324,7	547,4
Passive smoking	75,2	119,6	194,8
Welding fumes	32,0	39,0	71,0
Ionizing radiation	1,0	3,8	4,8
Uncertain connections			
Noise	338,4	439,0	777,4
Physical heavy work	0,0	1 548,8	1 548,8

The Swedish study identifies work exposures leading to premature deaths, with estimated numbers surpassing those of fatal occupational accidents. Stress and shift work contribute to the highest number of work-related deaths, and frequently occurring diesel exhaust exposure is also a significant cause. The fatal outcomes are primarily concentrated in occupational cancer, cardiovascular, and respiratory problems.

According to the ILO, Sweden recorded 4,250 work-related deaths in 2017. The latest data indicates approximately4407 deaths based on 2019 data. The increasing numbers of deaths are largely attributed to long-latency diseases at work, which continue to rise with increasing life expectancy. For the latest data on Sweden and other Nordic countries, refer to the EU-OSHA Barometer (ICOH Estimates): https://visualisation.osha.europa.eu/osh-barometer/osh-outcomes/work-related-diseases/icoh/prevalence-of-diseases/all-diseases and the printed document at https://osha.europa.eu/en/publications/occupational-safety-and-health-europe-state-and-trends-2023

Discussion in Parliament on deaths by work-related diseases: Case Denmark

A question regarding work-related deaths has been discussed in the Danish Parliament[6]. In response, the Danish Working Environment Authority noted that the Danish register of notified occupational diseases does not include records of deaths.

Estimates of mortality from occupational diseases were evaluated in a Danish report from the National Institute of Public Health in 2006, based on a Finnish model. This assessment resulted in approximately 2,000 cases in Denmark caused by occupational diseases each year. The ILO's past data for 2015, released in 2017, was notably higher at 2,445. The Danish report further estimated that around 1,400 deaths can be linked annually to mental health issues at work, although it did not provide detailed information on the exact cause of these deaths.

[5] Arbetsmiljöverket, Arbetsrelaterad dödlighet – delrapport 1, Beräkning av antalet dödsfall 2016 uppdelat på olika exponeringar i arbetet, https://www.av.se/globalassets/filer/publikationer/kunskapssammanstallningar/arbetsrelaterad-dodlighet-rap-2019-3-del-1.pdf?hl=arbetsrelaterad%20d%C3%B6dlighet

[6] https://www.ft.dk/samling/20131/almdel/beu/spm/84/index.htm

According to a 2005 report from the Danish Cancer Society, an estimated 1,300 cancer cases per year may be attributed to the working environment.

The current best estimates provided by the NMR project for the detailed questions are:

a) hvor mange der årligt dør af dårligt arbejdsmiljø i Danmark
(how many die annually due to poor working environment in Denmark)

- 2 472 fatal work-related diseases; occupational cancer has the biggest share of this or 1,153 deaths.
- 39 fatal occupational accidents
- 197 fatal work-related mental disorders or neuropsychiatric conditions (64 suicides linked to depression are included for work-related self-harm cases/depression)

These are the latest available data based on the source year 2019.

Negative outcomes caused by the psychosocial work environment were estimated in Denmark to have resulted in 1,400 occupational diseases, encompassing both fatal and non-fatal cases. However, it is important to note that the project lacks detailed data to confirm these estimates. The consequences of poor psychosocial work environment include circulatory diseases, depression, and even suicides. Separate tables for each Nordic country provide information on deaths and disabilities, as measured by DALYs.

b) overvejelser om omfanget af mørketal, således at det muligvis kun er muligt at angive et minimumstal (assessment of the size of underreporting, so that one could possibly provide a minimum number)

The confidence intervals (CI) for both upper and lower levels were calculated to be in the range 20-30 % in both directions, varying on the region and the specific disease under consideration. However, the reporting of mortality levels for diseases and accidents may vary significantly, with some countries reporting their data poorly. While this is not the case for Nordic countries, detailed country-level confidence intervals have not been estimated for these reasons.

c) hvad de tilsvarende tal er for Sverige? (what is the corresponding number for Sweden)

- 4 407 fatal work-related diseases; occupational cancer accounts for the largest share with 2,056 deaths.
- 36 fatal occupational accidents
- 924 fatal work-related mental disorders or neuropsychiatric conditions (including 118 suicides linked to depression in work-related self-harm cases)

These are the latest available data based on the source year 2019.

A separate table has been created in Sweden and published by the Swedish Work Environment Authority. The classification is different and is based on exposure rather than the cause of death.

d) **hvorledes forskelle mellem Danmark og Sverige kan forklares, når tallene er korrigeret for indbyggertal?** (how can the differences between Denmark and Sweden be explained, when the numbers are corrected according to population?)

The data are matching well when the Labour force data are taken into account between Denmark (3 023 904) and Sweden (5 081 363)

Top ten hazardous work exposure tasks and occupations: Case Finland

A new Finnish survey from 2017 has identified the highest hazardous work exposures and occupations[7]. The project examined the exposure of chemical agents at workplaces based on the registry data from the early 2000s and identified hazardous work tasks and occupations where exposure levels exceeded 50% of the occupational exposure limit values. It is possible that exposure levels were even higher in workplaces not included in the registry, where measurement data was not obtained.

The top ten hazardous work tasks and occupations were:

1. Work with reinforced plastics.
2. Dusty tasks in construction.
3. Dusty tasks in metal ore mining and quarrying.
4. Floor layering.
5. The manufacture of concrete products.
6. Car painting.
7. The use of formaldehyde adhesives in the wood industry.
8. Welding and flame cutting of metal products.
9. Aluminium welding and flame cutting.
10. Bakery work.

According to the calculated risk of the disease burden caused bywork, lung cancer cases were most often found in welding and flame cutting, as well as in welding acid-proof and stainless steel. However, the highest risk of lung cancer was in the mining and quarrying of metal ores, particularly increased by exposure to diesel exhaust gases.

The disease burden caused by asthma, chronic obstructive pulmonary disease (COPD), and silicosis in hazardous occupations revealed that dusty tasks in construction, such as building demolition, are the primary contributors to respiratory diseases in all three categories. The next highest number of respiratory diseases was estimated in welding and flame cutting. Exposure to dusts, sensitizing, or irritating agents represent the most common work-related hazards for respiratory diseases. Dusty tasks in construction, as well as welding and flame cutting work, pose the largest disease burden and risk of diseases.

[7] Kemikaaliriskien hallinta kuntoon - REKISTERITIETOON PERUSTUVA SELVITYS KEMIKAALEILLE ALTISTAVISTA RISKITÖISTÄ JA -AMMATEISTA, FIOH, 2017.

