

IMPACT OF LONG COVID ON WORKERS AND WORKPLACES AND THE ROLE OF OSH

What is Long Covid syndrome, who can be affected, and what are the effects on workers' health?

According to Johns Hopkins Coronavirus Resource Centre, as of 6 April 2022 there have been globally over 494 million reported cases of COVID-19 and over 6.16 million associated deaths¹. In Europe, Reuters (2022) estimates, through the combination of numerous sources, that there have been in excess of 181 million cases and over 2.1 million deaths². Given that the population of Europe has been estimated to be in excess of 750 million by the United Nations, numbers of actual cases are potentially much higher but unreported due to having mild symptoms or an unwillingness to report, with many others having experienced COVID-19 without positive test confirmation³.

COVID-19 is a condition similar to influenza but much more infective and with more serious effects⁴. As the emergence of COVID-19 represented both a new virus and a new disease, its impact, immediate effect and lasting influence has been poorly understood by health professionals and by employers. Young people usually recover quickly, and for most working-age people recovery will have occurred within four weeks⁵. However, COVID-19 infection can have serious consequences for the working population. The United Kingdom Office for National Statistics (ONS) estimates that between 7% and 18% of people who have had COVID-19 develop some symptoms of post-COVID-19 condition persisting for at least five weeks, leading to an estimated 1.3 million people in the United Kingdom (1 in 50) experiencing self-reported post-COVID condition⁶.

In the initial stages of the pandemic in 2020, McKinsey Global Institute hypothesised that working practices would be irrevocably altered beyond lockdowns⁷. The report estimates that around 94 million workers in Europe will need to augment their current working skills to adapt to the rigours of home and hybrid work, with a further estimation that over 21 million may require retraining by 2030.

In addition to these professional concerns, there remains the issue of individual health due to COVID-19, resulting in potential inability to return to pre-pandemic work because of physical illness. Taquet et al. hypothesised in September 2021 that as many as one in three COVID-19 sufferers retain aspects of Long Covid for weeks, if not months, beyond the initial infection⁸. Additionally, it must be noted that current understanding of Long Covid indicates that the majority of sufferers are of working age⁹.

¹ Centre for Systems Science and Engineering (CSSE), Johns Hopkins University, 'Covid19 Dashboard', data accurate on 6 April 2022. <https://coronavirus.jhu.edu/map.html> (accessed 06/04/2022).

² Reuters COVID-19 Tracker, Europe, updated 4am GMT, 04/04/2022. <https://graphics.reuters.com/world-coronavirus-tracker-and-maps/regions/europe/> (accessed 04/04/2022).

³ United Nations. (2020). Population. <https://www.un.org/en/global-issues/population> (accessed 17/03/22); Chow, C. C., Chang, J. C., Gerkin, R. C., & Vattikuti, S. (2020). Global prediction of unreported SARS-CoV2 infection from observed COVID-19 cases. *medRxiv - the preprint server for health sciences*, pp.1-39. <https://doi.org/10.1101/2020.04.29.20083485>

⁴ World Health Organisation (WHO), *Weekly epidemiological update on COVID-19 - 22 February 2022*. <https://www.who.int/publications/m/item/weekly-epidemiological-update-on-covid-19---22-february-2022> (accessed 17/03/22).

⁵ WHO. (2021). *A clinical case definition of post COVID-19 condition by a Delphi consensus*, 6 October 2021. <https://www.who.int/publications/i/item/WHO-2019-nCoV-Post-COVID-19-condition-Clinical-case-definition-2021.1> (accessed 17/03/22).

⁶ Soriano, J. B., Murthy, S., Marshall, J. C., Relan, P., Diaz, J. V., & WHO Clinical Case Definition Working Group on Post-COVID-19 Condition. (2021). A clinical case definition of post-COVID-19 condition by a Delphi consensus. *The Lancet Infectious Diseases*, 22(4), e102-e107. [https://doi.org/10.1016/S1473-3099\(21\)00703-9](https://doi.org/10.1016/S1473-3099(21)00703-9)

⁷ Smit, S., Tacke, T., Lund, S., Manyika, J., & Thiel, L. (2020, June 10). *The future of work in Europe. Automation, workforce transitions, and the shifting geography of employment*. McKinsey Global Institute. <https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-in-europe> (accessed 17/03/22).

