European Agency for Safety and Health at Work

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Prolonged constrained standing at work

Health effects and good practice advice

Report

European Agency for Safety and Health at Work

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Executive summary

Introduction

This report explores the issue of prolonged static or constrained standing at work (as opposed to work that involves walking around). Constrained standing is a significant problem for some groups of workers, and the health effects of prolonged standing include musculoskeletal disorders (MSDs) and non-MSDs, although the main focus of this report is on MSDs associated with prolonged constrained standing. The report examines the extent of prolonged standing at work, the health effects, guidance on 'safe limits' for continuous standing, and prevention practice to avoid prolonged constrained standing, reduce the risks when it cannot be avoided and promote a more dynamic workstyle. It also includes conclusions and pointers for policy-makers. The report aims to take into account the needs of micro and small enterprises (MSEs), and looks at various work sectors and gender and age issues.

A second report, linked to this one, covering prolonged sitting ([1]) and three OSHwiki articles ([2]) ([3]) ([4]) provide further information on prolonged sitting, prolonged standing and promoting moving at work.

Policy background

Although there is no specific occupational safety and health (OSH) policy on standing work in the European Union (EU), the general challenge of work-related MSDs has been recognised and prioritised in the EU's OSH strategy ([5]). There are a number of EU directives on OSH, implemented by EU Member States, that are relevant to preventing risks from prolonged constrained standing.

What is prolonged constrained standing?

Working in a static or constrained standing position can be a problem when it is not possible to alternate standing with other postures and when the duration, on a daily basis, is too long. Prolonged standing can be defined as standing continuously for more than 1 hour or standing for more than 4 hours a day. Prolonged constrained or static standing also involves standing on the spot (movement restricted to a 20-cm radius) and not being able to obtain temporary relief by walking or sitting.

How much do we actually stand at work?

According to Eurostat data from 2017, one in five workers in the EU (20 %) spent most of their working time standing up ([6]). In the 2010 European Working Conditions Survey (EWCS) ([7]), 69 % of workers reported standing or walking for at least 25 % of the time.

Workers at risk

- **Types of work**

Jobs in which prolonged standing is prevalent include kitchen staff and waiting staff, welders and cutters, retail salespeople, reception staff, electricians, pharmacists, school teachers and childcare workers, physiotherapists, bartenders, assembly line workers, machine operators, security staff, engineers, library assistants, hairdressers, laboratory technicians, nurses and care workers, and receptionists. Many workers who have to stand at work are in low-paid jobs. There is also evidence that temporary

([1]) EU-OSHA (European Agency for Safety and Health at Work), *Prolonged static sitting at work: Health effects and good practice*, 2020. Available at: https://osha.europa.eu/en/themes//musculoskeletal-disorders/research-work-related-msds

([2]) https://oshwiki.eu/wiki/Musculoskeletal_disorders_and_prolonged_static_sitting

([3]) https://oshwiki.eu/wiki/Musculoskeletal_disorders_and_prolonged_static_standing

([4]) https://oshwiki.eu/wiki/Promoting_moving_and_exercise_at_work_to_avoid_prolonged_standing_and_sitting

([5]) European Commission, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions — 'Safer and healthier work for all — Modernisation of the EU Occupational Safety and Health Legislation and Policy', COM(2017) 12 final, 10.1.2017, p. 9. Available at https://ec.europa.eu/social/BlobServlet?docId=16874&langId=en

([6]) https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190305-1

([7]) Eurofound, 'Fifth Working Conditions Survey: 2010', 2010. Available at: https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/fifth-european-working-conditions-survey-2010

workers are more exposed to standing work ([8]). Low-paid and temporary workers often have little discretion over how they work and when they can take breaks to sit or move around. In some jobs, workers can be required to stand unnecessarily, for example having to attend to clients standing up purely because it is considered more professional or for aesthetic reasons.

- **Gender**

According to the EWCS for 2010, in the EU 72 % of men report standing for at least 25 % of working time, while the figure for women is 66 % ([9]). Typical male jobs, such as those in construction or warehouses, while involving prolonged standing, often involve more walking around than more constrained standing, which is prevalent in typical female jobs (such as hairdressing, production line work, cashier work) ([10]). Women are often concentrated in low-paid jobs characterised by less control over how they work and when they can take a break from standing work. In addition, standing workbenches designed for the average-sized male worker will not be ergonomically suitable for many women.

- **Pregnant workers**

Prolonged constrained standing has been associated with adverse pregnancy outcomes ([11]). Standing becomes increasingly tiring as pregnancy progresses and could increase the risk of varicose veins. Standing time per day must be limited for pregnant women.

- **Age and workers with chronic musculoskeletal conditions**

In the EU, 70 % of workers aged 55 years and over stand and walk on the job, which is comparable to workers aged 25-54 years, whereas almost 80 % of workers aged under 25 years stand and walk on the job ([12]). Prolonged standing can become problematic for workers with chronic conditions such as arthritis. As the workforce ages, there will be more workers with such conditions. The prevalence of MSDs increases with age, which is related to the length of cumulative exposure to MSD hazards over the work-life course. To ensure the sustainability of work over the work-life course, prolonged static standing needs to be reduced for all age groups, and additional measures may be needed for older individuals with reduced work capacity ([13]).

- **Ethnic minority workers**

Workers born abroad are more likely to work mostly in standing positions than native-born workers. They are also more likely to report working in painful and tiring positions ([14]).

Health effects of prolonged static standing

Based on a short review of literature, the report presents the cause and health effects of prolonged static standing in a graphic model. Prolonged standing is associated with both MSD and non-MSD health effects, which include the following:

([8]) EU-OSHA (European Agency for Safety and Health at Work), *Work-related musculoskeletal disorders in the EU — Facts and figures,* 2010. Available at: https://osha.europa.eu/en/publications/osh-figures-work-related-musculoskeletal-disorders-eu-facts-and-figures/view

([9]) Eurofound, 'Fifth European Working Conditions Survey: 2010', 2010. Available at: https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/fifth-european-working-conditions-survey-2010

([10]) EU-OSHA (European Agency for Safety and Health at Work), *New risks and trends in the safety and health of women at work*, 2013. Available at: https://osha.europa.eu/en/publications/reports/new-risks-and-trends-in-the-safety-and-health-of-women-at-work

([11]) Waters, T. R. and Dick, R. B., 'Evidence of health risks associated with prolonged standing at work and intervention effectiveness', *Rehabilitation Nursing*, Vol. 40, No 3, 2015, pp. 148-165. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4591921/

([12]) Eurofound, 'Sixth European Working Conditions Survey: 2015', 2015. Available at: https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/sixth-european-working-conditions-survey-2015

([13]) EU-OSHA (European Agency for Safety and Health at Work), 'The ageing workforce: implications for occupational safety and health — A research review', 2016, Available at: https://osha.europa.eu/en/publications/ageing-workforce-implications-occupational-safety-and-health-research-review-0/view

([14]) EU-OSHA (European Agency for Safety and Health at Work), *Workforce diversity and MSDs: Review of facts, figures and case examples,* 2019. Figures 21 and 22 based on data from EU statistics on income and living conditions 2017 and EWCS 2015. Available at: https://osha.europa.eu/en/themes//musculoskeletal-disorders/research-work-related-msds

- pain and disorders of the legs, knees, ankles and feet ([15]) ([16]) ([17]);
- low back pain ([18]);
- high blood pressure/restricted blood flow;
- heart disease;
- varicose veins;
- fatigue;
- problems in pregnancy.

Exposure to whole-body vibration when standing for prolonged periods, for example standing on a surface that vibrates, increases the risks of low back problems and other MSDs, especially if postures are constrained, awkward or poor.

Research also suggests that occupations involving predominantly standing are associated with an even greater risk of heart disease than occupations involving predominantly sitting ([19]) ([20]). This underlines the importance of not just substituting standing work for sitting work but instead ensuring a combination of sitting, standing and moving on the job.

Regulations and guidelines

- **Regulations**

In accordance with EU directives, all employers in the EU have general duties to carry out risk assessments and put in place preventive measures based on the assessments ([21]). In selecting the measures, they should avoid risks if possible and adapt work to the worker. The risk assessment must also take account of any workers particularly sensitive to the risk, for example workers who are already suffering from sciatica or knee problems, whereas the directive on equal treatment at work ([22]) requires employers to provide reasonable accommodation for workers with a disability.