Occupational skin diseases and respiratory allergies occur most frequently in bakery work, hairdressing, stainless steel welding, and welding and flame cutting. The highest lifetime risk of occupational disease was identified among automotive painters.

Recommendations from the survey include incorporating the following factors into the chemical agents' management model:

1. Organizational factors (organization and its activities)
2. Chemical legislation
3. Risk assessment
4. Risk management
5. Education and skills
6. Communication and information within a company, and occupational health services.

Small businesses require more expertise in occupational safety at work, and certain approaches have been designed to assist these companies in controlling chemical and other risks in the work environment.

In the management and control section, the project proposes a set of control and enforcement practices targeting existing measures or lack of measures related to eliminating and reducing exposures using an established hierarchy of control. This set requires systematic long-term management efforts, exposure control structures, assigning responsibilities, training, record-keeping, enterprise-level surveys and questionnaires, and cooperation with occupational health providers.

A check list for workplaces/employers to control the chemical hazards was provided:

- Gather and update all chemical fact sheets and the list of workplace chemicals.
- Recognize all chemical risks and worker exposures.
- Assess and prioritized the chemical risks.
- Decide and carry out all needed preventive measures.
- Ensure adequate instructions and guidance for workers.
- Continuous surveillance.
- Training.
- Be open about the risks and commit yourself to prevention.

In risk assessments, it is important to consider the combined effects of different, but similarly acting substances, as well as combined exposures from multiple sources, such as work-related exposures and exposure related to nutrition and consumer products. This supports the EU's "one substance one assessment" goals.

A synergistic effect occurs when the combined effect of exposures is much greater than the sum of the individual effects. Examples include the synergistic effect of carbon tetrachloride and ethanol on liver toxicity and the synergistic effect on the lungs due to smoking and exposure to asbestos.

Regulation of PFAS (per- and polyfluoroalkyl substances) is currently under discussion. PFAS, resistant to heat, water, and grease, are used in everyday products like packaging, clothing and cosmetics. Termed "forever chemicals", due to their non-biodegradable nature, PFAS have been linked to multiple health issues, including cancers, high cholesterol, thyroid disease, liver

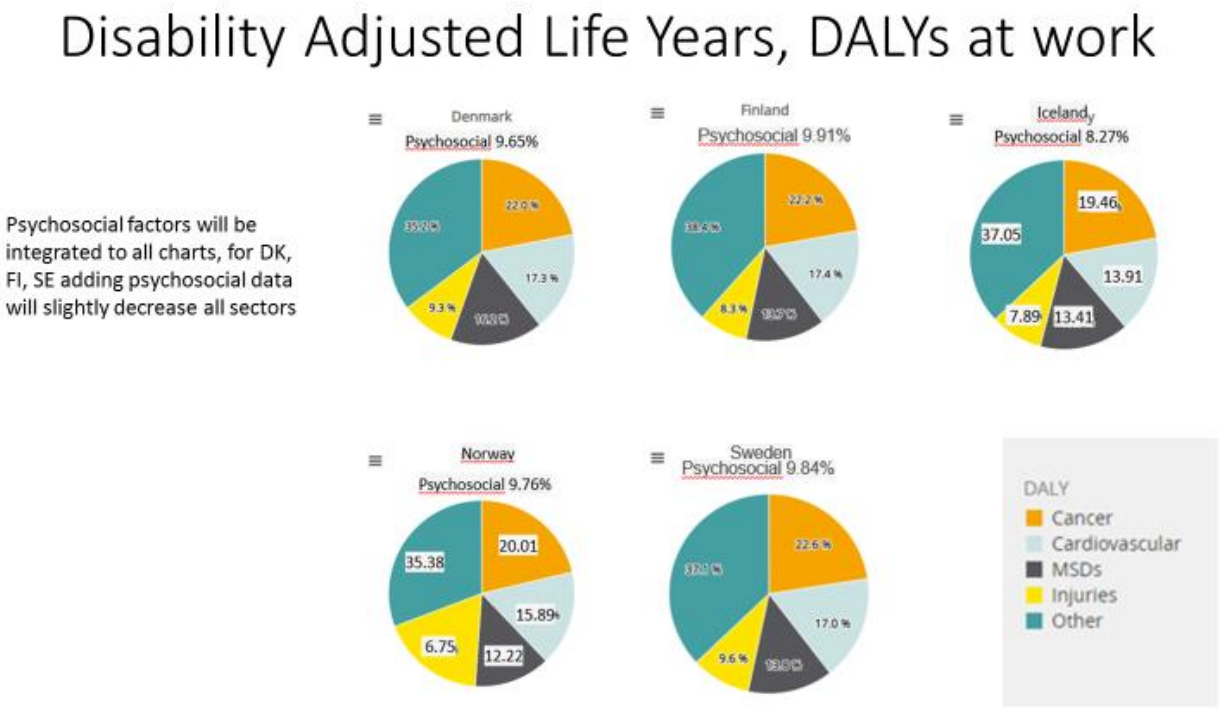
damage, decreased fertility, low birth weights, asthma, allergies, and reduced vaccine response in children. Even rainwater and soil across the globe are likely to contain unsafe levels of PFAS.

Causes of DALYs in the Nordic Countries

Disability Adjusted Life Years (DALYs) is an important indicator for assessing the level and duration of disability. While death cases are concrete and easily comprehensible for preventive purposes, disability level and duration are broader key indicators encompassing both Years of Life Lost (YLL) caused by deaths and Years Lived with Disease (YLD) due to permanent or temporary disability suffered by workers. The "adjustment" process is an internationally agreed-upon procedure that considers the severity of diseases or injury outcomes. For instance, a three-days disability is considered less significant than a loss of limb, blindness, or permanent mental incapacity to work, and DALYs distinguish between such cases.

The estimation methodology known as "Disability Adjusted Life Years" (DALYs) has been developed by WHO to provide a comprehensive view of the disease burden. One DALY represents the loss of the equivalent of one year of full health. By using DALYs, the burden of diseases causing premature death, as well as less serious disabilities, can be calculated and visualized with a single indicator. This also explains the higher share of accidental injuries (in DALYs) compared to the share of numbers of deaths (see the next page) only – represented by the yellow slice of the pie chart. This difference is due to the fact that occupational accidents cause the deaths of much younger workers, typically in their 30s, while victims of occupational cancer often pass away towards the end of their working career or later.

