

**PEROSH 3<sup>rd</sup> Research Conference**

**‘Innovative solutions in Occupational Safety and Health’**

**11 September 2019, Copenhagen, Denmark**

**Book of Abstracts**



## Content

<b>INTRODUCTION .....</b>	<b>3</b>
<b>PROGRAM .....</b>	<b>4</b>
<b>OVERVIEW OF ABSTRACTS .....</b>	<b>7</b>
PARISA ANSARI & MARIE JELENKO.....	7
SAM BRADBROOK.....	7
DIRK BROßELL.....	8
YIQUN CHEN .....	9
PATRICK CROWLEY.....	10
CARINA ENGEL.....	11
WOUTER FRANSMAN .....	12
MARIE JELENKO .....	13
TOMI KANERVA.....	14
PETE KINES .....	15
NILS LAMM .....	16
ELENA LIMÓN GARCÍA, LAURA RODRÍGUEZ MERINO .....	17
NATALIE LOTZMANN, SINA FELLHAUER .....	18
CARSTEN MÖHLMANN .....	19
CLAS-HÅKAN NYGÅRD.....	20
PRZEMYSŁAW OBERBEK.....	21
KAROLINA PAWŁOWSKA-CYPRYSIAK .....	22
JOHANNES PELZER .....	23
CECILIE ROSTING .....	24
MERVI RUOKOLAINEN .....	25
MINNA SAVINAINEN .....	26
OLE HENNING SØRENSEN.....	27
MATTHEW STEVENS.....	28
ANTONIO VALENTI.....	29
DAVID VERNEZ.....	30
JOLIEN VLEESHOUWERS .....	31
ANDREAS WAHMHOFF .....	32
NOORTJE WIEZER.....	33
PASCAL WILD & RÉGIS COLIN.....	34



## Introduction

PEROSH, the Partnership for European Research in Occupational Safety and Health, organises bi-annual research conferences, exclusively for its members since 2015. The first conference was in Warsaw, Poland, followed by a second conference in Sankt Augustin, Germany.

The main objective of this conference is to (a) allow both early stage and experienced researchers to share their latest findings with their colleagues from the other PEROSH institutes (b) give opportunities for networking and a platform for potential collaborations for international research projects.

The first two conferences were very successful and resulted in closer contacts between the member institutes and its researchers, development of joint projects or joint applications for research funding of the EU. Some of these examples are: joint HORIZON 2020 applications and exchange visits of researchers between the member institutes.

On 11<sup>th</sup> September 2019, we are organising the third PEROSH Research Conference in Copenhagen, Denmark. This third edition accommodates 29 high-quality abstracts. The conference has three parallel sessions on the following themes:

1. **Sustainable and prolonged working life**  
How are we tackling current and emerging challenges? (for instance, emerging challenges from digitalisation of work)
2. **Carcinogens and chemical substances**  
How do we deal with occupational cancer and increased awareness of chemical exposures in the workplace?
3. **Impact on society**  
How do we realise and measure the impact of our research outcomes to improve workplace health and safety?

In this book of abstracts, one can find the final programme and all names and contributions of the speakers.

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## Program

Wednesday 11 September 2019			
8:30-9:00	Arrival of participants at Symbion Conference center" on Fruebjergvej 3, 2100 Østerbro ( <a href="https://symbionkonferencecenter.dk/en">https://symbionkonferencecenter.dk/en</a> )		
9.00-10.00	Sustainable work ability – healthy retirement? Plenary session with key note speaker Prof. Clas-Håkan Nygård from Tampere University, Finland		
10.00-12.00	<b>Sustainable and Prolonged Working Life</b>	<b>Carcinogens and chemical substances</b>	<b>Impact on Society</b>
	Effect of Occupational Health & Safety training at school on the occurrence of workplace injuries in young people starting their professional career – Pascal Wild & Régis Colin (INRS)	Grouping of exposure and risk for processing of nanocomposites – Carsten Möhlman (IFA)	Models for improving research-to-practice and assessing impact – Ole Henning Sørensen (NFA)
	Promoting continuous learning at midlife with a career management intervention “Skills for Work” – A randomized controlled study (RCT) – Mervi Ruokolainen (FIOH)	Safe handling of asbestos – Andreas Wahmhoff (IFA)	Nanorama – New approach for interactive knowledge transfer – Johannes Pelzer (IFA)



	<b><i>Sustainable and Prolonged Working Life</i></b>	<b><i>Carcinogens and chemical substances</i></b>	<b><i>Impact on Society</i></b>
	Life-long learning as a chance and prevention of digital exclusion in the context of prolonged working life – Karolina Pawłowska-Cyprysiak (CIOP-PIB)	Metalworking fluid aerosol emissions handling in the machinery industry – Tomi Kanerva (FIOH)	Campaign on safe roofing works: The important thing is to get down alive – Elena Limón-García and Laura Rodríguez Merino (INSST)
	TREXMO plus: an advanced self-learning model for occupational exposure assessment – David Vernez (Unisanté)	Asbestos in plasters, adhesives and fillers: work associated with exposure in existing buildings – Nils Lamm (IFA)	“Gib Acht, Krebsgefahr!” (“Watch out, Cancer Risk!”). The AUVA-prevention campaign on carcinogens 2018-2020 – Parisa Ansari & Marie Jelenko
	The influence of digitalization and new technologies on psychosocial work environment and employee health – Jolien Vleeshouwers (STAMI)	A new risk banding scheme for high aspect ratio materials at the workplace – Dirk Broßell (BAuA)	Ethics and occupational health: from the development to the complexity of contemporary society – Antonio Valenti (INAIL)
<b>12.00-13.00</b>	Buffet Lunch		
<b>13.00-14.00</b>	<b>Stress and satisfaction in the Workplace</b> Plenary session with key note speaker Dr. Natalie Lotzmann, SAP Global Health Management, Vice President HR, Chief Medical Officer, Germany and Sina Fellhauer, Master Thesis Student, Global Health & Well-Being SAP		
<b>14.00-14.30</b>	Coffee break		