Any workers who habitually use display screen equipment as a significant part of their normal work are covered by regulations on display screen equipment ([23]) and must be provided with a chair. Directives on work equipment ([24]), machinery ([25]), vibration ([26]) and manual handling ([27]) may all be relevant to avoiding and improving the health and ergonomics of standing work. The directive on workplace safety ([28]) covers the provision of rest areas with seating that has a backrest. The directive covering construction sites ([29]) also includes provisions on rest areas. Employers should also provide protective footwear, if needed, that is suitable and comfortable. The directive covering pregnant workers ([30])

([15]) EU-OSHA (European Agency for Safety and Health at Work), *Work-related musculoskeletal disorders: Prevalence, costs and demographics in the EU*, 2019. Available at: https://osha.europa.eu/en/publications/msds-facts-and-figures-overview-prevalence-costs-and-demographics-msds-europe/view

([16]) Halim, I. and Omar, A. R., 'A review on health effects associated with prolonged standing in the industrial workplaces', *IJRRAS,* Vol. 8, No 1, 2011. Available at: www.arpapress.com/Volumes/Vol8Issue1/IJRRAS_8_1_03.pdf

([17]) Waters, T. R. and Dick, R. B., 'Evidence of health risks associated with prolonged standing at work and intervention effectiveness', *Rehabilitation Nursing*, Vol. 40, No 3, 2014, pp. 148-165. Available at: https://doi.org/10.1002/rnj.166

([18]) Health Council of the Netherlands, 'Standing, kneeling and squatting work'. Available at: https://www.gezondheidsraad.nl/documenten/adviezen/2011/12/23/staand-geknield-en-gehurkt-werken

([19]) Smith, P., Ma, H., Glazier, R. H., Gilbert-Ouimet, M. and Mustard, C., 'The relationship between occupational standing and sitting and incident heart disease over a 12-year period in Ontario, Canada', *American Journal of Epidemiology*, Vol. 87, No 1, 2018, pp. 27-33. Available at: https://academic.oup.com/aje/article/187/1/27/4081581

([20]) IWH (Institute for Work and Health), 'Prolonged standing on the job more likely to lead to heart attack than prolonged sitting', 17 August 2017. Available at: https://www.iwh.on.ca/media-room/news-releases/2017-aug-17

([21]) https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1

([22]) https://osha.europa.eu/en/legislation/directives/council-directive-2000-78-ec

([23]) https://osha.europa.eu/en/legislation/directives/5

([24]) https://osha.europa.eu/en/legislation/directives/3

([25]) https://osha.europa.eu/en/legislation/directives/directive-2006-42-ec-of-the-european-parliament-and-of-the-council

([26]) https://osha.europa.eu/en/legislation/directives/19

([27]) https://osha.europa.eu/en/legislation/directives/6

([28]) https://osha.europa.eu/en/legislation/directives/2

([29]) https://osha.europa.eu/en/legislation/directives/15

([30]) https://osha.europa.eu/en/legislation/directives/10

requires employers to assess risks and decide what measures should be taken. This includes risks from movements and postures and fatigue connected to a person's work.

- **Guidelines for standing at work**

Based on the guidelines reviewed in the report, the advice is to focus primarily on the following:

- Complaints due to prolonged constrained standing could occur when standing daily for 15 minutes or more.
- Prolonged constrained standing means being constrained to or near a specific spot (within 1 m^2 without stepping out of the area).
- Avoid prolonged constrained standing at work:
  - for more than 1 hour continuously; and/or
  - for a total of more than 4 hours a day.
- Alternate as much as possible between postures in the following proportions:
  - 30 % standing;
  - 60 % sitting;
  - 10 % walking/moving/cycling.

It is important to understand that the opposite of sitting is not standing — it is moving. So, although a sit-stand table to alternate between sitting and standing is often useful, it is not enough, as you are still alternating between two static postures. The Institute for Work and Health recommends that you 'sit when you need to, stand when you want to, and walk or move when you can' ([31]).

Prevention practice

The general goal is to avoid prolonged constrained standing if possible, achieve a balance between standing, sitting and moving, and make work more dynamic.

- **Prevention strategy to avoid prolonged standing**

As with all areas of risk management, actions to avoid prolonged standing should be implemented within a strategy that takes a systematic approach, uses risk assessment and follows a hierarchy of prevention measures. The prevention strategy should ensure good workplace ergonomics and worker participation, with specific measures to avoid prolonged standing and promote moving more and standing less at work (i.e. making work more dynamic). The report includes a graphic to help decide whether work should be carried out sitting or standing.

The prevention strategy should include the following:

- Provide a suitable **ergonomic workstation and environmental conditions**, including an appropriate chair, stool and workstation. Incorporating **adjustability** (of working height, seating, sit-stand workstations, etc.) is important for safe and comfortable working.
- **Organise work to limit standing**, balance the tasks to be performed, and provide possibilities for task rotation, breaks when needed, etc. Give workers sufficient control over how they work, for example give them opportunities to alter how they work and to take a break when needed. It may be useful to establish maximum standing times.
- **Introduce additional measures to reduce risks if standing cannot be avoided**, for example mats and cushioned insoles.
- Encourage consultation and **active worker involvement** — this is important for all aspects of the strategy.
- **Promote healthy behaviour,** for example through raising awareness of and providing training on prolonged standing and back-care programmes. This measure will be ineffective unless implemented together with the other abovementioned elements.
- **Implement organisational policies and practices** to make sure it happens in practice, for example measures for workers to report problems with standing work.

([31]) IWH (Institute for Work and Health), 'Sitting or standing? Which is best?', 2018. Available at: https://www.iwh.on.ca/videos-and-presentations/sitting-or-standing-which-is-best

It is important to assess the full range of risks factors, including prolonged standing, poor ergonomic postures, repetitive movements, manual handling and exposure to whole-body vibration and address them together in a comprehensive way.

Often workplace interventions are simple and low cost.

- **Workstation ergonomics**

Important elements of workstation ergonomics for standing work include the following:

- Design the workstation and organise work to allow workers to alternate sufficiently between standing, using a stool, sitting on a chair and/or walking.
- Design workstations according to the tasks to be performed, for example take into account working height, and to prevent workers from having to reaching too far or too high.
- Ensure sufficient leg, knee and foot space.
- Design workstations to avoid awkward neck or trunk postures, for example when viewing screens, or using tools and objects.

- **Our next posture is the best posture**

A good motto is 'sit when you need to, stand when you want to and walk or move when you can' ([32]). When standing is necessary, standing on a fixed spot should be substituted by more active or dynamic standing. Even being able to move around and change your standing posture within 1 m^2 can make a difference. A microbreak to move around every 30 minutes is important.

The report includes a chart for helping to determine whether work should be carried out sitting, standing or using a stool.

- **Measures and examples of workplace practice**

The report includes a number of measures that can be considered if constrained static standing cannot be avoided. These include flooring that provides some elasticity; anti-fatigue mats; comfortable, supportive footwear with cushioned soles; a wheeled saddle stool; measures to prevent whole-body vibration; and examples of ways to vary posture when standing.

The report also contains practical examples and sectoral guidance. For example, in an intervention for airport security staff, the following measures were found to be most effective: using a standing support; fatigue mats; and task rotation — alternating every 15 minutes between welcoming passengers (standing on a mat or using a stool), screen work (seated), X-ray work (standing on a mat), checking bags (standing on a mat) and body searching (being mobile).