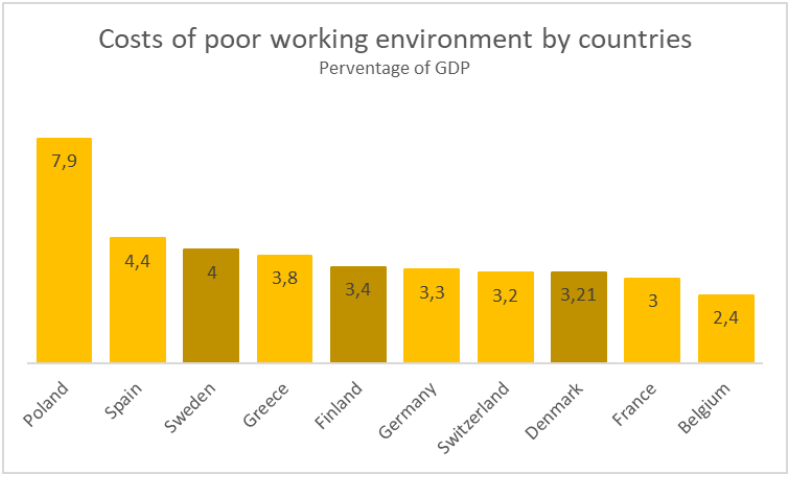
The DALY concept is based on life disability which is different from work disability used by workers' compensation bodies. Workers may be not be able to work for a short term or for a full working life in their respected jobs while they could continue to live, for example, through their full life expectancy. Work disability may be much stricter depending on the compensation rules and practices. When measuring productivity losses due to poor work environment the DALY concept provides considerably lower losses as compared to using Work disability measurements. See PALY concept being considered in Annex to this article.



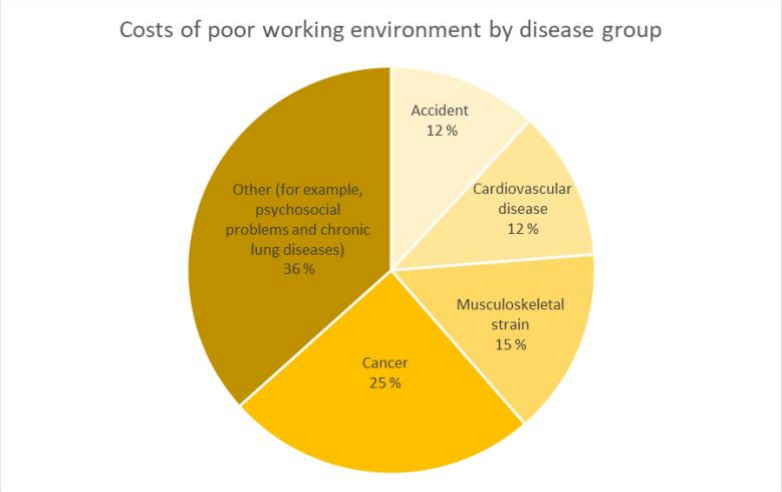
Note: To be updated by EU-OSHA to avoid overlapping estimates
Source: original data from EU-OSHA, new data by Nordic project, integrated already to Iceland and Norway charts

Costs of work-related diseases and deaths

On average, research estimates that the cost of poor working conditions is approximately 4 % of a country's GDP. In Finland, the estimated cost of lost labour input is 2 billion (milliards) euros per month, totalling 24 billion euros annually.



Examining the sources of these overall costs attributed to work-related injuries and diseases, the research indicates that occupational accidents account for 12 % of the total, while cancer incurs a cost of 25 %[8]. Heart and coronary diseases also contribute 12 %, musculoskeletal injuries contribute 15 %, and psychosocial issues and chronic lung diseases are grouped under 'Others'. That sector covers also occupational skin diseases, hearing loss, allergies and asthmatic conditions at work etc.



In Finland a major part of the loss of labour input relates to psychosocial risks at work and mental health issues leading to disability pensions and sickness absence:

1. Almost ¾ of all *work disability pensions* (of varying length) in Finland are caused by mental health disorders/psychosocial factors and 3% of these pension receivers in the workforce are diagnosed as having a *permanent (lifelong) disability* (corresponding to 3 % of the total sum of salaries paid in Finland), and
2. Shorter or longer *sickness absence days* caused by mental health/psychosocial factors corresponding to an additional 5% of the total sum of salaries paid in Finland. Today the highest economic losses for the society are from mental health disorders and followed by musculoskeletal disorders.

According to the Finnish Institute of Occupational Health about two life-long work disabilities are diagnosed every day and a high share of the victims are relatively young – in their 30's - and more often women than men.

Two Norwegian reports reviews the costs of work-related diseases and deaths. In 2016, the research institute SINTEF estimated that work-related diseases and injuries had an annual cost of about NOK 30 billion (milliards) (approximately 2,6 billion (milliards) Euro, according to today's exchange rate)[9]. However, this is a conservative estimate, as neither mental nor circulatory disease is included. Lumbar disease is the only musculoskeletal disease included. The other report was published by Oslo Economics in 2018. One conclusion here is that the annual socio-economic costs linked to a non-optimal working environment are calculated to about NOK 75 billion (milliards) (approximately 6,5 billion (milliards) Euro, according to today's exchange rate)[10]. Some of the difference from the SINTEF report can be explained by the fact that they have used a different value for a year of life lost. In addition, the loss of health associated with mental disorders is included.

[8] Source: Arbetarskydd 11/2017, data from European Agency for Safety and Health at Work, International Commission on Occupational Health, ICOH, and ILO.