⁸ Taquet, M., Dercon, Q., Luciano, S., Geddes, J. R., Husain, M., & Harrison, P. J. (2021). Incidence, co-occurrence, and evolution of long-COVID features: A 6-month retrospective cohort study of 273,618 survivors of COVID-19. *PLOS Medicine*, 18(9), Article e1003773. <https://doi.org/10.1371/journal.pmed.1003773>

⁹ Ayoubkhani, D., & Pawelek, P. (2021). *Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 4 June 2021*. United Kingdom Office for National Statistics (ONS). <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/prevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk/4june2021> (accessed 17/03/22).

However, clarification of COVID-19 and Long Covid has been sporadic in some areas and circumstances, potentially leading to unrecognised cases. Furthermore, tests to confirm previous COVID-19 infection are not reliable after about three months, as the antibodies in the blood can disappear, removing indication of past infection.

The World Health Organisation has defined post-COVID-19 as a condition that occurs in individuals with a history of probable or confirmed SARS CoV-2 infection, usually three months from the onset of COVID-19 with symptoms that last for at least two months and cannot be explained by an alternative diagnosis¹⁰.

Where symptoms continue beyond three months it has been called Long Covid by patient groups and post-Covid condition or syndrome by doctors, but the name Long Covid is the one most frequently used by patients and workers. Many of the studies of Long Covid have ignored the population with symptoms who have not had a positive test for the presence of the virus.

In one survey by the United Kingdom ONS of 20,000 cases, 13.7% had symptoms for over 12 weeks and the highest prevalence occurred between ages 35-49 years, with 25.6% of that age group with symptoms and women slightly more likely to have symptoms compared to men¹¹. Data analysis based on 368,857 responses to the Coronavirus (COVID-19) Infection Survey (CIS) collected over the four-week period ending 5 March 2022 by ONS, indicate that in the UK, Long Covid symptoms adversely affected the day-to-day activities of 1.1 million people (67% of those with self-reported long COVID), with 322,000 (19%) reporting that their ability to undertake their day-to-day activities had been "limited a lot".¹² Another UK study of more than 2,000 patients after hospitalisation with COVID-19 presented at this year's European Congress of Clinical Microbiology & Infectious Diseases (ECCMID 2022, Lisbon 23-26)¹³, and published in *The Lancet Respiratory Medicine*¹⁴ shows that, one year after having COVID-19, only 29% of hospital patients recovered within a year.

In a large United States study by Taquet et al. in 2021, 243,618 COVID-19 survivor cases were compared with influenza cases¹⁵. There was a significant difference in prevalence of symptoms in the COVID-19 survivors, with more than 33% of COVID-19 cases having had one or more Long Covid symptoms lasting over six months. The results of a telephone survey in France (with a 57% response rate reaching 478 patients) showed that at four months after hospitalisation for COVID-19, about half of the patients had at least one feature of Long Covid¹⁶. When the initial cases of Long Covid emerged, there was a lack of awareness and scepticism about post-COVID-19 among the public and medical professionals. Consequently, individuals with persistent symptoms did not get the necessary medical care they required.

What are the signs, symptoms and health impacts of Long Covid?

Long Covid can affect nearly every organ system with effects including disorders of the respiratory system and the nervous system, neurocognitive disorders, mental health disorders, metabolic disorders, cardiovascular disorders, gastrointestinal disorders, malaise, fatigue, musculoskeletal pain and anaemia. COVID-19 can therefore be defined as a new disease that can affect any organ in the body. While the mechanism responsible for these effects is still uncertain, it is probably due to inflammation of the lining of the blood vessels (endotheliitis), which means that it can affect any organ¹⁷.

Workers who are experiencing Long Covid may have any one or more of a number of symptoms:

¹⁰ Soriano et al. (2021), p. 1.

¹¹ Abyoukhani, D. (2021). *Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 1 April 2021*. ONS, p. 9.

<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/prevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk/1april2021> (accessed 19/02/22).

¹² Ayoubkhani D, Pawelek P (2022). *Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK : 7 April 2022*. ONS, p 3.