<b>14.30-16.00</b>	<b><i>Sustainable and Prolonged Working Life</i></b>	<b><i>Carcinogens and chemical substances</i></b>	<b><i>Impact on Society</i></b>
	Objectively measured Physical Activity at Work and Need for Recovery: A cross-sectional compositional data analysis – Matthew Stevens (NFA)	Revised method for the determination of N-nitrosamines – Carina Engel (IFA)	The TNO Impact Mapping Tool: a tool to show the impact of projects on societal goals – Noortje Wiezer (TNO)
	Implementation of a new working practice to the client process - the barriers and enablers – Minna Savinainen (FIOH)	Eliminating work-related cancer: Exposome and Safe by Design – Wouter Fransman (TNO)	Evaluation of Prevention Campaigns with eKIT*. With Examples of AUVA Campaigns on Hand Injuries and Carcinogens – Marie Jelenko
	Digitalisation and the Future World of Work– Sam Bradbrook (HSE)	Ionizing detector to study the emission of nanoparticles at workplaces – Przemyslaw Oberbek (CIOP-PIB)	Vision Zero and leading indicators for safety, health and wellbeing – Pete Kines (NFA)
	Aerobic capacity, workload and age – Patrick Crowley (NFA)	Biomonitoring of the urinary benzene metabolite s-phenylmercapturic acid in firefighters - Cecilie Rosting (STAMI)	The HSE Measuring Strategy – Yiqun Chen (HSE)
<b>16:00-16:15</b>	Overview recent work EUOSHA and appeal to PEROSH – Elke Schneider, European Agency for Safety and Health at Work		
<b>16.00-17.00</b>	Plenary discussion on outcomes/observations		
<b>17.00</b>	Summary & closing		



## Overview of abstracts

Below one can find an overview of all submitted abstracts arranged in alphabetical order of the surname of the first presenter.

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### **“Gib Acht, Krebsgefahr!“ (“Watch out, Cancer Risk!”). The AUVA prevention campaign on carcinogens 2018-2020**

The AUVA is currently conducting a campaign to prevent occupational cancer entitled “Gib Acht, Krebsgefahr!“ (“Watch out, Cancer Risk!”). In this context, we aim at raising awareness for carcinogens in the workplace by publishing relevant articles in trade journals and advertorials. However, increased awareness is just the first step in preventing occupational cancer. In addition, we help companies to identify and properly manage carcinogens by providing brochures and tools, as well as consulting and training. Only those who know where carcinogens can occur, how to identify them and how to deal with them properly can protect themselves and others.

The starting point of our campaign and our presentation is the current situation regarding occupational cancer in Austria. We will then give you an overview of the structure and content of our campaign. In addition, we will provide specialist information on the identification of carcinogens at the workplace and describe further necessary steps. As our consultants have already gained a lot of experience and we have to deal with different reactions and feedback on our campaign, we will give you some insights. Finally, we will look at the research needs arising from our experience.

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### **Digitalisation and the Future World of Work**

The world of work is now quite different from the one in which many of us started our careers. Digital technologies such as Artificial Intelligence and robotics are advancing at an accelerating pace and becoming increasingly pervasive in society. Ongoing technological innovation is changing the nature of work including how, where, and when we work. This is presenting new and emerging challenges and opportunities for health and safety. This presentation will discuss digital technologies and their possible impacts on health and safety in the context of their influence on ensuring a sustainable and prolonged working life. Any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

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### **A new risk banding scheme for high aspect ratio materials at the workplace**

High aspect ratio materials (HARM) like carbon nanotubes (CNT) show material properties that enable innovative applications but also raise concerns about harmful effects to humans due to their asbestos-like morphology. A banding approach for HARM with hazard- and exposure-related parameters has been developed as a promising way to enable risk assessment and risk mitigation for an important family of advanced materials. It also provides guidance for a safer design of HARM and corresponding products.

Our scheme attributes HARM to three risk levels: low, moderate and high. The two-dimensional risk matrix builds on a hazard and an exposure banding. Parameters for hazard banding are the biopersistence and the fibre rigidity. The latter has been derived from an extension of the classic fibre principle with the intrinsic material property flexural rigidity, hypothesized to play a significant role in limiting the toxicity of inhaled fibres. Current research efforts of BAuA focus on further investigating the influence of flexural rigidity on fibre toxicity aiming at threshold values e. g. for fibre diameter, which can be used as band limits. In addition, we are developing methods for measurement of fibre rigidity.

For exposure banding, relevant parameters are the material dustiness, the propensity of release of fibres with a critical morphology and the degree of fibre agglomeration. Fibres with a critical morphology are defined according to the WHO-convention for asbestos (thinner than 3 µm, longer than 5 µm, aspect ratio greater than 3:1). To characterize the dustiness of fibrous materials, we have developed and evaluated the 'fluidizer' as an aerosol generator to adequately perform dustiness testing with powders of HARM. In combining aerosol characterization and sampling with subsequent particle-morphological analysis, we enable the identification and characterisation of HARM with relevant potential for release of fibres with a critical morphology.

We improved our risk banding scheme with 15 different types of multi-walled CNT (MWCNTs) by determining their parameters for hazard, exposure and risk banding. MWCNTs show high variance resulting in allocations to all three risk levels. The use of risk banding scheme also enables identification of low risk MWCNTs to support a safe design of nanoproducts.

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### **The HSE Measuring Strategy**

Health and Safety Executive (HSE) is an independent, risk-based and intelligence-led health and safety regulator in Great Britain (GB). HSE's goal is to prevent work-related ill health, deaths and injuries. Having the right evidence base to inform HSE's activities in achieving its goal is an on-going challenge and will require sustainable and coordinated efforts, as well as long-term evidence base development.

The HSE Measuring Strategy aims to build a fit-for-purpose evidence base to support HSE's decision makings on prioritisation, targeting, monitoring and evaluation of national level health and safety interventions, and to identify new and emerging health and safety risks. The Strategy is forward looking and will involve systematic approaches for ongoing data collection, integration, analysis, and evidence synthesis.