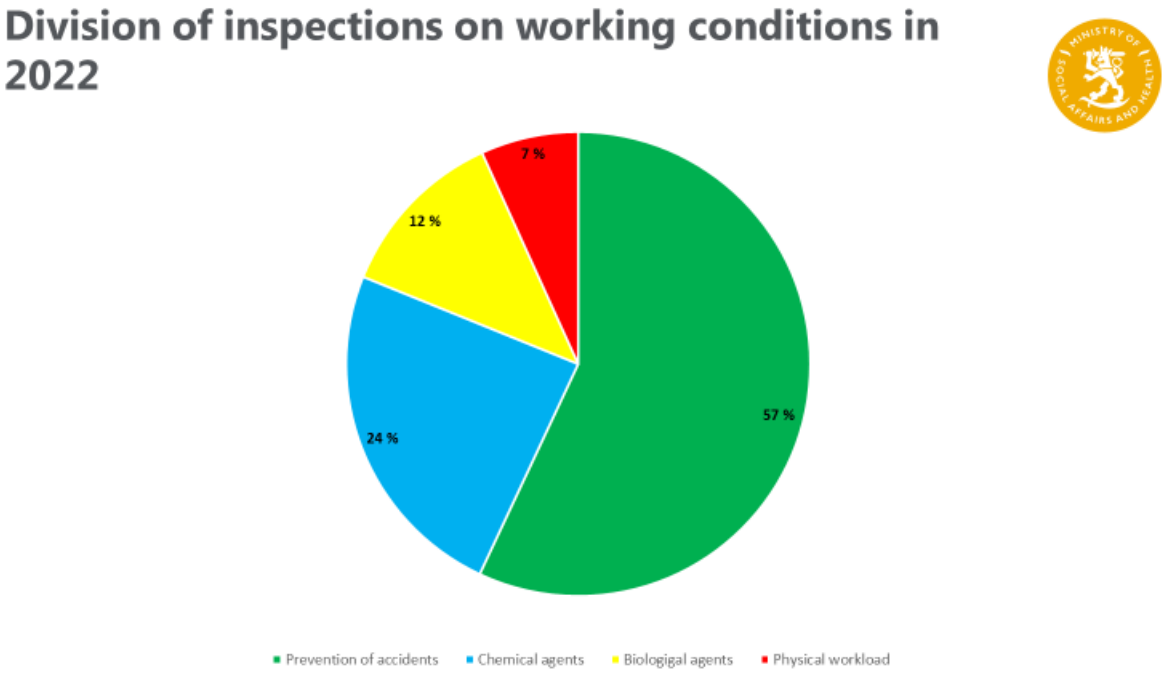
[9] SINTEF: Rapport A27430, Kostnader ved arbeidsrelaterte sykdommer og skader, 2016, https://www.sintef.no/globalassets/sintef-teknologi-og-samfunn/rapporter-sintef-ts/rapport-a27430-kostnader-ved-arbeidsrelaterte-sykdmmer-og-skader.pdf

[10] Osloeconomics: Samfunnsnytten av bedrifthelsetjenten, 2018, https://osloeconomics.no/wp-content/uploads/2018/05/Samfunnsnytten-av-bedriftshelsetjenesten.pdf

Focus of labour inspections (case Finland)

Labour inspections in Finland concentrate on three main areas: working conditions (50 %), fragmented working life (33 %) and psychosocial workload (17 %). Regarding the inspection of psychosocial workload, the emphasis is on identifying factors contributing to psychosocial workload and assessing the associated risks. The highest number of deficiencies was observed in the investigation and assessment of work hazards, the provision of occupational health care services, and the workplace survey conducted by the occupational health care provider. Employers should strive to prevent harmful workloads rather than merely managing their consequences, emphasizing proactive measures to eliminate or minimize the risk and harmful effect of work-related strain.

Inspections in the area of working conditions place a significant focus on accidents prevention (57 %), with a lower percentage allocated to chemical agents (24 %) and biological agents (12 %).



Considering the work-related burden of disease described in the previous chapters, it can be noted that the focus on prevention of accidents seems to have been successful, it is notable that the emphasis on preventing accidents appears successful, reflected in the decreased proportion of fatal occupational injuries to 1 % of the overall fatal work-related diseases and injuries in the Nordic countries.

In the implementation of the EU strategic framework on health and safety at work for 2021 – 2027, particularly the second focus on work-related diseases, additional efforts by labour inspection may warrant consideration. As work-related diseases are closely linked to various exposures, a resurgence (increase) in occupational hygiene measurements could contribute to understanding chemical and biological exposure levels, potentially reducing work-related diseases and fatalities.

Prevention of work-related diseases and injuries

EU strategic framework on OSH

The EU strategic framework on health and safety at work for 2021-2027, titled "Occupational safety and health in a changing world of work", is centred around three key focuses: 1) anticipating change, **2) work-related diseases,** and 3) preparedness for future crises. A significant proportion, one third of the focus is dedicated to addressing work-related diseases. Here is an excerpt from the EU framework:

Chapter 2.2., titled "Improving **Prevention of Work-related Diseases and Accidents,** places a strong emphasis on the challenge of work-related deaths. The Commission calls for the following actions:

- Work towards fulfilling the 'vision zero' approach to work-related deaths in the EU.
- Address occupational risks related to circulatory diseases.
- Promote the European Code against Cancer among workers to improve their health literacy and reduce cancer risks.
- Assess and address risks with a particular focus on groups most affected by the pandemic, such as persons with disabilities.
- Actively support reintegration, non-discrimination and the adaptation of working conditions of workers who are cancer patients or cancer survivors.
- Promote gender considerations in design, implementation and reporting.
- Actively address hazards in the healthcare sector by putting in place and implementing safe working procedures and providing appropriate training.
- Provide improved guidance and training for the risk-assessment and prevention measures, in particular to micro-enterprises and SMEs. .
- Provide training to farmers via Farm Advisory Services to increase their skills and awareness on the health and safety rules on farms, including safe use of chemical substances, in particular plant protection products.
- Develop a guidance for the health care sector focusing, among other things, on workers protection from the exposure to hazardous medicinal products, paving the way for developing the online interactive risk assessment (OiRA) tool specifically for the health care sector in collaboration with the EU-OSHA

Main work-related exposures and inspection advice

Priority items for inspectors and inspectorates: Questions to workplace stakeholders, including selected individual workers.

Prevention of Occupational Cancer

1. In workplaces where there might be asbestos in structures: Do you have a comprehensive workplace-wide record confirming that a check has been conducted for possible asbestos exposures, both in infrastructure – walls, floors, ceiling, piping and insulation in heating or energy saving systems? Has any work taken place or been planned that could result in exposures to asbestos fibres?
2. Is there any record of potential exposure and related preventive actions for other key carcinogens, such as shift/nightwork, mineral oils, solar radiation causing occupational skin diseases, silica dust, diesel exhaust, polyaromatic hydrocarbons, painting and welding processes, external tobacco smoke, radon, and more? (A more comprehensive list is provided at the end of this paper in annexes)

Circulatory Diseases at Work: Cardiovascular Diseases and Stroke

3. What control measures are in place to reduce long working hours, shift and night work combined with strain?
4. What control measures exist to reduce noise, engine exhaust (including carbon monoxide), and external tobacco smoke (carbon dioxide, nicotine)?
5. What control measures are in place to address harmful psychosocial factors, including job strain, effort-reward imbalance, job insecurity, sexual harassment and bullying?