Conclusions for the workplace

Prolonged constrained standing is related to various serious health problems, including lower back pain, pain in the legs, foot and heel disorders, cardiovascular problems and fatigue. Although many jobs in Europe involve prolonged constrained standing, some entirely unnecessarily, much can be done to organise work to avoid and limit it, and improve ergonomics and working conditions if standing work is performed. The factors identified in this report include the following:

- The most commonly used definitions of prolonged standing are more than 1 hour of continuous standing and/or a total of more than 4 hours of standing in a day.
- Unnecessary constrained standing should be avoided.
- Our next posture is the best posture. A good motto is 'sit when you need to, stand when you want to and walk or move when you can' ([33]). When standing is necessary, standing on a fixed spot should be substituted by more active or dynamic standing. A minibreak to move around every 30 minutes is important.
- The general approach to avoiding prolonged constrained standing at work should be through a prevention strategy that avoids unnecessary constrained standing, ensures good workplace

([32]) IWH (Institute for Work and Health), 'Sitting or standing? Which is best?', 2018. Available at: https://www.iwh.on.ca/videos-and-presentations/sitting-or-standing-which-is-best

([33]) IWH (Institute for Work and Health), 'Sitting or standing? Which is best?', 2018. Available at: https://www.iwh.on.ca/videos-and-presentations/sitting-or-standing-which-is-best

ergonomics to limit standing and improve standing work, promotes movement at work and ensures worker participation. Adjustability of workstations, options to work in a variety of ways and workers being able to take breaks from standing work when needed are important. Finally, if constrained standing cannot be avoided, there are measures to alleviate its negative health effects, such as mats and cushioned insoles.

- As with all MSDs, early reporting of problems related to prolonged standing is important.

Pointers for policy-makers

- **Prevention strategy and practice**
  - For the sustainability of work over the work-life course, prolonged static standing needs to be avoided if possible and reduced for all age groups.
  - More dynamic ways of working and alternating between standing, sitting and walking need to be promoted.
  - Many workplace interventions are simple and low cost; however, employers must be provided with information to understand the basics. Good practices need to be shared.
  - Guidelines on workstations and active working are needed, preferably sector- and subsector-specific guidelines. This includes simple, sector-specific resources for MSEs.
  - Age and gender issues should be included in prevention approaches. One size does not fit all, especially when it comes to the ergonomics of standing work. More attention needs to be given to prevention of risks in constrained static standing jobs in which women predominate.
  - Standing is not the opposite of sitting — moving is. Standing should not be just substituted for sitting in interventions to limit prolonged sitting.
- **Gaps in knowledge and research tools**
  - Improved data are needed on the extent of constrained standing work and MSDs linked to constrained standing work. Data need to distinguish between constrained standing and walking. Gender-disaggregated data are needed.
  - More research is needed on the cause-effect relationship between exposure to prolonged standing and health problems.
  - There is a need for research on the right mix of sitting, standing and walking, as well as more research on the effects of alternating postures and taking microbreaks. This needs to take account of the type of work and gender.
  - With regard to pregnancy, more information is needed on the effects on the foetus, as well as on ergonomic and fatigue issues for the woman.
  - Improved tools to assess prolonged constrained standing and static standing postures are needed.

Overall conclusions

Tackling prolonged standing at work is part of making work more sustainable. Work should provide good ergonomic working conditions, and work and workstations should be designed to avoid prolonged constrained standing if possible. If standing work is carried out, workers should be able to move around, stretch and vary their posture when standing and also to vary between standing, sitting and perching. They need to be able to take breaks to sit and move when needed. There are many simple and low-cost steps that MSEs can easily take to avoid and improve standing work.

Remember:
Our next posture is the best posture! Sit when you need to, stand when you want to, and walk or move when you can.

1 Introduction

Constrained or static standing is standing in a fixed or restricted position without being free to walk, move around or sit.

Prolonged constrained standing occurs in many types of working situations, including among industrial assembly line workers, hairdressers, sales people, receptionists, traffic police and security workers. Prolonged standing on a regular basis can lead to a number of musculoskeletal health problems, as well as other complaints and diseases such as sore feet, swelling of the legs and varicose veins, and coronary heart disease, all of which underline the importance of prevention practice to avoid prolonged standing.

This report explores the issue of musculoskeletal disorders (MSDs) (see Box 1) associated with prolonged constrained standing, although it also considers other health effects. Prolonged constrained standing is when a person is more or less restricted to standing on the spot, without being free to walk, move around or sit. It therefore involves maintaining a static posture over time.

The report explores the extent of standing at work, the health effects of prolonged constrained standing and recommendations for time limits for continuous standing. It provides good practice advice and examples on avoiding prolonged constrained standing, reducing the risks when it cannot be avoided and promoting a more dynamic workstyle. It explores the cause-effect relationships between constrained standing and both MSD and non-MSD health effects, as understanding these will inform correct prevention practice. It also includes conclusions and pointers for policy-makers. The report aims to take into account the needs of micro and small enterprises (MSEs), and looks at various work sectors and gender and age issues. In addressing how to avoid prolonged constrained standing the report explains why 'Our next posture is the best posture'.

The report is part of a larger project on MSDs, static postures and work that includes a second report on prolonged sitting (EU-OSHA, 2021a), four OSHwiki articles — on prolonged static sitting (de Langen and Peereboom, 2020a), promoting exercise at work (de Langen and Peereboom, 2020b), prolonged static standing (de Langen and Peereboom, 2020c) and lower limb disorders (de Langen and Peereboom, 2020d) — and an information sheet on making work more active (EU-OSHA, 2021b) together with an infographic ([34]) and a PowerPoint presentation ([35]). The two reports, in turn, are part of a larger research activity on MSDs ([36]).

Box 1 MSDs

All of our postures and movements are dependent on the functioning of the musculoskeletal system, which is complex and made up of muscles, joints, tendons, ligaments, nerves, cartilage, bones and blood vessels. Impairments to the system are known as musculoskeletal disorders (MSDs). Work-related MSDs are mostly cumulative, resulting from repeated exposure to loads at work over a period of time, such as awkward or fixed postures, repetitive work or handling heavy loads (EU-OSHA, 2007).

1.1 Background

1.1.1 Policy context

Although there is no specific occupational safety and health (OSH) policy on constrained standing at work in the European Union (EU), the general challenge of work-related MSDs has been recognised and prioritised in the EU's Strategic Framework on Health and Safety at Work 2014-2020 (EC, 2014, 2017). The framework defines MSDs as one of the main challenges to address. It recommends that

([34]) https://osha.europa.eu/en/tools-and-publications/infographics/get-moving-work
([35]) https://osha.europa.eu/en/publications/move-msds-and-avoiding-prolonged-static-sitting-work/view
([36]) https://osha.europa.eu/en/research-work-related-msds

'specific attention should be given to addressing the impact of changes in work organisation in terms of physical and mental health'. It also underlines the need to improve 'prevention of work-related diseases by tackling existing, new and emerging risks'.

Tackling prolonged constrained standing work to help keep workers healthy throughout their working life will contribute to allowing them to work for longer. This in turn contributes to addressing the long-term effects of demographic ageing, in line with the Europe 2020 strategy's objectives for smart, sustainable and inclusive growth (EC, 2010).

There are also a number of EU directives on OSH, implemented by EU Member States, that are relevant to preventing risks from prolonged standing. These are described in Chapter 6.

1.1.2 Background to this report

This report builds on previous European Agency for Safety and Health at Work (EU-OSHA) reports on MSDs. EU-OSHA (2010, p. 160) concluded that exposure to static work postures and prolonged standing and sitting were significant risk factors which were on the increase, but that prolonged standing and sitting as risk factors were underestimated. It stated that: 'prevention also needs to address the trend towards … more static work postures including prolonged standing and sitting and lack of variety of tasks. Besides the provision of ergonomic workstations and equipment, particular attention should be paid to work organisational measures: For example, more emphasis should be given to ensuring variation in tasks especially where repetitive and monotonous tasks are being carried out and where workers have a low influence on the pace of work and how their work is organised. Effective examples of prevention should be screened to identify successful work organisational measures.' The report concluded that 'prevention needs to be targeted at prolonged sitting and standing, for example by providing the possibility to vary between both postures (providing sitting aids for workers who have to stand up, sit-stand office equipment, etc.).

The report raised concerns that lower limb disorders, a risk factor for standing work, were underestimated. It also raised the concern that recognition of MSDs was focused on back pain, and upper limb and neck disorders, but that little emphasis was placed on lower limb disorders that might affect women more, because a large proportion of women frequently stand at work because of the jobs they are over-represented in, for example in the healthcare, hotel and catering, cleaning, education and retail sectors.

The report concluded that standing work should be better researched and monitored and addressed in risk assessment, and that those groups of workers particularly affected should be targeted to raise awareness of exposure and prevention practice.