Although the long-term objective of the Strategy is broad and ambitious, its initial development has been focusing on building the right evidence base to support the evaluation of the Health and Work (H&W) programme. The HSE Health and Work (H&W) programme designs and carries out a wide range of interventions; including inspection, enforcement and other regulatory activities as well as prevention; targeting priority health conditions in high-risk sectors. It is anticipated that long-term, sustainable and coordinated actions developed as part of the programme will over time improve awareness, behaviours, control of exposures, and, as a result, prevent work-related ill health in GB workforce

The HSE Measuring Strategy draws together outcome focused measures based on a simple ABCDE model, covering A -attitude, B-behaviours, C-control of exposures, D-disease and work-related ill health reduction, and E-evidence of attribution, to provide the evidence required for evaluating the short, medium- and long-term impacts of the H&W programme on the GB health and safety system. This was based on our understanding that national level health and safety interventions achieve impact through firstly making positive changes in employers' and employee's attitudes and behaviours to workplace health. Consequently, these lead to a better control of risk, and therefore the prevention of work-related ill health, providing that these are supported by evidence of attribution. The Strategy gives a new focus on measuring behavioural changes and risk reductions; and emphasizes longitudinal measurement designs to assess progress over time.

The development and implementation of the Measuring Strategy requires close collaboration from a multidisciplinary team of regulatory scientists and policy makers. The lessons learnt will help to build the right evidence base for a more holistic approach to monitor and evaluate a range of national level intervention programmes for reducing health and safety risks.

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## **Aerobic capacity, workload and age**

### Introduction

Research on the prevention of all-cause mortality and cardiovascular disease indicate associations with capacity-related phenomena, therefore, people with a daily aerobic capacity-load imbalance – such as older workers with a high physical workload – may be exposed to a greater risk of poor health outcomes. Although laboratory studies show a clear relationship between aerobic capacity and aerobic load, it has not been verified in non-laboratory settings. We aimed to verify the transferability of laboratory-based findings to an occupational setting, while also examining the effect of age.

### Methods

Data of 840 workers from the DPhacto cohort in the Danish cleaning, manufacturing, and transportation sectors was included in the analysis. Aerobic capacity, measured using a submaximal cycle ergometer assessment, was followed by four consecutive days of 24-hour heart rate measurement. The latter was used for estimating mean and maximum levels of relative aerobic workload (percentage of heart rate reserve (%HRR)) during occupational hours and the duration (work hours) of high occupational aerobic workload ( $\geq 30\%$  HRR). Compositional data analysis was conducted using multivariate linear regression models.

### Results

Higher aerobic capacity was significantly associated with decreased mean  $-0.32$  [95%CI:  $-0.39$  to  $-0.25$ ] and maximum %HRR  $-0.35$  [95%CI:  $-0.45$  to  $-0.25$ ] at work as well as a decreased amount of high occupational aerobic workload  $-1.8\%$  [95%CI:  $-2.2$  to  $-1.5\%$ ] Across age groups, a 'u-shape' relationship was observed, with the strongest association for workers between the ages of 46 and 51.

### Conclusion

Significant associations between aerobic capacity and levels of aerobic workload were found using free-living measurements of workers from the cleaning, manufacturing, and transportation sectors in Denmark.

Keywords: Cardiorespiratory fitness, heart rate reserve, sustainable employment; ambulatory heart rate, ActiHeart

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### **Revised method for the determination of N-nitrosamines**

With the entry into force of the new TRGS 552 "Carcinogenic N-nitrosamines Cat. 1A and 1B", an acceptable concentration of 0.075 µg/m<sup>3</sup> and a tolerable concentration of 0.75 µg/m<sup>3</sup> were established for N-Nitrosodimethylamine. To comply with these concentrations, the measurement procedure for N-nitrosamines has been completely revised in 2018.

The revised IFA method, which will be presented here, includes the analysis of seven N-nitrosamines. Sampling is carried out with Thermosorb-N-cartridges specially designed for N-nitrosamine analysis. After elution of the N-nitrosamines, the analytical determination is achieved by gas chromatography with TEA detector (Thermal Energy Analyser), which is specially designed for the analysis of nitroso compounds and implies a high sensitivity.

An essential step in complying with the acceptable concentration was the doubling of the sampling time from previous 2 hours to 4 hours. As a result, a limit of quantification of 0.010 µg/m<sup>3</sup> per N-nitrosamine (based on a 400 L air sample) was achieved.

However, this increased sampling time implicates the problem of breakthroughs occurring at relative humidities greater than 40% and simultaneously increased N-nitrosamine concentrations in the workplace air. This concerns especially the more volatile N-nitrosamines.

In order to enable sampling at workplaces with higher humidity levels, various tests were carried out on a dynamic test gas facility. Some changes in the sampling procedure finally made it possible to measure N-nitrosamines concentration-independent also in the air humidity range of 40% to 60%, although with minor restrictions. Unfortunately, sampling at a relative humidity greater than 60% is still not possible.

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### **Eliminating work-related cancer: Exposome and Safe by Design**

Work-related cancer is responsible for around 2,700 deaths in The Netherlands each year. Despite good initiatives to create healthy working conditions, exposure to carcinogenic substances like Respirable Crystalline Silica, welding fumes and hardwood dust is often higher than the occupational exposure limits. This means that workers are subject to unnecessary health risks. A combination of substitution of chemicals, safe-by-design of new chemicals, design of safe processes by technological solutions, effective enforcement of the regulations and behavioral change among employers and employees will lead to the end of exposure to carcinogenic substances and get the number of work-related cancer cases down to zero.

TNO is currently working in various international knowledge programs to find safer alternatives to existing carcinogenic substances (substitution) as well as to assist R&D and industry to develop safer materials and products (Safe-by-Design). Together with tool producers TNO has developed technological process solutions that greatly reduce exposure to carcinogenic substances in the workplace, such as a welding torch with a built-in source extractor that reduces the inhalation of hazardous welding fumes. Dust-free tools and ways of working are only effective if those working with them do so in the right way in the workplace and if there are adequate checks and enforcement. Employers and employees must embrace the new ways of working and apply them in practice.

In those cases where the development of safer materials and design of safer processes is not adequate, TNO develops innovative exposure measurement techniques in order to enable the collection and interpretation of personal external and internal exposures with a high resolution in time and space (i.e. Exposome). This will form the basis for collective and personalized intervention strategies.