W**ork-related Respiratory Diseases (Chronic Obstructive Pulmonary Disease, Asthma)**

6. What control measures are in place related to:
   - Welding fumes, oxides of nitrogen, and ozone, chromium, nickel,
   - Dusty work in manufacturing industry, construction work, and farming (e.g., organic dust, microbial dusts, endotoxins, textile dust),
   - Occupations such as bakers (flour dust), food manufacturing workers, painters and lacquerers, floor layers, farmers, plastic product workers, animal husbandry workers (grain dust, hay dust, animal epithelia, hairs or secretions, fodders),
   - Spray painters and lacquerers (epoxy resins or paints, isocyanates),
   - Hairdressers and beauticians, etc. (hair, acrylic monomers, resin, phthalates, persulfate salts, hair dyes, and colorants)

Occupational Injuries (Accidents) and Work-related Diseases in General

7. What is the existing occupational safety and health management system at the workplace? What reports and records exist, who are involved, and is there any certification or other evidence of the system's functioning?

Work-related skin diseases

8. Are there exposures to solar and ultraviolet radiation at work which causes skin diseases such as melanoma and non-melanoma skin cancer? Are there sources that can cause irritant and allergic contact dermatitis cases? Hand and other skin dermatitis can be caused by work-related allergens due to several substances such

as resins and plastic-related chemicals (rubber latex). Occupations of particular interest are bakers, chefs and cooks, farmers, veterinarians, gardeners and hairdressers.

Other Risk Exposure Factors Causing Further Work-related Diseases

8. What control measures are in place related to metal dust, wood dust, lead, chromium, quartz (sand dust), oxygenated hydrocarbons? What measures have been taken to prevent neuropsychiatric diseases and mental disorders, such as controlling pesticide (herbicide and insecticide) and fertilizer exposures leading to dementia and Parkinson's disease?
9. What inspectorate actions have been taken, in general, for working out checklists and guidance on risk assessment and management in:
    - Industry and economic sectors, such as primary sectors, manufacturing and construction industries,
    - Specific occupations, such as nurses, hairdressers, welders, painters,
    - jobs, such as those exposed to shift work, night work, and long working hours.

Discussion points within the Nordic Inspectorates

In view of the EU OSH strategy 2021 – 2027 with a focus on work-related diseases and accidents and the presented distribution of fatal consequences of exposures (1 % of the absolute numbers and approx. 10 % of the DALYs are attributable to occupational accidents, compared to the higher fractions on cancer, circulatory and respiratory diseases).

Q1. Do you consider the findings relevant and reliable for the strategic approach and methodology of your national inspections? Would you need more data and in-depth conclusions concerning the impact of work-related exposures related to economic sectors and occupations?

Q2. The EU OSH Strategic Framework allocate one of three targets to the protection against work-related diseases. Is the national Inspection aligned with the EU Strategy's focus on work-related diseases?

Q3. Do you think that the findings would warrant a review of the targeting of the present inspections and eventually an increase of occupational hygiene measurements? In which way?

Q4. Does your national Inspectorate have the required capability (special knowledge, information, mixture of occupational skills, competence) to handle work-related exposures leading to the listed major mortality causes (cancer, cardio-vascular, respiratory diseases)?

Q5. To improve the identification of the listed exposures leading to work-related deaths, what should be done

- **a. In the Inspectorate**
- **b. At the workplaces and with the social partners**
- **c. In occupational health services**
- **d. In cooperation with the OSH research community?**

Validation seminar of the Report with Invited Nordic and International Experts - October 11, 2023

The project organised a validation seminar with selected Nordic and international labour inspectors, occupational health professionals, and experts. Twenty-four experts attended the online seminar on October 11, 2023.

The presentations and ensuing discussion helped to refine the findings, confirm presented facts, and especially refine the suggested advice to Nordic labour inspections. The dialogue between the labour inspectors, occupational health professionals, and international experts was particularly fruitful in ensuring common understanding between practitioners and researchers. The content and formulations in the report were edited to enhance mutual understanding between the two groups.

Additionally, experts from European and international organisation were asked to provide short comments on the report in general and specifically on how the Nordic report could be applied in other countries or in an international context. A few comments are presented below.

William Cockburn, EU-OSHA

"I would say that the information produced is essential for other countries. Estimates of the burden of work-related injuries and diseases on society should lead to more resources being directed towards OSH. Those that are sufficiently detailed, such as presented in this research, allow priorities to be set in terms of where is action most needed and which levers are likely to have the greatest impact. However, resources will only be increased, and priorities acted upon if the information is communicated effectively. This is a big challenge when the key target audience is in another policy area and doesn't speak our language. Fatal injuries are easy to comprehend; DALYs and PALYs not at all. So, to build on this excellent work, I would say that we need to find a way of communicating the findings and the needs."

Balint Nafradi, ILO

" I firmly believe that securing reliable information, both actual data and estimates, regarding work-related exposures, diseases, and injuries is an essential initial step. However, the key to success in redirecting resources towards OSH lies in effective communication. To achieve this, we must speak the language of decision makers, which is often grounded in economic data. It is crucial to convey not only what they understand but, more importantly, what they deeply care about.

In my view, resources can be found within the realm of public health financing. On average, governments allocate approximately 5-10% of their GDP to finance public health. Their primary concern, though, is not merely the number of deaths DALYs; it predominantly the cost of treating each case. By demonstrating to decision makers that preventing worker hospitalizations through effective OSH is more cost-effective than treating resultant diseases or injuries, we can prevent significant suffering within the workforce.

Another group worth targeting is employers themselves. In 2022, the global OSH market amounted to 4.5 billion USD, and it is projected to expand to 5.9 billion USD by the end of the

decade. However, to influence any of these groups, in my opinion, we must use a carrot rather than a stick."

Matthias Fritz, European Commission

"In my personal opinion, the Joint Estimates of WHO/ILO of fatal is a very important project, because it gave us for the first time an estimate for some important occupational causal agents and disease pairs concerning fatal cases and DALYs. I agree with William that the concept of fatal cases is easier to comprehend by decision makers.