1.2 Aim and methodology

1.2.1 Aim

The aim of this report is to increase understanding of the health effects of prolonged constrained standing at work and provide advice on practical measures that can be taken to tackle it. By examining practice, guidance and recommendations, and providing practical information, it aims to inform workplace interventions, including what MSEs can do, and also inform policy-makers and the research community. The outcome should improve understanding of what the issues are and what employers and other stakeholders can do in practice.

The report explores the following:

- the extent of prolonged standing at work;
- health effects and the cause-effect relationship between prolonged standing and ill health;
- guidelines on prolonged constrained standing, to inform the prevention of health problems;
- preventing prolonged constrained standing, introducing a dynamic work style and the essentials of good workplace design, providing simple suggestions for employers and practical examples;
- prolonged standing in different work sectors and gender and age issues.

1.2.2 Methodology©

To explore the relationship between ill health conditions and prolonged sitting, maximum 'safe' sitting times and successful measures to limit prolonged sitting and reduce the health effects, a study was performed on 107 selected sources of information (see Appendix 2). The results were incorporated into a model of the cause-health effect relationship between prolonged sitting and both MSD and non-MSD health effects. Regarding prevention practice and guidelines, reference was also made to grey literature and campaigns.

An overview of good practice recommendations in relation to avoiding prolonged sedentary work and promoting dynamic standing and working was made, and examples of prevention practice were selected for inclusion in the report based on their relevance to MSEs and with the aim of covering a range of different types of work.

Further details of the methodology, including the search strategy, are given in Appendix 1.

1.3 What is prolonged constrained standing?

Working in a static or constrained standing position can be a problem when it is not possible to alternate between standing and other postures and when the duration, on a daily basis, is too long. Prolonged standing can be defined as standing continuously for more than 1 hour or standing for more than 4 hours a day. Prolonged constrained or static standing also involves standing on the spot (movement restricted to a 20-cm radius) and not being able to obtain temporary relief by walking or sitting.

Definitions of prolonged standing, which were used to formulate the above definition, are covered further in Chapter 5.

2 Extent of standing work and prevalence of lower limb disorders

This chapter examines the extent of prolonged standing at work and the incidence of work-related lower limb disorders.

2.1 Extent of standing work

- A total of 20 % of workers in the EU spend most of their working time standing up (Eurostat, 2019).
- In the 2010 European Working Conditions Survey, 69 % of workers reported standing or walking for at least 25 % of the time (Eurofound, 2010).

It is difficult to estimate exactly how much constrained standing workers do. The extent of standing work has been underestimated and monitoring has been lacking (EU-OSHA, 2010, p. 160); it is not always easy to ascertain workers' exposure to constrained standing, as much of the data on standing do not distinguish between standing and walking.

An indication of the magnitude of standing at work in the EU comes from Eurostat data. According to Eurostat data from 2017, an estimated one in five workers in the EU (20 %) spend most of their working time standing up (Eurostat, 2019). As shown in Table 1, percentages differ greatly between Member States. For example, the figures were 11 % in Germany and Greece, whereas they were 35.6 % in Romania and 43 % in Spain.

In the 2010 European Working Conditions Survey (EWCS) (Eurofound, 2010), 69 % of workers reported standing or walking for at least 25 % of the time. In the previous survey, of 2005 (Eurofound, 2007), 43 % of respondents reported standing or walking all or nearly all of the time.

Table 1 Percentage of workers reporting that most of their working time is spent standing up

Territory	Physical activity			
	Sitting	Standing	Moderate physical effort	Heavy physical effort
European Union — 28 Countries	39.0 (e)	19.9 (e)	29.7 (u)	11.4 (u)
Belgium	43.1	20.8	25.6	10.5
Bulgaria	34.8	28.4	28.2	8.6
Czech	36.5	15.5	36.7	11.2
Denmark	48.2	12.0	33.0	6.9-
Germany	53.9	11.3	23.7	11.1
Estonia	41.0	7.6(u)	40.0(u)	11.5(u)
Ireland	38.9	20.3	29.3	11.4
Greece	20.8	11.3	46.4	21.5
Spain	31.2	43.1	17.9	7.8
France	36.9	17.7	32.5	13.0
Croatia	31.8	16.2	38.0	14.0
Italy	30.7	28.5	30.5	10.3
Cyprus	39.7	14.0	37.5	8.8
Latvia	34.1	10.0	40.7	15.2
Lithuania	32.6	7.0	50.2	10.2
Luxembourg	52.0	20.1	19.8	8.1
Hungary	33.3	14.6	36.1	15.9

Territory	Physical activity		Moderate physical effort	Heavy physical effort
	Sitting	Standing		
Malta	40.5	31.5	21.9	6.0
Netherlands	54.0	9.8	28.4	7.7
Austria	38.6	14.0	33.4	14.1
Poland	32.8	12.7	38.4	16.1
Portugal	30.9	36.4	30.7	12.1
Romania	25.3	35.6	26.5	12.6
Slovenia	37.5	19.6	35.0	7.8
Slovakia	32.3	22.7	32.4	12.6
Finland	44.8	8.3	35.2	11.7
Sweden	41.5	12.6	36.5	9.4
United Kingdom	40.4(u)	16.3(u)	33.4(u)	9.9(u)
Norway	45.7	8.0	38.5	7.8
North Macedonia	24.5	46.3	20.2	9.1
Serbia	30.7	17.3	40.2	11.7

Notes: The results shown were given in response to the question 'Do you spend most of your working time standing up?' (u) Low reliability source; (e) estimated.

Source: Eurostat, 2019 (data from 2017)

In Australia's National Hazard Exposure Worker Surveillance (NHEWS), workers reported high levels of exposure to both standing at work (62 %) and sitting at work (81 %) (Safe Work Australia, 2011). In the US National Health Interview Survey (NHIS) in 2016, two thirds (66.6 %) of workers working at least 20 hours a week reported frequent standing at work (CDC, 2016). Prolonged standing while spending more than three quarters of their working time on their feet in North America has been established at a level of 45 % for male and female workers, and it has also been established that 40 % of these workers cannot sit at will (Messing et al., 2015).

There is a view that standing work may have become more common in some jobs where the worker must attend to the public, as it is thought that this creates a better image to the clients (*Hazards*, 2005).

2.2 Prevalence of lower limb disorders and the costs of MSDs

MSDs affect the general health of many workers. They are a major cause of absence from work and work-related disability, with resultant economic impacts on enterprises and the economies of EU Member States. Results from the 2015 EWCS revealed that around three out of every five workers in the EU report MSD complaints (Eurofound, 2017). Of all workers in the EU with a work-related health problem, 60 % identify MSDs as their most serious issue.

As data are limited on prolonged standing, so is information on the cost of worker ill health related to it. One of the health effects associated with prolonged standing are lower limb disorders, although other forms of work, such as kneeling and squatting, can also cause lower limb disorders. The EWCS of 2015 found that 29 % of workers reported muscular pains in the lower limbs in the past 12 months, which was similar to the figure of 30 % reported in the 2010 survey.

According to the UK Health and Safety Executive (HSE), in 2009/2010, workers in the United Kingdom took an average of 25 days off work because of lower limb disorders, and around 2.4 million working days were lost due to lower limb disorders (Okunribido, 2009). Looking at more recent studies in the

United Kingdom, the social and economic impacts of work-related lower limb disorders led to an estimated 1.5 million lost working days in the United Kingdom in 2018 to 2019 ([37]).

Standing work is one of the work-related factors linked to low back pain. Again, there are no estimates of the costs of back pain linked to standing; however, in general, significant costs are associated with work-related back problems. For example, in France, work-related lower back pain resulted in 12.2 million lost workdays, or 57,000 full-time equivalents. Estimates of the direct annual costs borne by French companies exceed EUR 1 billion per year, through their contributions to occupational accidents and diseases, while more than half (EUR 580 million) is related to sick day compensation (data for 2017) (INRS, 2018).

([37]) See HSE (2020), Table 3 'Estimated days lost (full-day equivalent) and average days lost per (full-time equivalent) worker due to self-reported illness caused or made worse by work, by type of illness, for people working in the last 12 months Great Britain', from the Labour Force Survey 2018/19.