The prevention of occupational diseases benefits those at work, employers and society: it restricts the costs of absence and work disability, it boosts employability and participation, it creates a satisfied workforce and helps workers stay healthy. The innovative technical solutions and ways of working that are available must become the norm in the workplace. In this way, work-related cancer can finally be eliminated.

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### **Evaluation of Prevention Campaigns with eKIT\*. With Examples of AUVA Campaigns on Hand Injuries and Carcinogens**

Against the backdrop of scarce resources, proof of effectiveness and efficiency is becoming increasingly important. Facing these challenges, AUVA (Austrian Workers' Compensation Board) has commissioned the scientific association ECE to develop an integrated modular system for evaluations in the field of prevention called "EvaluationKIT" (short form: eKIT). The aim was to create a common basis for the evaluation of the efficacy of prevention measures (i.e. whether they work), which could also clarify and examine the underlying causal models (i.e. why they work). eKIT has now become the common standard for the evaluation of AUVA prevention activities, which contributes to making successes and challenges transparent and the results of interventions comparable.

In the first part of my presentation, I will give an overview of the main elements of eKIT including behavioural and situational prevention, the underlying types of logic (input, output, outcome and impact), different evaluation approaches, the four-level model developed by Kirkpatrick and Kirkpatrick (2006) and the importance of the accuracy in the implementation of measures.

eKIT presents its individual modules along the process of prevention projects, starting with the project launch, the planning and development, the training of multipliers and the implementation of measures up to the completion of the project.

In this context, in the second part of my presentation I will illustrate selected modules of the eKIT using two examples: 1) the completed AUVA campaign to prevent hand injuries and 2) the current AUVA campaign on carcinogens.

Finally, I will summarise the findings from the evaluation of our prevention campaigns with eKIT and the challenges that we will have to address in the future in order to achieve our goals and target groups even better.

\*eKIT (2013). An Integrated Modular System for Evaluations in the Field of Prevention at AUVA, REPORT NR. 63.1.

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### **Metalworking fluid aerosol emissions handling in the machinery industry**

During machining metalworking fluid aerosol (MWF) is formed containing both particulate and semivolatile compounds harmful to health. Concentrations of single contaminants, such as oil mist, are usually well below the occupational exposure limits. Still, machinists have respiratory symptoms although the machining centres are usually equipped with air cleaners to purify the recycled air. Therefore, FIOH suggest the use of total alkanolamine concentration as an indicator for metalworking fluid aerosol exposure.

Studies performed in four metal machining companies shows that semivolatile compounds penetrates the conventional air filtering units used in machining centres. The aim of the study was to find out how the different air handling methods influenced the indoor air quality in machining shops.

Studied methods were: 1) the recirculation of the local exhaust ventilation air back to the workspace after particulate filtration, 2) leading the air from the local exhaust ventilation directly to outdoors, and 3) enhance the filtration by adding the filtration of volatile compounds to the existing air filtering systems.

The measured alkanolamine concentrations after HEPA filtering equipment were significantly higher (1.2 - 3.7 times) compared to the measured concentration in the general workplace air. Returning air from the local exhaust ventilations system back to the workspace air increased the contaminant levels and thus, increases the workers' exposure. If the air from the filtering device was led outdoors, the concentrations of both alkanolamines and volatile organic compounds in workplace air decreased by 60-70%. However, this solution increases energy costs and hinders often needed modifications and enhancements of the processes on the factory site.

The results showed that the new type of multi-stage particulate filtration combined with treatment of volatile contaminants might be the best choice for the cleaning of the exhaust air of the machining centres.

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### **Vision Zero and leading indicators for safety, health and wellbeing**

A previous PEROSH project running from 2014-2015 involving researchers from eight countries focused on companies with an ambitiously stated strategy for the prevention of accidents at work - a so called Vision Zero for safety. The study was based on surveys, interviews and workshops with 27 companies across various sectors and sizes.

The project had impact in being inspirational for The International Social Security Association (ISSA) that launched a global campaign in 2017 entitled Vision Zero for Safety, Health and Wellbeing ([visionzero.global](http://visionzero.global)). ISSA subsequently initiated a project in 2019 to identify a limited set of leading indicators for safety, health and wellbeing, which are relevant and meaningful across sectors and for small, medium and large enterprises.

In order to secure impact, the project utilizes a knowledge transfer and exchange approach in building on inputs and involvement of Vision Zero organizations, scientific literature, and the expertise of the project team and the ISSA steering committee.

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### **Asbestos in plasters, adhesives and fillers: work associated with exposure in existing buildings**

Besides obvious asbestos applications in buildings (e.g. asbestos cement), chemical construction products were used in Germany between around 1960 and the mid-1980s to which asbestos was added, either as a reinforcement or for modification of the application properties. Typical products are fillers, adhesives (e.g. for tiles) and plasters. These product types were manufactured and used both with and without asbestos. During work in existing buildings, such product applications are inadvertently worked mechanically. Since it is not immediately apparent whether materials in wall structures contain asbestos, a special surveying and sampling concept is required by which it can be determined with sufficient statistical accuracy whether asbestos will be encountered during the planned work.

The concept involves taken samples from the wall structure in which (in contrast to samples of archetypal technical asbestos products) it must be possible to detect asbestos even at very low concentrations of < 0.1% by mass. Due to the particular properties of the samples a special preparation strategy has been developed. The aim of this strategy is, on the one hand, to enhance the visibility of asbestos where present (uncovering of fibres, elimination of disturbing components) in order to facilitate subsequent scanning electron microscopy; and on the other, for preparation to be sufficiently gentle to prevent excessive breakdown of the chrysotile that may render it invisible for analysis.

With regard to the analysis of material samples, a comprehensive measurement campaign is also being conducted for the surveying of exposure to asbestos and dust (silica, respirable and inhalable dust) arising during various tasks performed in existing buildings. The German Social Accident Insurance Institutions are conducting reference measurements on a large scale and with use of particular protective measures, the purpose of which is to define low-emission methods for as many of the tasks as possible.