1. In order to direct resources to labour inspections and preventive measures, it is indeed a big step forward to know the number or percentage of occupational disease / accident fatal cases due to different causal agents. We all know that the difficulty concerning some occupational diseases is that the outcomes may manifest only many years later (cancers have often a latency period of 20-40 years to develop), and that the causal link is somewhat weaker than for accidents. However, we also know that the costs of occupational disease and in particular cancer is much higher.
2. I think it will simply need more time and awareness raising among all actors (labour inspector, employers, workers, their representatives, occupational doctors, health insurances, labour ministries, etc.), maybe we also need a new generation of involved actors to concentrate on the factors that are most relevant for the lives of workers as opposed to those which were important in the past. It may be that awareness is not yet as high as we would like it to be but such awareness raising processes can take time, depending on how hard the data evidence is. I think we are on a good way. However, we should not decrease but rather increase our awareness raising effort at all levels - hard data is among the most important tools in this. This project of the Nordic countries, offering better and richer data, is for sure a contribution to that end.
3. All advances in science to estimate the number of cases or to proof (with medical technology) that a case is indeed work-related will help. This would include the interdependencies and estimations between different factors that may contribute to an occupational disease (such as chemicals, stress at work, influence of private factors etc.).
4. I was impressed by the Austrian approach to use (anonymised) data of public health insurances to calculate the real (administrative) absence days of workers from work due to ICD-10 diagnoses in specific Austrian regions and economic activity sectors. The Austrian labour ministry can use such anonymised data to target inspections to those regions, sectors and diseases which have the highest number of absence days. This may not be ideal for cancer which develops sometimes only after retirement but for many other diseases, the public health insurances have a lot of unused data, which - in case or Nordic countries - may also be often linked with (employment) registers which could give similar information. Unfortunately, access to public health insurance data is often subject to strict data protection rules and linking it with information about the company or sector of the victim may be lacking in many countries. Nevertheless, in public health there are efforts to get hold of (anonymised) public health insurance data, which should anyway be a right of information of all citizens as it concerns their contributions, which

would contain a treasure of information also for occupational health if the link to the economic sector or other employment data could be achieved.

5. An comparison of all major cost items between the many different areas of labour inspections (employment contracts, bogus self-employment, working time issues, OSH etc.) and also of different areas of employment and social policy (unemployment benefits, poverty alleviation, social work, early school leavers etc.) may help to prioritise overall resources better. If we would know what all these items cost society individually, we could know which size the budget for OSH should have and then we would be able to determine which costs should also be applied within the area of OSH. If there is a question mark on how high the overall costs for dealing with OSH at national level should be (ideally), there will always also be questions marks on how to distribute the resources within OSH (labour inspection etc.). Of course this would mean estimating the costs of all the different policy areas, which could be done in a joint effort in (the European Commission department) EMPL or within national ministries / budgets of employment and social affairs policies, but I think such a project would be worth the effort and could in fact also be done in the Nordic countries before possible spreading it to other Member States.
6. I wonder whether it is possible to create "severity profiles" per occupational disease / causal agent pair to estimate less severe outcomes from fatal ones (characteristic numbers of cases of non-fatal outcomes, such 4 days - 1 month, 1-3 months of absence, 3-6 months of absence, permanent incapacity to work etc., based on fatal cases). This would facilitate estimations of the total burden of a disease, on the basis of fatal cases."

Yuka Ujita, ILO/Bangkok

"Allow me to add two points from my experience covering 25+ middle- and low income countries in Asia and the Pacific.

1. Interests of decision makers in the estimates are high.

I always start my presentation with the estimates by ICOH and WHO/ILO. Often, they seek more information and want to be involved. This clearly demonstrates the strong demand.

2. Engagement of social security/insurance institution would be a key.

They have data, resources and power, more than ministries. In some countries, MOL (labour inspectorate) has established agreements with SECSOC on data sharing and ILO is supporting such initiatives. They have capacity in cost analysis and severity profiling, which Mattias proposed."

Annexes

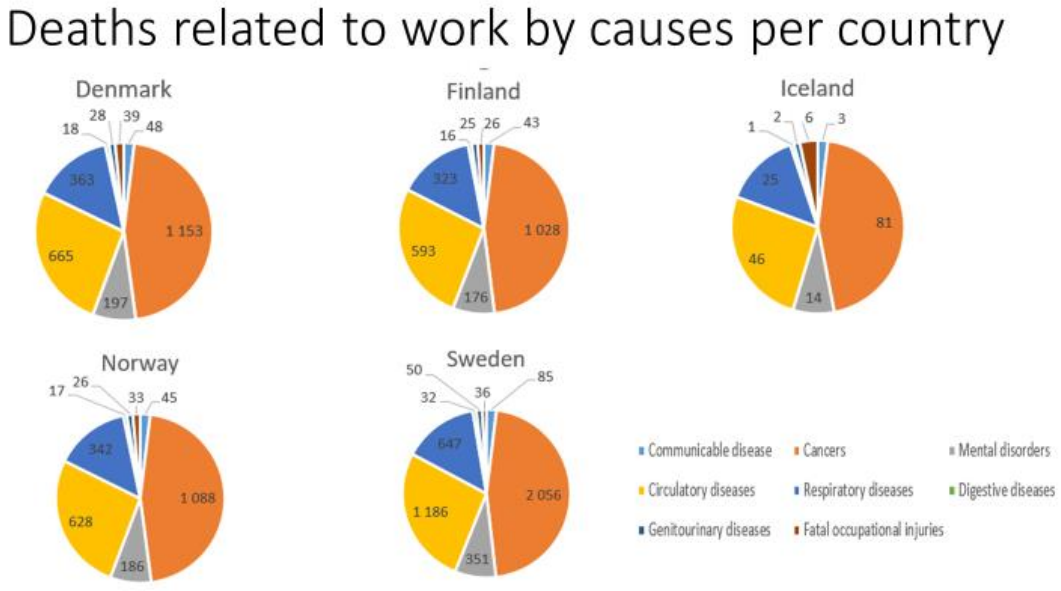
Annex 1: ILO Global Estimates of occupational injuries and fatal work-related diseases in the Nordic countries

The ILO Global Estimates are based on employment data from year 2019. These are used as a first estimated on the scope of the problem. The data will be amended based on data received directly from fresh national sources during the progress of the project.

	Occupational injuries (2019)					
	Project estimates		Reported by Nordic countries			
	Fatal injuries	Absence of 4 days or over	Fatal injuries	Absence of 4 days or over	Fatal work-related diseases 2019 Project estimates	Occupational diseases (2020) reported to Eurostat*
Denmark	39	50 227	39	50 179	2 472	2 410
Finland	33	42 500	33	43 126	2 203	1 186
Iceland	2	2 576	2	1 410	173	
Norway	33	42 500	33	40 000	2 332	
Sweden	36	46 364	34	36 795	4 407	107
Total	**143**	**184 167**	**141**	**171 510**	**11 587**	

The table indicates that the reported occupational accidents by Nordic country correspond to the estimates calculated by the project. The project estimates of absence of at least four days are based on the number of fatal injuries reported to Eurostat.