<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/prevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk/7april2022#measuring-the-data>

¹³ <https://www.eccmid.org/#>

¹⁴ The PHOSP-COVID Collaborative Group (2022), *Clinical characteristics with inflammation profiling of long COVID and association with 1-year recovery following hospitalisation in the UK: a prospective observational study*. Published Online, April 23, 2022, [https://doi.org/10.1016/S2213-2600\(22\)00127-8](https://doi.org/10.1016/S2213-2600(22)00127-8)

¹⁵ Taquet et al. (2021), p. 1..

¹⁶ Ibid., p. 8.

¹⁷ Varga, Z., Flammer, A. J., Steiger, P., Haberecker, M., Andermatt, R., Zinkernagel, A. S., Mehra, M. R., Schuepbach, R. A., Ruschitzka, F., & Moch, H. (2020). Endothelial cell infection and endotheliitis in COVID-19. *The Lancet*, 395(10234), 1417-1418. [https://doi.org/10.1016/S0140-6736\(20\)30937-5](https://doi.org/10.1016/S0140-6736(20)30937-5)

- Extreme tiredness (fatigue)
- Shortness of breath
- Chest pain or tightness
- Problems with memory or concentration ('brain fog')
- Difficulty sleeping
- Heart palpitations
- Dizziness
- Pins and needles
- Joint pain
- Depression and anxiety
- Tinnitus, earaches
- Nausea, gastric symptoms, stomach ache
- Postural dizziness
- Loss of taste and smell
- Skin rashes
- Exacerbation of pre-existing conditions

The most common long-term effects are fatigue and breathlessness. The loss of taste and/or smell may persist. Most if not all of these symptoms will improve with time and treatment, but some symptoms such as loss of taste and smell, dizziness on standing up from a seated position, chest pains and mental health issues may persist. Any part of the body can be affected.

Many other diseases can cause some of these symptoms and about 33% of all working people, especially older workers, will already have pre-existing diseases that Long Covid may adversely effect.

The time it takes to recover from COVID-19 varies significantly between infected individuals. Anecdotal evidence suggests that in a population of Long Covid patients who had been hospitalised, about half will recover within three months. Generally, Long Covid represents symptoms that have been present for longer than two months, though there is no reason to believe that this choice of cut-off is specific to infection with the SARS-CoV-2 virus. Most people will recover within six months, and very few will still be unfit to work after two years. Where there has been severe damage to an organ such as the lungs because of scarring, the changes (in this case in the function of the lungs) may however be permanent, even if the other Long Covid symptoms have disappeared.

It is also normal and expected that people who experience severe symptoms or complications requiring hospital treatment may suffer from post-intensive care syndrome or secondary infections¹⁸. As a result, they will naturally take longer to recover than people who did not require hospitalisation and had no such complications; but most people with Long Covid will not have required ventilation¹⁹. This natural variation can make it difficult to determine whether a specific individual's set of ongoing symptoms are related to hospital care or Long Covid. New viral treatments are being developed for COVID-19 but as yet there is no one treatment that will cure COVID-19 or Long Covid.

¹⁸ Rawal, G., Yadav, S., & Kumar, R. (2017). Post-intensive care syndrome: An overview. *Journal of Translational Internal Medicine*, 5(2), 90-92. <https://doi.org/10.1515/jtim-2016-0016>

¹⁹ Heo, J., Han, D., Kim, H.-J., Kim, D., Lee, Y.-K., Lim, D., Hong, S. O., Park, M.-J., Ha, B., & Seog, W. (2021). Prediction of patients requiring intensive care for COVID-19: Development and validation of an integer-based score using data from Centers for Disease Control and Prevention of South Korea. *Journal of Intensive Care*, 9, Article 16. <https://doi.org/10.1186/s40560-021-00527-x>

What are or could be the effects on workers' safety and health?

As has been described above, there are many symptoms and physical limitations in the Long Covid population, with fatigue, breathing issues and cognitive dysfunction being the top three most debilitating symptoms listed by patients. Musculoskeletal, cardiovascular, gastrointestinal, pulmonary and neuropsychiatric symptoms were prevalent in about 85% of participants²⁰.