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### **Campaign on safe roofing works - The important thing is to get down alive!**

In the construction sector, the most frequent form of fatal accident is fall from height. In the case of works executed by small and medium-sized companies, about 50% of these falls occur while carrying out maintenance tasks on roofs. According to the data gathered, these companies have little awareness of the risks to which their employees are exposed and do not have sufficient knowledge about their obligations and technical criteria to protect them.

In order to reduce the incidence rate of this type of accidents, the Spanish National Institute for Safety and Health at Work (INSST) intends to develop a campaign in 2020 on safe roofing works, with the slogan: The important thing is to get down alive! This campaign aims to increase the awareness of promoters and contractors about these risks and improve their technical knowledge to reduce these accidents. For that purpose, different informative products have been elaborated (video, brochures, technical documents, etc.). These accidents can occur in any kind of building (industrial building, office building, residential housing, etc.), therefore this issue is a matter of social interest. Accordingly, the main challenge is to have as much impact as possible.

We have developed two ways of measuring the impact of our project:

- numbers of downloaded and distributed information products
  - Incident index of these kind of accidents evolution
- 



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**Key note speaker**

### **Stress and satisfaction in the Workplace**

In our volatile, uncertain, complex and ambiguous world psychomental strains in the workplace seem to be increasing. Based on the resulting challenges a constant reflection of demands and balancing resources is of tremendous importance. Established and validated questionnaires, like the COPSOQ or WAI, are only suitable for yearly statistical surveys due to the great amount of questions and the rather small attention span of individuals. At the same time a working environment, that is constantly changing requires a real-time screening of demands and resources to be able to react fast and flexibly.

A study with executives in a global company was able to show that a two-item screening tool, about stress and job satisfaction, is able to measure psychomental strains. Furthermore, results showed that a stress level that is higher than the satisfaction is negatively associated with health. These results show, that two items about stress and satisfaction are able to replace time-consuming questionnaires in the day-to-day business. They can be used flexibly to show a real-time reflection of psychomental strains and draw conclusions regarding health.

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### **Grouping of exposure and risk for processing of nanocomposites**

In the course of the German project nanoGRAVUR to develop a framework for the grouping of nanomaterials concerning their risks, the IFA performed the determination of exposure during grinding of selected nanocomposites. The goal was to investigate whether grouping of physical-chemical characteristics of nanomaterials influences the exposure and thus the risk.

Composites on basis of epoxy resin, hardened cement mixtures, and aluminium with the additives of nano objects from the groups of fibres (CNT, WS2), platelets (graphene) and compact particles (TiO<sub>2</sub>, SiO<sub>2</sub>, carbon black) were chosen. Grinding exposure tests were carried out and number and mass concentrations were determined at the worker and near to him. Particle number concentrations ranged between 5600 and 23000 1/cm<sup>3</sup> and only the epoxy resin composites showed a decrease with adding nano-objects, lowest with WS2. The added nanomaterial is less influencing the exposure than the matrix material, which is in accordance to pure release measurements.

Besides the exposure determination, the assessment scheme for describing the risk at workplaces had been worked out. The influence of material properties on their hazard like bio-resistance, toxicity (or rigidity for fibres) and modulating properties (agglomeration, critical dimensions, dustiness) has been grouped and class boundaries defined. Similarly, the exposure was classified by using information on material processing and concentrations at the workplace. Combining the information on hazard and exposure leads to the risk specified in three levels.

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**Key note speaker**

### **Sustainable work ability- healthy retirement?**

Research on work-related aging (occupational gerontology), focuses on the adaption of middle-aged and older workers to employment and their transition to retirement, and takes in to account that different ages have their own specific needs. It is about balancing work demands with individual capacities throughout the working life, especially from midlife on, in to retirement and old age.

Work ability is primarily a question of a balance between work and personal resources. Personal resources change with age whereas work demands may not change parallel to that, or only change due to globalization or new technology.

Functional abilities (capacity) change with increasing age, physical abilities decrease faster than psychosocial abilities. Work ability decreases with age, but not always linearly. Several different trajectories (pathways) exists from midlife to old age. Work ability of the majority of people decreases linearly but both sudden decreases and increases are possible. Work demands at midlife very much predict further work disability, health, functions and even mortality. Factors related to both ergonomics and general lifestyles explain the declines and improvements in work ability during aging.

People with higher occupational classes are more likely to have a good work ability and also continue working beyond the pensionable age compared to those with lower occupational classes. This is explained by a physically lighter job, better work time control and better self-rated working capacity. Work ability and work life satisfaction are important contributors to retirement intentions of employees.

Although longitudinal studies already show a significant association between work ability and health during retirement, there is a lack of reliable and feasible interventions to show what is important in promoting work ability during working life.

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### **Ionizing detector to study the emission of nanoparticles at workplaces**

Nanomaterials owe their unique properties to their small size. At the same time, this very feature is problematic due to the safety and health hazards. Employees manufacturing these products are exposed to harmful effects, mostly as a result of inhalation. The currently available devices for nanoaerosol sensing are relatively complex and expensive. There is therefore a need to simplify and reduce the costs of devices for nanoparticles detection. Ionization smoke detectors are used to identify fires at an early stage, when only a small amount of thin smoke is produced. This has spawned the idea to study their usability for nanoparticles detection in the work environment.

The detector has been modified by exposing signals from both reference and active chambers. Radioactive isotope Americium-241 ionizes the air creating a current flow between two electrodes. When ions recombine with aerosol particles in the active chamber, a voltage difference is created proportional to the particles' concentration. When the voltage difference reaches a level above the set threshold, a fire alarm is triggered. Voltage signals from both chambers were measured using microcontroller with an analog digital converter and an operational amplifier used as a voltage follower. The output signal was calculated as the difference between the two voltage signals.

The device was placed in a sealed container with inlet and outlet hose connectors. Nanoaerosol was produced using a Palas GFG 1000 generator with graphite electrodes. TSI NanoScan SMPS 3910 was used as a reference device for nanoparticles concentration measurements.

The value of the output signal from the modified detector increases with the increasing number of aerosol particles. The relationship may be estimated from linear trend line in the aerosol concentration range up to  $8.3 \times 10^5$  particles/cm<sup>3</sup>. Low-cost detectors with such response characteristic could be used to assess long-term exposure in real time as well as to detect unforeseen events.