3 Health effects of prolonged constrained standing

Standing is a natural human posture and, by itself, poses no particular health hazard. However, working in a constrained standing position for long periods of time and on a regular basis can cause musculoskeletal and other health problems. The reasons for these health effects are summarised in Box 2.

Box 2 The musculoskeletal consequences of prolonged standing

- Prolonged standing can cause fatigued legs, increasing the tendency to fall by slipping and tripping and the risk of developing lower back pain.
- Insufficient blood flow may lead to discomfort/fatigue and pain in the neck and shoulders.
- Insufficient blood flow can also lead to circulatory problems in the legs and lead to pain, varicose veins and swelling of the legs.
- Development of venous disorders of the lower limbs and discomfort at the ankle/foot may result and, eventually, discomfort may lead to ankle/foot complaints.
- Immobilisation of the joints (spine, hip, knees and feet) may occur and lead to degenerative damage of the joints and pain as a consequence. This immobility can later lead to rheumatic diseased due to degenerative damage to the tendons and ligaments.
- Standing places significant pressure on the joints of the hips, knees, ankle and feet but without any significant movement of them. This reduces the normal lubrication and cushioning of synovial joints, causing them to tear. The combined effect of pressure and tearing can cause considerable pain and make it difficult to move or walk.
- Temporary discomfort in the legs and feet may result from prolonged standing, along with stiff joints and stiffness in the neck and shoulders from lack of movement and constrained posture.
- As the duration of prolonged standing increases, so does the risk of complaints.

This chapter explores further the cause-effect relationship between standing and both MSDs and non-MSDs.

3.1 Standing and MSDs

Regarding physical working conditions and work-related MSDs, it needs to be kept in mind that, from the available data, it is not always possible to identify a clear cause-health effect relationship between working conditions and MSDs. For example, statistics on back pain mostly do not differentiate between back pain arising from poor posture (e.g. standing) and that associated with excessive external loads (e.g. manual handling) or other causes. In addition, a distinction is not always made between constrained standing and walking. Nevertheless, various studies do cover MSDs related to prolonged constrained standing.

When constrained or static standing occurs, it decreases the circulation of blood and reduces the nutrient supply to muscles, leading to muscular fatigue (Okunribido, 2009), and eventually pain in the legs, back, neck and feet. Working in a standing position can be a problem when it is not possible to alternate between a standing posture and other postures, and when the duration on a daily basis is too long. As well as the length of exposure to constrained standing, the health risk will depend on other factors such as the standing posture needed to do the job, if a foot pedal has to be operated, as in some factory work or train driving, if any twisting, reaching or manual handling is involved, or if the worker is exposed to vibration.

The most commonly reported MSD symptoms related to prolonged constrained standing are (OHS Reps, 2020):

- low back pain;
- discomfort, fatigue and swelling in the legs;
- painful feet and legs;
- bunions/corns;

- heel problems, including plantar fasciitis/heel spurs;
- Achilles tendonitis;
- orthopaedic changes to the feet;
- immobilisation of joints;
- arthritis in the knees and hips;
- stiffness in the neck and shoulders.

3.1.1 Self-reported links between standing/walking and MSDs

Although both men and women sitting for at least 25 % of their working day report significant levels of MSDs, the prevalence of MSDs among workers exposed to standing and walking for at least a quarter of their working day is higher (Table 2). Where the job involves standing, three quarters of men and over two thirds (69 %) of women workers report having an MSD (EU-OSHA, 2019).

Table 2 Percentage of workers with MSDs, by gender, reporting that they are exposed to sitting or standing at least 25 % of the time

Working position	Women (%)	Men (%)
Sitting	60	56
Standing	69	75

Note: data on standing were obtained from the fifth (2010) wave of EWCS (Eurofound, 2010). Data on sitting were obtained from the sixth (2015) wave of the EWCS (Eurofound, 2015). Data concern workers who worked at least 12 hours per week; standing includes static standing and walking. Source: Sixth European Working Conditions Survey 2015, Eurofound, 2015

In Germany, the Federal Institute for Vocational Education and Training (Bundesinstitut für Berufsbildung — BIBB) and the Federal Institute for Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin — BAuA) carry out large-scale employment surveys on working conditions and health from the workers' perspective. Table 3 shows the results on standing at work from the 2012 survey. Over a quarter (28 %) of those who reported working while standing most of the time reported that it was a burden to them. (Wittig et al., 2013).

Table 3 BIBB/BAuA employment survey — extent and burden of standing work

Do you work while standing up?	
Most of the time	54 %
Often	14 %
Not much	18 %
Never	13.4 %
Does working while standing burden you? Responses for those working most of the time standing	
Yes, it does burden me	28.3 %
No, it does not burden me	71.7 %
No answer	0 %
Total	100 %

Notes: The meaning of burden or stress from standing work is not defined; standing includes static standing and walking
Source: Wittig et al., 2013

Tissot et al. (2005) found in a survey on working postures that those who work standing and/or who work in more constrained postures are more likely to be exposed to other physical work demands, such as handling heavy loads, repetitive work, forceful exertion and low job decision latitude. Only one person in six reported being able to sit at will. While the survey is old, it highlights the issue that various other MSD risk factors can occur with standing work.

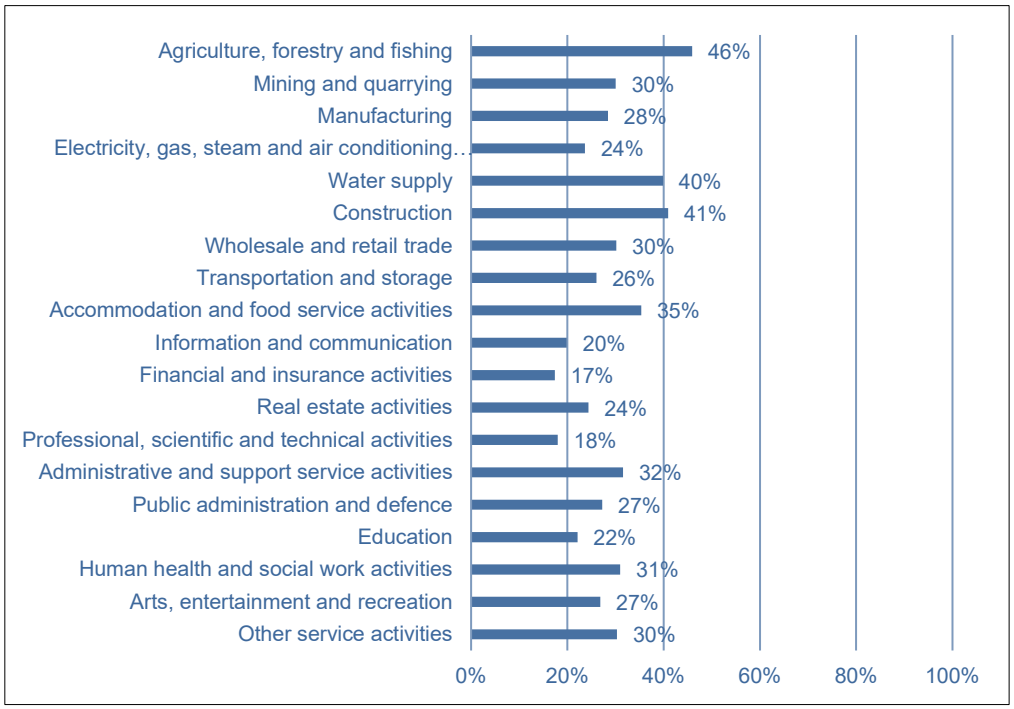
3.1.2 Standing and lower limb MSDs

The lower limbs include the knees, ankles, feet, upper and lower legs. Various studies show an association between prolonged standing and lower limb pain and disorders (Halim and Omar, 2011; Waters and Dick, 2015; EU-OSHA, 2019). Workers working for prolonged periods in a kneeling and/or squatting position and workers that are standing for more than 2 hours without a break are at risk of lower limb disorders.

The risk of lower limb disorders increases with the amount of time spent standing. Four cross-sectional studies investigated multiple types of lower limb complaints from standing work (Chandrasakaran et al., 2003; Chee et al., 2004; Messing et al., 2008). These investigations involved self-reporting of experienced pain during the past year or since the date of employment. The studies showed that workers who worked standing for more than 4 hours per working day had between two and six times as many pains in their upper legs, lower legs, ankles or feet as workers who worked less than 4 hours per working day while standing up (see also Tables 4 and 5).