An Occupational disease database does not currently exist at the European level. The objective of a European Occupational Diseases Statistics (EODS) pilot project is to gather national data in a unique database and provide trends on the most recognized occupational diseases in the European Union. Information from Iceland and Norway is not available.



Source: EU-OSHA Barometer, https://visualisation.osha.europa.eu/osh-barometer/accidents-diseases-well-being/work-related-diseases/icoh/prevalence-of-diseases/all-diseases

The attributable fractions give a first estimate of the prevalence of work-related diseases. The project will collect more representative data going deeper into economic sectors, occupations, gender and age.

Attributable fractions (due to workplace exposure) of diseases not classified as occupational diseases.

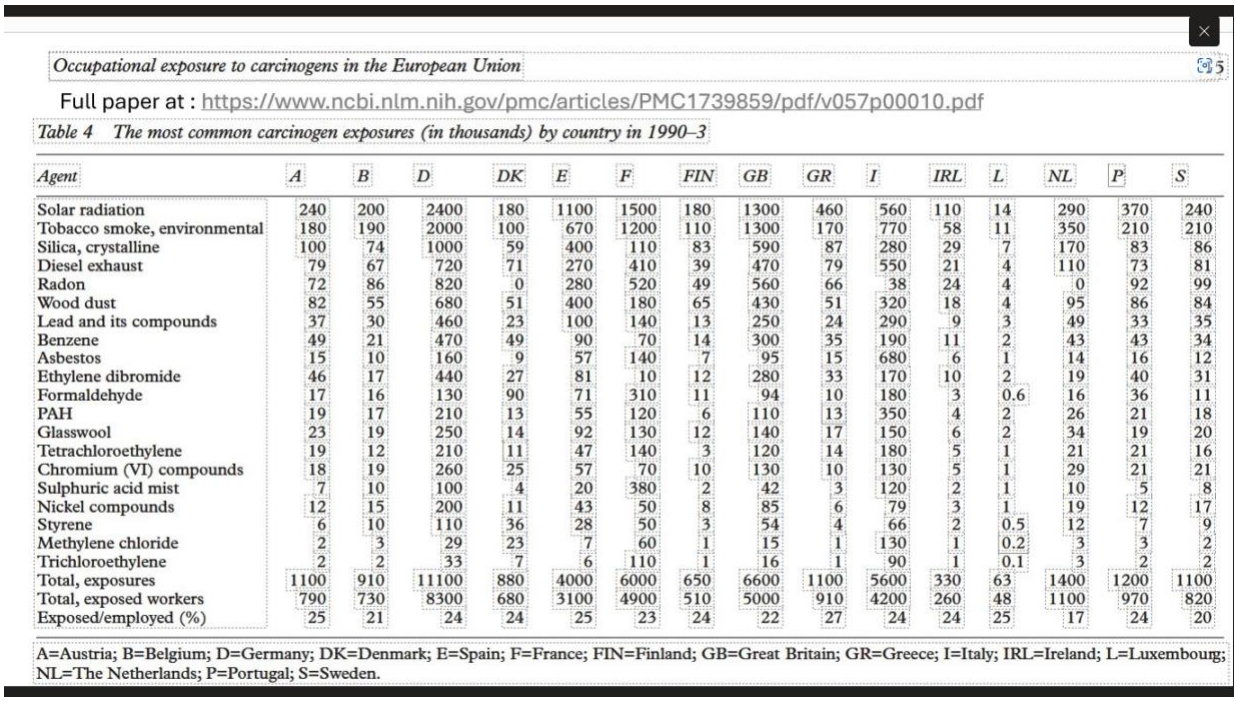
	Attributable fraction									
	Nurminen and Karjalainen (2001)		Rushton et al. (2008)		Steenland et al. (2003)		Morrel at al. (1998)[a]		Leigh at al. (1997)[b]	
Causes	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Communicable diseases	4.8	32.5								
Cancers	13.8	2.2	8.0	1.5	3.3-7.3	0.8-1.0				6-10
Respiratory diseases	6.8	1.1								10[c]
Circulatory diseases	14.4	6.7				6.3	1.0	1.0		5-10
Mental health disorders	6.6	1.8					1.0	1.0		1-3
Digestive diseases	2.3	1.5								
Genitourinary system	3.0	0.4					1.0	1.0		1-3

[a] Covers only deaths due to occupational exposure to hazardous substances
[b] Pneumoconiosis are not included in the figure of Leigh at al.

Sources:

1. Nurminen M, Karjalainen A. Epidemiologic estimate of the proportion of fatalities related to occupational factors in Finland. Scand J Work Environ Health 2001;27(3):161—213.
2. Takala J, Hämäläinen P, Sauni R, Nygård C H, Gagliardi D, Neupane S. Global-, regional- and country-level estimates of the work-related burden of diseases and accidents in 2019, Scand J Work Environ Health, 2023. https://doi.org/10.5271/sjweh.4132 . Includes updated population attributable fractions as Supplementary Annex
3. Occupational exposure to carcinogens in the European Union. Authors: T Kauppinen, J Toikkanen, D Pedersen, R Young, W Ahrens, P Boffetta, J Hansen, H Kromhout, J Maqueda Blasco, D Mirabelli, V de la Orden-Rivera, B Pannett, N Plato, A Savela, R Vincent, M Kogevinas, Occup Environ Med 2000 Jan;57(1):10-8. doi: 10.1136/oem.57.1.10.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1739859/pdf/v057p00010.pdf
See Table below

Occupational exposure to carcinogens in the European Union (CAREX EU)



Occupational exposure to carcinogens in the European Union 5

Full paper at : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1739859/pdf/v057p00010.pdf