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### **Life-long learning as a chance and prevention of digital exclusion in the context of prolonged working life**

Low level of education is one of the main factors that leads to unemployment and increases the risk of disability or health loss among the elderly (Richert- Kaźmierska, Forkiewicz, 2013). Education helps people to adapt to changing living conditions at each stage of life and improves the quality of life. For the elderly, the education is also a way to level stereotypes about old age and social marginalization. Furthermore, it positively affects one's self-esteem and gives opportunities to establish social contacts.

Learning allows the elderly to maintain their mental, physical and social efficiency (Szczurek, 2013). It also helps them to adapt to organisational and technological changes, update their skills (Vianen, Dalhoeven, Pater, 2011, Picchio, 2015) and increase their ability to work (Froehlich et al., 2014).

Research conducted at CIOP-PIB in 2017-2018 showed that workers aged 50 and over (N=544) believed that learning was essential in all age groups (89,9%). Only 10.8% of respondents believed that even if older individuals took part in training, they would not find it as effective as younger individuals, and 8.3% believed that learning was only for the young. Slightly more than half of the respondents (50.6%) wanted to participate in the training in order to acquire new skills. On the other hand, every third respondent (33%) wanted to take part in the training for financial reasons, and slightly fewer (27.2%) wanted to pursue their interests.

Older workers pointed out that they had the same access to resources and information as younger workers. A slightly lower percentage of respondents indicated, however, that they had equal access to training and courses. The research also showed that workplace is not a friendly environment where older workers could learn and develop their skills.

When asked about their preferences for training topics, the respondents answered that they were interested in vocational courses (35.7%) or computer courses (27.4%). More than half of the respondents (64.8%) who participated in the training strongly agreed or agreed that the training allowed them to improve their way of working; 58.7% strongly agreed or agreed that the training made their work more secure, 47.7% strongly agreed or agreed that the training improved their chances for employment in the future.

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### **Nanorama – New approach for interactive knowledge transfer**

Nanorama is a new approach for an interactive knowledge transfer related to nanosafety. The target group varies from OHS specialists to employer and employee. Up to now five scenarios are implemented, two of them, car workshop and production, are translated into English. The tool shows a 360° picture of a lab or a car workshop. The user can turn the view and zoom in and out to get a closer look to details. Everything that has a connection to “safe working with nanomaterial” gets highlighted by mouse-over function and short information pops up. To motivate the user to look for more details, further information is included in a multiple-choice quiz. By clicking on the highlighted objects multiple choice questions appear. After answering the question additional information is given in pictures or short video clips. A score card is located at the edge of the screen.

This online tool deals as a starting point for information gathering. The main aim is to sensitize everybody to the possible existence of nanomaterial in the workplace environment in a playful way. Often the gap of basic knowledge results in workplace exposure. Bridging this knowledge gap as early as possible, when nanomaterials are implemented in working procedures, is the primary objective of this tool.

The tool is embedded in a web page where detailed information and links are offered

<http://nano.dguv.de/nanorama/bgrci/en/>

The feedback is mostly positive in design as well as content. Technical stability and very good user guidance are additional pleasing comments.

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### **Biomonitoring of the urinary benzene metabolite s-phenylmercapturic acid in firefighters**

In 2010 the International Agency for Research on Cancer (IARC) classified the occupational exposure of a firefighter as possibly carcinogenic to humans (Group 2B). Fire fighters are exposed to a number of carcinogenic chemicals that are released during a fire and benzene is a central substance to monitor in this aspect. The benzene metabolite s-phenylmercapturic acid (SPMA) is a specific urinary biomarker for benzene and can be used for monitoring personal exposure at low air concentrations of benzene.

In an ongoing project (Cancer risk among firefighters) at the National Institute of Occupational health in Norway, SPMA is one of several biomarkers examined in urine donated from firefighters. Urine was collected from 16 firefighters after a fire drill (prior to, immediately after and approximately six hours after firefighting) and the samples were analysed by liquid chromatography mass spectrometry. SPMA was detected in all urine samples donated from the firefighters six hours after the fire drill. To our knowledge, this is the first study detecting SPMA in urine donated from firefighters.

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### **Promoting continuous learning at midlife with a career management intervention “Skills for Work” – A randomized controlled study (RCT)**

#### Background and study aim

The need for developing professional competences throughout a working career is widely acknowledged. However, there is lack of effective methods supporting employees’ motivation to life-long learning and occupational skill development. The main goal of this study was to examine the efficacy of a peer group-based training intervention focusing on employees’ competence development management in the mid-career.

#### Methods

The data were collected in a randomly assigned field experimental study (RCT) between 2017 and 2018 among 1119 individuals. The participants were recruited from a student register of Haaga-Helia University of Applied Sciences and from members of the Union of Professional Engineers. The mean age of participants was 49 years. The training lasted 16 hours and included web-based assignments, self-learning, group meetings and an employer interview.

#### Results

The results of regression analyses showed that the intervention was effective in increasing participants’ competence development management immediately after the intervention. Moreover, the probability to participate in a tertiary education 12 months after the intervention was almost twofold among intervention group participants than among control group participants (19 % intervention vs. 11 % control group).

#### Conclusions

Skill for work training program could be used in universities of applied sciences or other educational institutions as a program for developing preparedness for continuous learning in the mid-career, and also at workplaces as change security.

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### **Implementation of a new working practice to the client process - the barriers and enablers**

FIOH has developed a new working practice – the Abilitator – for assessing the work ability and functioning of the persons with a weak labour market situation. This has been done in a coordination project called the Social Inclusion and the Changes in Work Ability and Capacity funded by the European Social Fund (ESF). The Abilitator is a digital self-assessment questionnaire analysing the given answers and producing an individual feedback. It has mainly been used in the Finnish ESF projects between 2015 and 2018.

The aim of this study is to investigate the factors that enable or hinder the implementation of the Abilitator to the client processes of different service providers.