Breathlessness may be due to scarring of the lungs, which may cause a permanent reduction in lung function or disordered breathing that may be treatable. In either situation, there are clearly limitations for workers' capacity for physical work, especially if there are muscular symptoms as well.

Some individuals may also have inflammation of the heart muscle (myocarditis), or even have had a heart attack, which could also affect their ability to undertake physical work²¹. Some of these individuals can suddenly experience a rise in their heart rate from the normal level of around 70 beats per minute up to levels of 100-140 beats per minute.

A further complication of Long Covid can be postural orthostatic tachycardia syndrome (POTS), which combines the difficulty in standing because of a sudden fall in blood pressure with a fast heart rate and a feeling of profound fatigue. These symptoms may be episodic and, in these workers, further occupational medical assessment and advice is required²². Additionally, another common symptom (occurring in around 10% of workers) that can occur is the condition called 'brain fog', a neurocognitive effect of COVID-19 infection, when a worker has difficulty with concentration and memory, usually a temporary effect²³.

Where there has been no permanent damage to organs, these effects of Long Covid can be expected to decrease and a worker's health will usually return to normal. The development of Long Covid can be a traumatic experience for previously active and vigorous workers and as a result, often after long hospitalisation, cause anxiety and depression in the individual. This requires treatment – either talking therapy such as cognitive behavioural therapy (in person by a therapist) or therapy available online, and sometimes, in addition, medication.

The implications for worker's occupational safety and health (OSH) of these conditions may be considerable and the fundamental principle of the employer being aware of the symptoms of a worker returning to work and their limitations is important for all workers with Long Covid. This knowledge will then inform the steps to be undertaken by the employer to ensure the safety of a worker, and the safety of others as well, which could be the case for drivers, process operators, heavy machinery operators and so on. This will have to be done through adjustment of duties and modification of tasks.

What are the implications for work ability?

When considering the size of the potential Long Covid population and the fact that most of this group are workers, Long Covid presents a considerable challenge for employers because key workers may have difficulty returning to their normal jobs within usual timescales.

There remain important questions for workers, employers and their occupational health advisors:

- What are the functional limitations of an individual worker with any condition including Long Covid?
- What are the task requirements of their job?
- What are their specific limitations in relation to their job?
- What is the likely trajectory of their recovery?
- What flexibility, adjustments or modifications can be made to the job or the working hours?
- Does the work organisation provide access to occupational health and rehabilitation services such as physiotherapy or mental health support?
- Are there any safety-critical issues that need to be considered?

²⁰ Davis, H. E., Assaf, G. S., McCorkell, L., Wei, H., Low, R. J., Re'em, Y., Redfield, S., Austin, J. P., & Akrami, A. (2021). Characterizing long COVID in an international cohort: 7 Months of symptoms and their impact. *EClinicalMedicine*, 38, Article 101019. <https://doi.org/10.1016/j.eclinm.2021.101019>

²¹ Becker, R. C. (2020). Anticipating the long-term cardiovascular effects of COVID-19. *Journal of Thrombosis and Thrombolysis*, 50(3), 512–524. <https://dx.doi.org/10.1007%2Fs11239-020-02266-6>

²² Raman, B., Bluemke, D. A., Lüscher, T. F., & Neubauer, S. (2022). Long Covid: Post-acute sequelae of COVID-19 with a cardiovascular focus. *European Heart Journal*, 43(11), 1157–1172. <https://doi.org/10.1093/eurheartj/ehac031>

²³ Hugon, J., Msika, E. F., Queneau, M., Farid, K., & Paquet, C. (2022). Long Covid: Cognitive complaints (brain fog) and dysfunction of the cingulate cortex. *Journal of Neurology*, 269, 44–46. <https://doi.org/10.1007/s00415-021-10655-x>

If a worker with Long Covid has complex health issues that are preventing their return to work, an occupational health assessment will be necessary to identify their work ability and their limitations. This may involve communication with the worker's personal physician – providing there is consent given to do so.

Employing organisations normally have sickness absence policies that have various triggers and thresholds for the level of absence from work, or incapacity that can be accommodated. For workers with Long Covid, these triggers may however not be appropriate as recovery may be very slow because of fatigue or other symptoms, and modification of these policies may need to be considered and timescales extended.