Lower limb MSD data from the EWCS indicate that women are more likely than men to report MSDs in the upper limbs, lower limbs or back). It can be concluded from the 2015 survey that 24 % of European workers under 25 years of age and 38 % of European workers over 55 years of age experience muscular pains in the lower limbs that are related to their work (Eurofound, 2015). Regarding work sectors, experiencing lower limb disorders in the past year was reported by at least one in five workers (20 %) in a broad range of sectors, with the highest rates in the agricultural, forestry and water supply sectors (Figure 1).

Figure 1 Percentage of workers reporting MSDs in the lower limbs in the past 12 months, by sector (NACE rev. 2), EU-28, 2015



Source: data from EWCS 2015 (as reported in EU-OSHA, 2019)

In Switzerland, a simulation of a shift in a manufacturing plant, which simulated light tasks while standing at a workbench for 5 hours with one 5-minute rest breaks per hour and one 30-minute lunch break, found the following (Garcia et al., 2015):

- standing for 5 hours a day contributes to significant and prolonged lower limb muscle fatigue;
- 2 hours of standing on the job is not associated with problems;
- prolonged standing for over 2 hours is considered likely to have detrimental effects.

3.1.3 Standing and low back pain

Prolonged constrained standing is also associated with back pain, and the number of complaints increases as daily exposure increases.

A review by the Health Council of the Netherlands of the health effects of standing, kneeling and squatting at work maps the risks of low back pain against exposure to standing work (Table 4). Low back complaints start being noticeable in workers from 15 minutes of daily standing onwards, increase from 30 minutes of daily standing onwards and significantly increase from 2 hours of daily standing onwards. This was compared with workers who stand for less than 15 minutes a day at work. Health risks due to low back pain were found to be 2.2 % higher in workers who stand for 1 hour a day at work than in workers who do not stand at all at work (Health Council of the Netherlands, 2011).

Table 4 Low back complaints and daily time spent standing

Working in a standing position (hours a day)	Onset of low back pain in working population per year (%)	Extra incidence of low back pain compared with 0 hours of standing at work (%)
0	13	-
0.5	14.1	8
1	15.2	17
2	17.7	36
3	20.5	58
4	23.7	82

Note: Information obtained from a meta-analysis of 29 studies on the extent of the risk of lower back complaints having occurred in the past 12 months when working in a standing position.

Source: Health Council of the Netherlands, 2011

Two further studies that tracked people over time and established a relationship between standing and low back pain show a clear increase in both low back complaints and lower limb complaints as the duration of prolonged standing increases (Table 5).

Table 5 Low back complaints and lower limb complaints caused by working in standing position based on the results of two studies

Working while standing	Low back complaints that occurred in the past 12 months compared with workers who stand < 15 minutes a day at work (%)	Lower limb complaints that occurred in the past 12 months compared with workers who stand < 15 minutes a day at work
From 15 minutes a day up to 2 hours a day	+ 5	Not available
From 2 hours a day up to 4 hours a day	+ 50	Not available
More than 4 hours a day	+ 100	+ 70

Sources: Harkness et al., 2003; Andersen et al., 2007

Of back complaints, inguinal hernias are considered a major health problem, affecting up to 30 % of men at some stage in their lives. Research shows that workers who spend more than 6 hours a day standing or walking at work have a 45 % greater risk of requiring lateral inguinal hernia surgery than those who walk or stand for fewer than 4 hours a day (Vad et al., 2017).

3.1.4 Standing and exposure to whole-body vibration

Whole-body vibration (WBV) is caused by vibration from machines being transmitted into a worker's body through the seat or floor. Occupational exposure to WBV is associated with increased risk of low back pain, herniated discs and early degeneration of the spine, among other health effects (Safe Work Australia, 2016a; Martin et al., 2017). It may aggravate pre-existing back injuries. The risks of back pain from prolonged standing are increased if the worker is exposed at the same time to WBV, especially if postures are constrained, awkward or poor. Exposure to WBV can come from standing to drive vehicles or mobile equipment or standing on surfaces that vibrate, such as concrete crushers, drill platforms and vibratory separators (see also section 8.9).

3.1.5 Exacerbation of existing problems

If a worker has an existing health problem, such as sciatica, related to a back problem or painful joints due to rheumatism, constrained standing, even for a short time, can provoke the associated symptoms of pain and exacerbate the condition.

3.2 Standing and non-MSDs health effects

The most commonly reported non-MSD health problems related to prolonged standing are (OSHREPS, 2020):

- high blood pressure/restricted blood flow;
- varicose veins;
- heart disease;
- fatigue;
- problems in pregnancy.

3.2.1 High blood pressure/restricted blood flow

Prolonged standing is associated with chronic venous disorders, circulatory problems and an increased risk of stroke (McCulloch, 2002).

Insufficient blood return in the legs may occur while standing, as gravity 'pulls' blood down into the feet. One way that blood returns to the heart is through cyclic muscle contractions (*vis a latere*). When muscles are engaged in one long contraction to keep a person standing, this restrains proper circulation of body fluids. Put simply: the muscular 'pump' cannot operate. This can result in blood pooling in the legs, which contributes to varicose veins.

A German employment survey that included questions on standing and swollen legs found that 7 % of men and 17 % of women reported swollen legs. The 12-month prevalence of swollen legs was 1.4 times higher for those who frequently stood at work than those who never stood at work. Swollen legs occurred 2.7 times more often in women who stand to work than in men who stand to work (Brendler et al., 2019).

3.2.2 Varicose veins

Varicose veins are any dilated subcutaneous veins of the leg. Workers may complain of feelings of heaviness and pain, a sensation of swelling of the legs, night-time calf cramps and restless legs. These symptoms can increase during the day, especially after prolonged standing.

There are various studies linking varicose veins in the lower legs to standing work, for example Health Council of the Netherlands (2011). Studies show that workers from different professions who predominantly perform work in a standing position (50 % of the working day or more) are at an increased risk (between 25 % and 225 %) of developing varicose veins in the lower limbs (Sisto et al., 1995; Tüchsen et al., 2000). A study published in 2015 found that both prolonged standing and/or heavy lifting at work are risk factors for varicose veins in workers' legs (Tabatabaeifar et al., 2015).

A Danish study found an association between working in a standing position and subsequent hospitalisation due to varicose veins in the legs for both men and women. A group of 1.6 million 20- to 59-year-old workers were followed for 3 years concerning hospitalisation for varicose veins, and 5,940 people were interviewed about occupational exposure and confounding factors (e.g. smoking). Comparing those working over 75 % of the time in a standing position with other workers, men who

stand at work were calculated to have a 1.85 times higher risk of hospitalisation for varicose veins than other men, and women who stand to have a 2.63 times higher risk than other women. A consistent pattern of the risk of varicose veins increasing with the proportion of standing at work was found (Tüchsen et al., 2000).

3.2.3 Heart disease

Research suggests that occupations involving predominantly standing are associated with a greater risk of heart disease than occupations involving predominantly sitting (Smith et al., 2018). The link with heart disease is thought to result from the fact that standing for too long can result in blood pooling in the legs, increased pressure in the veins and increased oxidative stress, all of which contribute to an increased risk.

Smith et al. (2018) found that people who predominantly stand on the job (5 hours or more throughout their shift, without opportunities to sit) are twice as likely to suffer from a heart attack or congestive heart failure than people who predominantly sit on the job. This underlines the importance of not just substituting sitting work for standing work, but ensuring a combination of sitting, standing and moving on the job. Notwithstanding this, the same study found that, although jobs that involved a combination of sitting, standing and walking were associated with a 40 % lower risk of heart disease among men, these jobs did not result in a decreased risk among women. Smith hypothesises that this may be because nurses and teachers accounted for most of the jobs held by women in the 'sitting, standing and walking' category in the study, jobs known to be stressful in different ways (IWH, 2017). He concludes that workplaces need to consider both physical activity and the psychosocial work environment to protect the cardiovascular health of workers (IWH, 2017).