The study was based on an action research and implemented with an employment and a health service provider. The data included transcribed material of individual (n=2) and group (n=5) interviews, SWOT-analysis (n=7), the descriptions of operational environments (n=2) and client processes of the service providers (n=2), memos (n=3), e-mails (n=9) and the data gathered in the workshops (n=4). The concepts of implementation, barriers and enablers were used as a framework for data analysis. The data were analysed using content analysis and ATLAS.ti-programme.

The results showed that the main barriers of the implementation related to the way the working practice was used (e.g., poor digital skills, lack of resources, non-systematic use), the environment of use and the characteristics of the practice. The main enablers related to the users' attitudes and competence. Other enablers were a need for a new working practice and its perceived benefits.

When developing a new working practice, it is important to engage both clients and professionals, demonstrate the benefits of the practice and create a plan for the implementation. The positive results of the Abilitator encourage to develop new working practices for client processes also in the future despite the constantly changing operational environment.

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### **Models for improving research-to-practice and assessing impact**

The National Research Centre for the Working Environment in Denmark (NFA) aims to improve the assessment of how the centre's research affects society. This presentation will share and discuss preliminary ideas about how the centre can improve and systematize its research-to-practice practices. In the future, the NFA plans to strengthen collaboration with knowledge brokers of working environment knowledge, such as educators, consultants, social partners, etc.

The presentation will also discuss how the centre's anticipated improvements in proximal and distal research impact can be assessed. Proximal impact measures such as scientific output and popular communication are relatively straightforward to assess, whereas assessment of distal outcomes such as societal impact on health and economic outcomes are much more difficult to estimate.

The presenters invite participants to share experiences with methods to collaborate with knowledge brokers and with methods to assess societal impact of OHS research.

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### **Objectively measured Physical Activity at Work and Need for Recovery: A cross-sectional compositional data analysis**

#### Introduction

Previous research has shown strong associations between occupational physical activity (OPA) and need for recovery (NFR). However, this research has only utilised self-reported measures of OPA which have clear biases. Thus, there is a need for investigating if the previously documented association between self-reported OPA and NFR can be found when using technical measures of OPA. There is also the need to investigate whether older workers are particularly susceptible to increased NFR, since age related declines in physical capacity mean that it is likely these workers will have a higher NFR for a given physical activity. The aim of this study is to investigate the association between technically measured OPA and NFR, and whether this relationship is modified by age.

#### Methods

This study utilised data from the DPhacto cohort - comprising Danish workers (n=840) from the cleaning, manufacturing and transportation sectors. OPA was measured by accelerometers attached to the thigh and upper back for at least one work day and classified into 4 movement behaviour categories (sedentary, standing, light or moderate/vigorous). NFR was measured using a shorted version of the Danish NFR scale. Analysis was conducted using linear regression and isotemporal substitution analyses for compositional data.

#### Results

The overall association between OPA and NFR was statistically significant in the unadjusted model ( $p < 0.001$ ), but not when adjusted for age, sex, occupation and shift work ( $p = 0.166$ ). Isotemporal substitution showed small but significant reductions in NFR with increased sedentary time (adjusted:  $\Delta \text{NFR} = -0.010$  [0.019; -0.001]). There were no significant interactions between age and OPA ( $p = 0.409$ ).

#### Conclusions

This study found significant associations between OPA and NFR, but the size of these associations was small. Reallocating 30 minutes to sedentary behaviours from other behaviours was associated with a reduced NFR, but the effect size may not be practically relevant. Moreover, no clear modifying effects of age were identified.

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## **Ethics and occupational health: from the development to the complexity of contemporary society**

### Background

Over the past decades new ethical issues have come to the fore, partly reflecting changes in the world of work, demographic shifts, new technologies and, more generally, the impact of globalization. A very central role in this scenario is played by the occupational health professionals (OHPs) because of the increasing complex and sometimes competing responsibilities of OHPs towards workers, employers, public health and labour authorities and other bodies such as social security and judicial authorities. We analysed the development of the concept of ethics in occupational health in the contemporary world of work, focusing on emerging ethical concerns.

### Methods

After reviewing the development of the concept of ethics in occupational health, we analysed the existing literature focusing on the ethical conflict in occupational health, from the individual, professional and institutional point of view, in order to identify drivers and barriers for correct professional ethics.

### Results

Although the topic of ethical conflict in occupational health has been discussed since the 1970s and has received increased attention in recent years, there has been no systematic attempt to study the true extent of ethical issues and how they are resolved in practice. The presence of numerous variables to be taken into consideration, as well as the growing number of potential stakeholders involved in ethical choice, prevented the identification of an ideal proposal able to solve ethical challenges in OHPs practice.

### Conclusions

To deal with the complexity in today's changing world of work, the logic of an integrated approach must take account of the importance of all three types of ethics: personal (individual), professional and institutional.

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### **TREXMO plus: an advanced self-learning model for occupational exposure assessment**

Within the context of the EU's REACH regulation, several occupational exposure models are recommended for chemical exposure assessment. These models require exposure parameters to be entered from a few to many, depending on the level of models' complexity.

As of today, the performance of these models is not fully evaluated for a wide range of exposure conditions because of the lack of adequate exposure data. In this study, we developed and tested a new model for airborne exposure, named "TREXMO Plus (+)", that uses three REACH models, i.e. ART, Stoffenmanager (version 4.0), and ECETOC TRAv3, as the independent predictors. This model considers that the performance of the different exposure models may vary over different exposure conditions (such as for lower and higher vapor pressure values).

TREXMO+, therefore, is conceptualized by applying weights developed from the training data sets into the independent predictors of three models to derive a refined exposure estimate. The exposure data, which counted 1058 exposure measurements, was split in two sets, where 80% was used to develop the model and the remaining 20% to test its performance.

Compared with the three REACH models individually, TREXMO+ was the least biased model and the most accurate. It was found that, on average, the TREXMO+ estimates differ by a factor between 2 and 3 from the measurements. The model was significantly correlated against the measurements; explained best the variance (R-squared, 0.44-0.71). Although more data is required to test further this model, the concept of TREXMO+ is expected to provide better estimates in comparison with the use of the exposure models individually.