Most workers recovering from Long Covid will require a slow, phased return to work, beginning with a small amount of work every day and every week, and gradually extending working hours over a period of one to two months or longer.

■ Working within their capacity

Phasing of work is particularly important: to reduce the risk of relapses, workers should not be doing more than 70% of what they feel capable of doing at any time in order to avoid fatigue. Becoming fatigued can cause relapses in their condition and further delay their recovery. The worker is the person who can best assess their own level of fatigue and regular discussion between worker and manager is important to guide the successful rehabilitation of workers affected by Long Covid. As in any positive working relationship, trust between employees and managers plays a significant role for effective adaptation of work.

This will not always be successful and a small number of Long Covid workers have had to retire from work on the grounds of ill health – which is not a desirable outcome for either the worker or their employer. In addition, as a result of routine application of existing policies, a number of individuals have been retired by their employers, who with more time may have been rehabilitated to work.

What are the challenges for prevention and management of the OSH risks related to Long Covid and what could be the possible threats?

It is important to minimise the risks of infection and reinfection in the workplace. The SARS-CoV-2 virus is frequently changing its infectivity and all workplaces should have undertaken a risk assessment for COVID-19 infection, and instituted control measures. The workplace risk assessment should regularly be updated to account for changes in infectivity or in knowledge about infection risk. Training of all workers in COVID-19 safety should also be in place and refreshed regularly. Where possible, home working should be encouraged. For travelling to work, training in the assessment of the risks and implementation of control measures is advised. In addition, where necessary, risk assessment should be undertaken for workers who have underlying conditions that make them more vulnerable.

Furthermore, returning to work after acute COVID-19 or long COVID is not always easy. Some symptoms can persist long after diagnosis, and worker's condition may vary from one day to the next. To address those issues, EU-OSHA has published two practical guides (one for workers and one for managers) for helping employees to return to work after acute COVID-19 or long COVID²⁴.

They guides cover several stages, such as making contact with the employee, arranging a phased return and discussing adjustments to the worker's duties and schedules to enable them to cope. Workers will require different levels of support depending on their role and any ongoing symptoms, so listening to their needs and checking in regularly are key. In any case, returning to work is part of the recovery process, even if it must be flexible or phased at first.²⁴

²⁴ <https://osha.europa.eu/en/publications/covid-19-infection-and-long-covid-guide-managers> and <https://osha.europa.eu/en/publications/covid-19-infection-and-long-covid-guide-workers>

According to those guides, it is important to promote a phased return to work. For some people, a successful return will be more likely if this is done at a slow pace. This is likely to prevent relapse and further absence. For a few, ongoing symptoms may mean that they are unable to meet the requirements of the job – if so, it could be time to talk about a change of duties or redeployment.

For workers returning to work with Long Covid, it is important that the manager regularly enquires about the employees' health, to be aware of the limitations imposed by safety-critical symptoms and to ensure that the workers are not putting themselves, co-workers or customers at risk.

The prognosis is for improvement and the objective should be to try and return a worker to full duties. For workers with complex problems, regular review by the occupational physician or the occupational health service may be necessary regarding safety-critical tasks.

What measures at the policy, research and practice levels are expected to be effective to diminish the unwanted side effects of Long Covid on OSH?

▪ Policy – Company level

Long Covid is a poorly understood condition because of the variable symptoms. Workers may be seriously affected, for example, by fatigue, but may look quite normal to their work colleagues and not receive much support from their treating doctors because of the more acute patient care issues associated with the pandemic.

It is therefore important that employers recognise the importance of Long Covid for the affected individual and the organisation and how it should be managed optimally to rehabilitate a worker to their job, or provide alternative work. This suggests a need for a dedicated policy within organisations or at least an explicit recognition of Long Covid within existing sickness absence policies.

▪ Policy – Country level

Countries' national health services have all been under pressure because of the pandemic, and the care available to workers suffering from Long Covid has been variable and, in some cases, very poor because of other demands.

Thus, workers who did not require hospital care but developed Long Covid can experience poor healthcare support and feel relatively abandoned if the health service system has been overloaded by sicker people.