3.2.4 Fatigue

Standing still for any length of time is tiring. One review study concluded that there appears to be general agreement that prolonged standing without dynamic movement, even for periods as short as 30 minutes, leads to physical fatigue, discomfort and pain in several body regions. It is also apparent that age affects how individuals respond to prolonged standing (Waters and Dick, 2015).

3.2.5 Problems in pregnancy

Prolonged constrained standing and adverse pregnancy outcomes for woman workers have been examined in many studies. In the United Kingdom, the HSE lists standing or sitting still for long periods of time among the more common risks for pregnant women in guidance on health and safety regulations covering pregnant workers (HSE, 2013a).

On balance, evidence suggests that small increases in risks of premature birth, low birth weight and small birth size for gestational age are associated with prolonged standing while pregnant (RCP FOM, undated; Palmer et al., 2013; Waters and Dick, 2015).

Looking at 29 studies from a systematic literature search, the Health Council of the Netherlands (2011) found that pregnant women who spend more than 3 hours per working day standing were between 26 % and 40 % more likely to suffer premature births than pregnant women who performed less or no standing work. Five other studies in the same report also show an association: pregnant workers who performed standing work for 4 hours or more, whether or not in combination with walking, were up to about three times more likely to have premature births than pregnant colleagues who were less exposed to this risk.

Another review concluded that there is evidence of increased incidences of stillbirths, spontaneous abortions and preterm deliveries associated with prolonged standing for 3 or more hours (Waters and Dick, 2015). A review by the UK NHS and Royal College of Physicians found a moderate association between preterm delivery, spontaneous miscarriage and perinatal mortality when standing for prolonged periods during pregnancy (NHS Plus and RCP FOM, 2009).They concluded that, on balance, evidence suggests a small increase in risk for all three outcomes (RCP FOM, undated).

Standing for long periods at work while pregnant may also curb the growth of the developing foetus, which leads to lower birth weight and high blood pressure for the mother (Snijder et al., 2012), although the Royal College of Physicians review (NHS Plus and RCP FOM, 2009) did not find evidence to support this link.

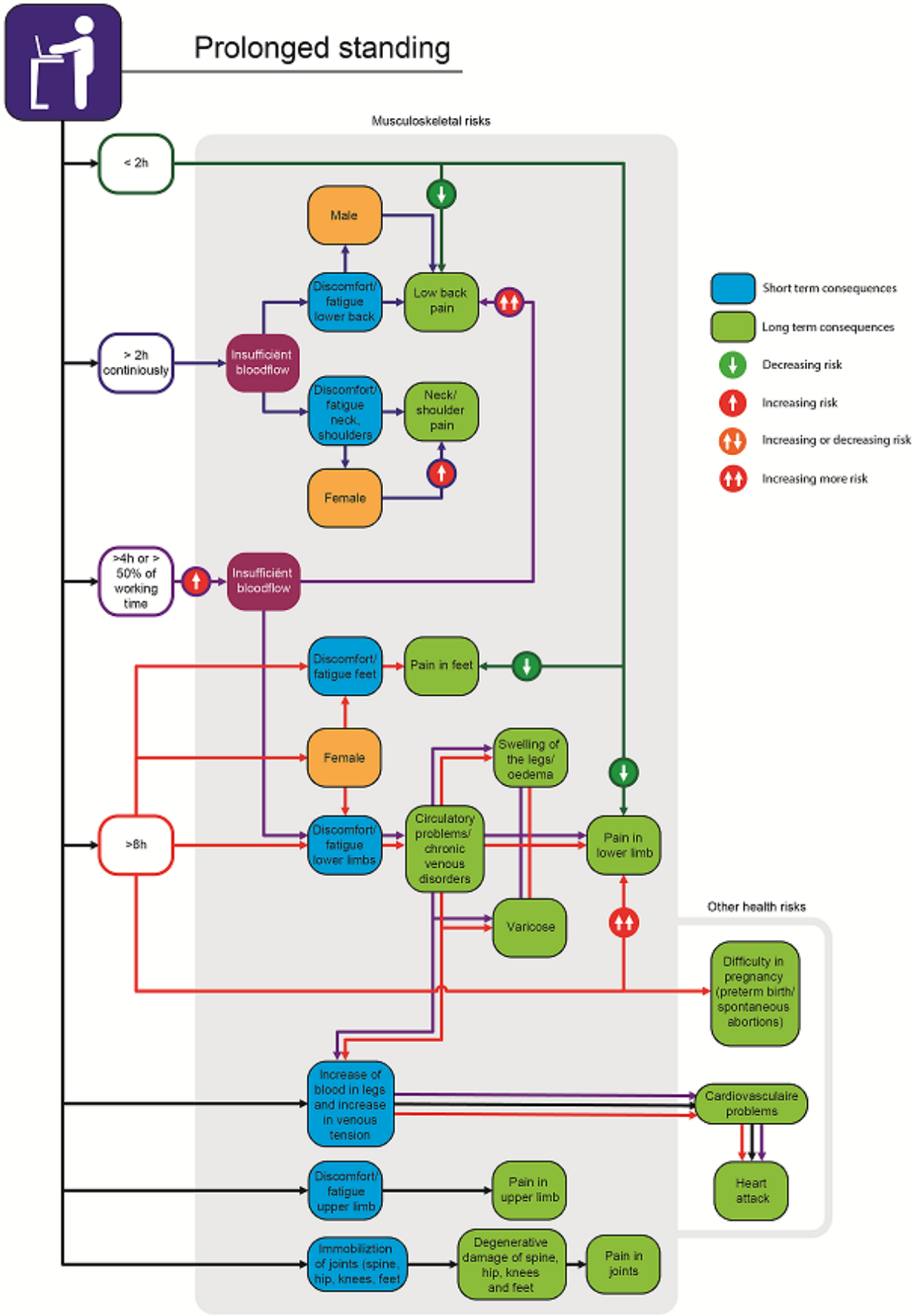
In Sweden, prolonged standing while pregnant is thought to increase the risk of swelling, varicose veins and thrombosis in the legs (Gerhardsson and Lillienberg, 2020). Standing will be more tiring as pregnancy progresses, and pregnant women who habitually stand at work also have a higher risk of high blood pressure.

Standing for long periods of time can trigger back pain, and as pregnancy progresses a woman's posture changes to accommodate the weight of the baby (Health Service Executive, 2018). As pregnancy advances, the pregnant woman will need to stand further from her workstation. This will adversely affect her posture (Waters and Dick, 2015), as she has to stand with her hips positioned further back with increased trunk flexion and with her arms further extended (Paul and Frings-Dresen, 1994). In the later stages of pregnancy, it may also become difficult to perform awkward working movements and to work in confined spaces while standing.

3.3 Cause-health effect model of prolonged constrained standing

A model depicting prolonged standing and its effect on health is given in Figure 2. The model was developed based on the short review of the literature listed in Appendix 2. The model covers both MSD and non-MSD health effects. It does not attempt to cover all of the risk factors relating to MSDs, focusing instead on those for which relevant research has been identified. However, it also highlights some risk areas to which more attention could be given regarding sustainable work. The model helps understanding of the cause-effect health relationships of standing work, their seriousness and how they interrelate and also helps to pinpoint preventive measures.

Figure 2 Cause-effect diagram of prolonged constrained standing



4 Workers at risk

4.1 Types of work

Many jobs involve prolonged constrained standing, including those performed by kitchen and waiting staff, bartenders, catering staff, retail sales personnel, school teachers, childcare workers, assembly line workers, machine operators, welders and cutters, electricians, engineers, library assistants, hairdressers, security staff, pharmacists, laboratory technicians, physiotherapists, nurses, care workers and other healthcare workers, conference staff and receptionists. In some jobs, workers can be required to stand unnecessarily, for example to attend to clients, because it is considered more professional, or for aesthetic reasons (*Hazards*, 2005).

Many workers who have to stand at work all day are in lower paid jobs and will often have little discretion over how they work and when they can take breaks to sit or move around. A study on Canadian workers showed that, in general, workers who stand all day are lower status workers with little ability to exert pressure on employers. On the contrary, they wish to impress the employer with their honesty and productivity. They may perceive their job as temporary and would rather leave than try to transform it, even though their new job may also involve many of the same characteristics. Other aspects of the job such as salary and schedules seem to be of greater importance than discomfort. This means that workers, even if they do understand the risks of sustained prolonged standing, are unlikely to address this with their managers (Messing et al., 2008).