Keywords: exposure factors, exposure models, industrial hygiene, occupational, risk assessment, statistical methods

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### **The influence of digitalization and new technologies on psychosocial work environment and employee health**

As part of a larger project initiated by the Nordic Council of Ministers set to establish the future of work in the Nordic countries, we conducted a literature review investigating the effects of digitalization and new technologies on the psychosocial work environment and employee health and well-being.

The original screening for relevant articles resulted in 6238 publications retrieved, 43 of which were included in the final summary. Ten additional publications were identified by searching reference lists, making a total 53 studies to be included in the current review.

The introduction of new technologies at work has long been recognized as a source of worry, uncertainty, and new work environment risks. Existing skills may become redundant, and having to acquire new skills or having to adapt existing ones can present immense challenges for workers.

Outcome factors were divided into two general categories; 1) health and well-being outcomes, which included among others pain, burnout, general health, and sleep problems, and 2) work factor outcomes, which included among others job satisfaction, work - private life balance, and perceived job control.

The included studies identified an emphasis on some topics and aspects of the current research out there, namely, 1) Introduction to new technologies, 2) "ICT demands", 3) Technostress, 4) "Workplace telepressure", availability demands, and work-private life interference, 5) Attitudes towards technology, and 6) Interpersonal stressors. The individual topics and findings from studies exploring these topics will be discussed in detail.

As a brief conclusion, however, we can see that in many instances, it seems that new work technologies are accompanied by problems balancing work with private life, lack of restitution due to extended availability requirements or -norms, quantitative as well as qualitative work overload, and a range of other potential challenges to employee well-being.

However, there were also a number of studies that reported no significant adverse health effects, or that contributed to a more nuanced view by specifying conditions under which potentially adverse health effects of new technologies could be avoided. And while the theoretical interests of most studies seemed to pertain mainly to potential adverse effects, some studies identified ways in which new technologies could benefit employees, for instance by providing freedom (or control) and flexibility, or by altering job tasks in ways that increased job motivation, satisfaction, and performance.

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### **Safe handling of asbestos**

The presentation „Safe handling of asbestos“ will start with a brief overview of the material properties and the hazard potential of asbestos as well as the history of the asbestos usage. Based on the scientific and historical background, the development from the "miracle fibre" to the carcinogenic hazardous substance is explained. In this context, reference is also made to the sociological-demographic aspect of the topic: the mass use of asbestos began with the industrial revolution, driven first by the armaments industry (shipbuilding) and later by the construction sector. Though early known as a hazardous material, consequences for occupational health and safety were not drawn until the strategic importance in the war economy diminished. At the same time, the life expectancy of (industrial) workers increased and therefore, asbestos-related illnesses appeared massively.

Following, the different uses of asbestos and the resulting challenges in handling these materials are presented. Here, the well-known products are outlined briefly, a focus is placed on the so-called new asbestos materials (plasters, fillers, etc.) or the "non-targeted handling" with asbestos. The latter includes e.g. activities involving materials in which asbestos is not necessarily contained in the manufacturing process, but which may contain asbestos because of processing and contamination. On this basis, the low-emission methods developed in Germany according to the TRGS 519 are presented exemplarily. Applications for admission of these working methods are examined by the Institute for Occupational Safety and Health of the DGUV (IFA), published in the DGUV Information 201-012 and thus made available to users.

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**The TNO Impact Mapping Tool: a tool to show the impact of projects on societal goals.**

Impact for TNO means that the knowledge we develop is applied to the maximum possible extent and allows to solve societal challenges together with our clients and research partners. Creating impact is part of the mission of TNO. Realizing this mission is important for the outside world to justify funding, to disseminate results of projects and to stimulate new collaborations. Aiming for societal impact also guides internal decision making. Since purposeful work is important for employees, creating impact increases motivation of employees.

To measure this impact and be able to provide better insight into impact, TNO developed the Impact Mapping Tool, a tool that helps show the impact of projects in regard to the Sustainable Development Goals. This tool is a qualitative tool that provides insight into the intended impact, taking into account several dimensions of impact (i.e. not only economic impact).

The Impact Mapping Tool is applied in several areas within TNO. In this presentation the results will be shown of an analysis with the Impact Mapping Tool of the TNO research program 'Sustainable Work'. In an interactive part of the presentation the Impact Mapping Tool will be applied to a project brought in by a volunteer in the audience (or if there are no volunteers, on one of the PEROSH joint research projects).

At this moment, the Impact Mapping Tool is a qualitative tool to predict impact of research activities. In the next step of the development of this tool, relevant impact indicators will be identified to enable quantitative insight into impact. Challenges in developing these indicators and in determining what part of impact is realised by one research program, will be discussed.

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### **Effect of Occupational Health & Safety training at school on the occurrence of workplace injuries in young people starting their professional career**

The objective of this study was to determine the effect of occupational safety and health (OSH) education during formal schooling on the incidence of workplace injuries (WIs) in young people starting their careers. Secondary objectives focused on the effect of “First aid at work” training during schooling and the conditions encountered upon arrival in the company (occupational hazard information, safety training, and job task training) on WIs occurrence.

A prospective cohort study has been carried out among apprentices or students, in the last year of levels V, IV or III diploma in specialties of production or service. At the time of inclusion, information about training course and personal characteristics were collected, and subsequent half-yearly contacts gathered information relating to work and personal data. During the two-year follow-up, WIs were directly reported by participants and were identified by searching the French National Health Insurance Funds’ databases listing compulsory WI declarations.

The 755 participants reported holding 1290 jobs. During follow-up, 158 WIs were identified, corresponding to an incident rate of 0.12 [0.10–0.14] WIs per full-time worker. Subjects who reported having received OSH education at school had 2 times less WIs than those declaring not having received OSH education (IRR=0.51 [0.00-0.98]). A lower WI risk was observed for participants who received the First aid at work training (IRR=0.68 [0.00-0.98]). The conditions upon arrival in the company were not associated with WIs occurrence.

This longitudinal study highlighted a lower risk of work injury among young people who have received OHS training at school. The OHS training provided to apprentices and students has a broader-spectrum than the specific risks of the future job. The lack of effect of the discrepancy between initial training and job may suggest the interest of strengthening this approach.