Table 4 The most common carcinogen exposures (in thousands) by country in 1990–3

Agent	*A*	*B*	*D*	*DK*	*E*	*F*	*FIN*	*GB*	*GR*	*I*	*IRL*	*L*	*NL*	*P*	*S*
Solar radiation	240	200	2400	180	1100	1500	180	1300	460	560	110	14	290	370	240
Tobacco smoke, environmental	180	190	2000	100	670	1200	110	1300	170	770	58	11	350	210	210
Silica, crystalline	100	74	1000	59	400	110	83	590	87	280	29	7	170	83	86
Diesel exhaust	79	67	720	71	270	410	39	470	79	550	21	4	110	73	81
Radon	72	86	820	0	280	520	49	560	66	38	24	4	0	92	99
Wood dust	82	55	680	51	400	180	65	430	51	320	18	4	95	86	84
Lead and its compounds	37	30	460	23	100	140	13	250	24	290	9	3	49	33	35
Benzene	49	21	470	49	90	70	14	300	35	190	11	2	43	43	34
Asbestos	15	10	160	9	57	140	7	95	15	680	6	1	14	16	12
Ethylene dibromide	46	17	440	27	81	10	12	280	33	170	10	2	19	40	31
Formaldehyde	17	16	130	90	71	310	11	94	10	180	3	0.6	16	36	11
PAH	19	17	210	13	55	120	6	110	13	350	4	2	26	21	18
Glasswool	23	19	250	14	92	130	12	140	17	150	6	2	34	19	20
Tetrachloroethylene	19	12	210	11	47	140	3	120	14	180	5	1	21	21	16
Chromium (VI) compounds	18	19	260	25	57	70	10	130	10	130	5	1	29	21	21
Sulphuric acid mist	7	10	100	4	20	380	2	42	3	120	2	1	10	5	8
Nickel compounds	12	15	200	11	43	50	8	85	6	79	3	1	19	12	17
Styrene	6	10	110	36	28	50	3	54	4	66	2	0.5	12	7	9
Methylene chloride	2	3	29	23	7	60	1	15	1	130	1	0.2	3	3	2
Trichloroethylene	2	2	33	7	6	110	1	16	1	90	1	0.1	3	2	2
Total, exposures	1100	910	11100	880	4000	6000	650	6600	1100	5600	330	63	1400	1200	1100
Total, exposed workers	790	730	8300	680	3100	4900	510	5000	910	4200	260	48	1100	970	820
Exposed/employed (%)	25	21	24	24	25	23	24	22	27	24	24	25	17	24	20

A=Austria; B=Belgium; D=Germany; DK=Denmark; E=Spain; F=France; FIN=Finland; GB=Great Britain; GR=Greece; I=Italy; IRL=Ireland; L=Luxembourg; NL=The Netherlands; P=Portugal; S=Sweden.

While this Table desperately needs updating it provides a rough idea of the magnitude of exposures leading to occupational cancer cases and deaths in selected Nordic countries. Roughly 20-25 % of workers are exposed.

For preventive action the number of negative outcomes is not sufficient, rather each individual exposures at places of work must be identified and using the hierarchy of control eliminated and reduced continually. Individual workplaces should work out a list of exposures and present a plan – e.g. to inspectors – how these can be gradually limited and eliminated.

Annex 2: Productivity Adjusted Life Years (PALY)

The PALY introduces a novel, yet well-tested, approach to quantify the population-level impact of disease on productivity, encompassing factors such as unemployment, days off work, reduced efficiency at work, and premature death, within the broader economy. It is not intended to replace the disability-adjusted life-year or the quality-adjusted life-year. Instead, it is representing a further development of the DALY, especially considering the impact of the inability to work.

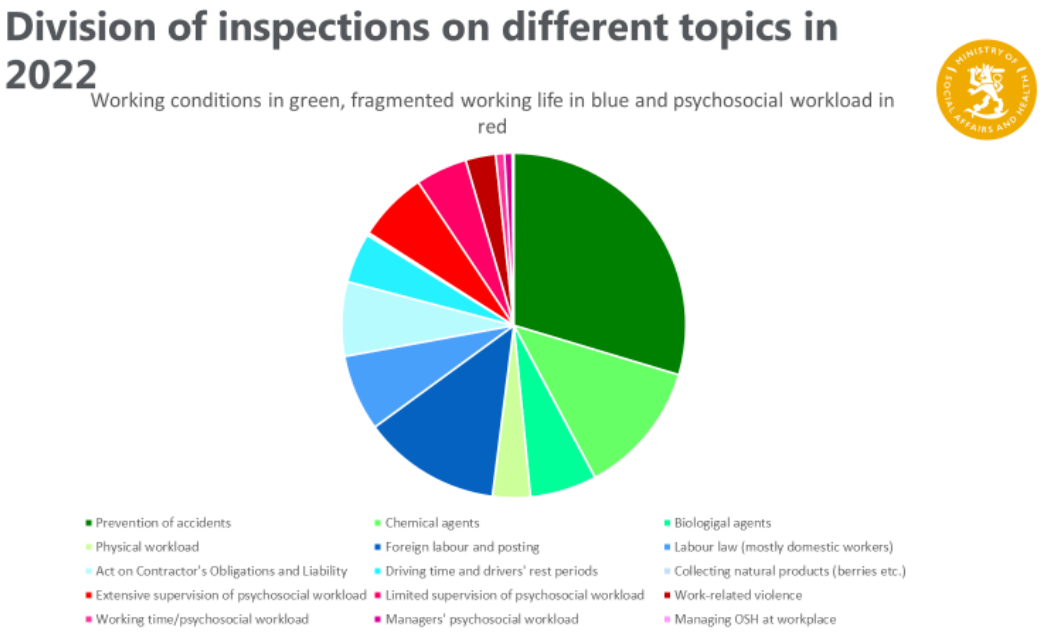
Calculation of the PALY involves multiplying a 'productivity index' by years lived. The productivity index ranges from 0 (completely unproductive) to 1 (completely productive) and is estimated using data on time worked by fully healthy individuals, absenteeism, presenteeism, and premature workforce exit. The productivity index is derived by dividing the days worked in a year (maximum working days minus days missed due to the condition of interest) by the maximum working days in a year. This maximum working days value is obtained by combining information on the overall percentage of equivalent full-time workers, specific to the country, age and sex.

Our project will continue to search for additional Nordic information on PALYs.

Annex 3: Focus of labour inspections in 2022, Case Finland

The labour inspection in Finland focus on three areas: working conditions, fragmented working life (employment issues) and psychosocial workload.

An in-depth review of the Finnish labour inspection shows a broad variety of topics targeted for inspection, including working conditions (including chemical and biological exposure), conditions of employment (driving time, domestic work, berry picking, etc.) and psychosocial workload. See slide below for details.



The inspections and other activities (2022) in numbers, from which the above percentages have been derived are presented below. Source communication from the OSH Department in the Finnish Ministry of Social Affairs and Health.

Inspections and other activities by the Finnish Labour Inspectorate in 2022

- 23 100 inspections
- 18 800 separate workplaces inspected
- Over 48 700 obligations (written advises and improvement notices) given at inspections
- Almost 1100 serious occupational accidents investigated
- Over 1000 demands for investigation or statements on ongoing investigation to police
- Over 1000 applications handled
- More than 41 600 statutory notifications received
- Over 34 300 customer initiatives/contacts received
- 1,4 million users of OSH administration national website