Much national healthcare is segmented and based on disease due to single system failures, for example, mental health, musculoskeletal, respiratory, cardiac, dermatological, or neurological. As such, workers are usually treated by different specialists or specialised services to match their associated ailments. Medicine has become very compartmentalised with doctors who are specialised in only one area, such as respiratory diseases, cardiology, neurology, or psychiatry. Workers affected by Long Covid may have a variety of symptoms and if they need medical assessment, they have to navigate through a fragmented healthcare system.

Workers with Long Covid whose specific health problems have been identified and treated are in need of holistic care and access to vocational rehabilitation services. Most countries are developing one-stop clinics and rehabilitation facilities designed to rehabilitate individuals with multiple symptoms with the aim of improving their performance and helping them return to work, but these developments have been very slow. Occupational physicians could play an important role in this respect.

▪ Research needs

A lot of research on Long Covid has been commissioned by research funding councils, but most of these studies are designed to improve understanding of the disease process. While numerous studies of Long Covid are underway, more research is needed into the effects on working-age people.

To improve knowledge on the specific workplace issues and improve management at the workplace level, further research is needed with occupational health academic organisations to identify:

- the occupational needs of these workers;
- the impact of Long Covid on the workplace and for employers;
- the relevance for safety-critical work;
- how to reduce the social inequalities associated with the disease
- the role of work and OSH in recovery from long covid and
- the most effective workplace-based interventions that maximise the work ability of affected individuals.

Are there any conclusions to be drawn for OSH that would help address possible future biological hazards based on lessons learned from the COVID-19 pandemic?

OSH failures are central factors in the history and evolution of this pandemic. The origin of the SARS-CoV-2 virus is obscure, with initial reports pointing to transmission from animals in a live market. The pandemic has highlighted the importance of biosecurity, and thus effective segregation of potential sources of infection has been reinforced. This increase in focus on health and safety includes the principles of control or avoidance of hazards and best practice including risk assessment, elimination, substitution and containment. In this pandemic, failures have been noted in the provision and adequacy of the hierarchy of prevention measures and processes as well as effective personal protective equipment; this has resulted in increased risks to workers in occupational settings as diverse as healthcare, food processing and transport.

Ultimately, we can now put a worker into a nuclear plant or into space without harm occurring and higher standards of hazard control in industry and workplaces can be achieved, yet the pandemic has revealed control failures. Though outdated by modern medical practice, the Hippocratic and Victorian ideals of ventilation, maintenance of hygiene standards and specialist oversight are once again prevalent, at least in conjunction with a significant degree of modernisation. While epidemiologists and medical professionals may scoff at the notion of historic medical diagnosis such as miasma, the Victorian obsession of cataloguing, communicating and clarifying is never more essential and demands better cooperation between public health and OSH actors and the vigilant recording of diseases. After the gruelling experiences and losses of the last three years under the pandemic, it is important that future epidemics be prevented as far as possible and where not, their harmful effects mitigated. It is essential that employers clearly understand their responsibility to address risks from exposure to biological agents, and for workers their right to a safe working environment in every aspect. Framework Directive 89/391/EEC²⁵ clearly indicates this responsibility. In addition, the Framework Directive describes the responsibility of workers to take care as far as possible of their own safety and health and that of other persons affected by their acts or tasks at work, in accordance with the training and the instructions given by their employer. In that context, it is important to normalise hygiene and sanitation practices within the public domain, as well as to build stronger links between employers and occupational health within a programme of assessment, employee support and effective safeguards to remain vigilant against rising infections. As was stated by Paracelsus, one of the fathers of modern medicine, nearly 500 years ago: 'The ultimate cause of human disease is the consequence of our transgression of the universal laws of life'²⁶.

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This discussion paper was commissioned by the European Agency for Safety and Health at Work (EU-OSHA). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect the views of EU-OSHA

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²⁵ Council of the European Union. (1989). Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work. *Official Journal of the European Communities*, No L 183/1. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31989L0391&qid=1649357566099>

²⁶ Graham, S. (1839). *Lectures on the science of human life*. Marsh, Capen, Lyon, and Webb.