There is also some evidence that temporary workers are more exposed to standing work (EU-OSHA, 2010).

4.2 Gender issues

4.2.1 Men and women

Although working while standing and walking is prevalent among both men and women, more men report standing than women. According to the 2010 EWCS, around 72 % of men report standing for at least 25 % of their working time, whereas the figure is 66 % for women (Eurofound, 2010). However, these figures do not distinguish between the types of standing. Walking around while working is not as tiring as prolonged constrained standing. Although typical male jobs, such as in construction or warehouses, involve prolonged standing, they often involve more walking around than the static standing prevalent in typical female jobs, such as hairdressing, production line work, shop sales assistants, teaching and health care (EU-OSHA, 2013). Tissot et al. (2005) found that women who usually stand at work were relatively more likely to move short distances while men moved longer distances. Other jobs involving constrained standing, in which women predominate, include teaching and health care.

EU-OSHA also points out that women may be exposed to prolonged standing together with other MSD risks: ‘As an example, while workers in the hotel, restaurant and catering sector more often perform monotonous and repetitive tasks, carry heavy loads and are exposed to tiring postures, their counterparts in the healthcare sector report complex tasks, frequent interruptions and working with computers. Both groups are highly exposed to prolonged standing and other multiple physical and organisational risk factors that may lead to MSDs’ (EU-OSHA, 2013).

Women are more likely than men to work in low-paid jobs characterised by less control over how they work and when they can take a break from standing work. Segregation of women into low-grade jobs with a lack of promotion prospects can result in women being more likely to be ‘trapped’ in these types of lower level jobs with poorer ergonomic work conditions than men, resulting in long-term exposure. This applies for instance to sectors with a high degree of manufacturing work, cashier work, transport and storage work, cleaning work, hairdressing work, catering services work, retail work, healthcare work and agriculture work (Safe Work Australia, 2011; EU-OSHA, 2013), and where prolonged static standing may also be prevalent.

A work dress code or uniform may require women to wear high-heeled shoes, but standing in heels of more than 5 cm affects normal posture and leg muscle use (de Langen and Peereboom, 2020c). Wearing tights, which restrict the toes, can also can also cause problems.

Concerning the non-MSD type of complaints of varicose veins, Danish research underlines that when working mostly in a standing position the risk for women was 42 % higher than for men (Tüchsen et al., 2000). Apart from the differing exposures of men and women to prolonged static standing due to the differing nature of jobs performed, there are several mechanisms underlying these differences in work-related MSDs between men and women, such as joint flexibility, power, muscle activity, fatigue resistance and movement variability. Maximum static standing times should take account of the type of work, as well as biological sex differences (Messing et al., 2015). Standing workstations, designed for the average male, may be ergonomically unsuitable for women (or very tall or short men).

Finally, it may well be that different types of intervention strategies work better for women than for men and vice versa.

4.2.2 Pregnant workers

As discussed in section 3.2, standing for long periods of time is among the more common risks for pregnant women (HSE, 2013a). Prolonged standing is associated with increased risk of high blood pressure, swelling, varicose veins and thrombosis in the legs. Links to spontaneous abortions and still births have been identified (NHS Plus and RCP FOM, 2009). Evidence also suggests that small increases in the risks of premature birth, low birth weight and small birth size for gestational age are associated with prolonged standing (RCP FOM, undated; Palmer et al., 2013; Waters and Dick, 2015). Standing during pregnancy becomes increasingly tiring as pregnancy progresses; it can cause back pain and the need to stand further away from the workstation will adversely affect the woman's posture (Paul and Frings-Dresen, 1994; Waters and Dick, 2015).

Standing time per day for pregnant women must be limited and sitting facilities should be provided. However, pregnant women should not be required to carry out tasks that require prolonged sitting either. When assigning pregnant workers sedentary tasks that are not physically demanding, it is important that they are not obliged to maintain the same posture all the time (ILO and IEA, 2010). One recommendation is to limit standing to less than 2 hours at a time, as well as providing floor matting, and pregnant workers should be provided with breaks when they can raise their legs (Occupational Health Clinics for Ontario Workers, undated).

Providing adjustable workstations would help to minimise postural changes due to pregnancy.

Regulations in EU Member States on pregnant workers include provisions to make temporary changes to duties (see section 6.1 on EU directives.)

4.3 Age

Standing and walking work is prevalent across all age groups, but higher among younger workers. In the EU, of workers aged 50 and over, around 68 % stand or walk on the job for 25 % or more of their time. Of workers under 35 years of age, almost 72 % stand or walk on the job. Of workers under 25 years of age almost 80% stand or walk on the job. ([38]).

The prevalence of MSDs increases with age. Although muscle capacity and joint mobility, for example, deteriorate with age, the impact of fatigue and the need for recovery increase with age, and it is often the physical demands of the job and cumulative exposure over time to these work hazards rather than age per se that is the issue (Yeomans, 2011; EU-OSHA, 2016).

Owing to economic pressures, European countries have been raising official retirement ages ([39]) meaning that workers will have to work for longer and at an older age. This may increase the cumulative exposure to risks such as prolonged static standing and so has implications for the sustainability of work. According to the 2015 EWCS, 22 % of workers aged 50 or above believe that they would not be able to do their current job at the age of 60 (Eurofound, 2015).

As the workforce ages, there will also be more workers with chronic diseases such as rheumatic and arthritic conditions (Woolf, 2019). Standing work can be particularly problematic for someone with a chronic MSD. As working in fixed postures is not recommended for workers of any age, to improve the sustainability of work the first approach should be to improve the working conditions of all workers, with specific additional considerations for ageing workers or workers with a chronic condition if necessary (see Box 3) (EU-OSHA, 2016).

To sum up, for the sustainability of work over the work-life course, prolonged static standing needs to be reduced for all age groups, and additional measures to limit standing work may be needed for older individuals with reduced work capacity (EU-OSHA, 2016).

Box 3 Accommodating older workers and workers with chronic MSDs

Although the first priority should be to make work safer, healthier and easier for the whole workforce, older workers or worker with chronic musculoskeletal conditions may need additional measures. This includes providing additional support for worker requirements, and enhancing workplace adjustability and workplace design. Individual accommodations for someone who has problems with standing for long periods could include, depending on the work they do, providing a portable perching stool, ensuring more frequent breaks or allowing job rotation.

4.4 Migrant workers and ethnic minorities

According to EWCS data from 2015, first-generation migrant workers are more likely to report working in painful and tiring positions than native-born workers or second-generation immigrant workers, and are less likely to report working in a sitting position (EU-OSHA, 2020a). Migrant workers may be more likely to work in specific sectors and occupations characterised by higher MSD risks, including prolonged periods of standing (EU-OSHA, 2020a), with poor working conditions and little control over how they work. The same may be true of some ethnic minority groups. Female migrant workers are likely to have even less control over how they work.

([38]) Source, data from European Working Conditions Survey (EWCS) fifth wave (2010): https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys-ewcs
([39]) https://en.wikipedia.org/wiki/Retirement_in_Europe

5 Defining prolonged constrained standing

Prolonged constrained standing was described in Chapter 1 of this report as 'standing continuously for more than 1 hour or standing for more than 4 hours a day. Prolonged constrained or static standing also involves standing on the spot (movement restricted to a 20-cm radius) and not being able to obtain temporary relief by walking or sitting.'

This definition is based on an examination of several definitions of prolonged constrained standing that are found in the scientific and 'grey' literature.

In Germany, the Federal Committee on Occupational Safety and Health (Länderausschuss für Arbeitsschutz und Sicherheitstechnik — LASI) defines prolonged static standing as standing at work (Berger et al., 2009):

- without the possibility of moving at least 20 cm to the side, forwards or backwards, and;
- without temporary relief by walking or sitting, and;
- with 'continuous duration without a break' for 2.5 hours or more on a daily basis.

The Health Council of the Netherlands gives the following definition of standing: 'Standing is a position where the body rests on the legs and where the legs cannot be moved further than within a circle with a radius of 1 m relative to the original location. When exposure exceeds the one-hour mark or the daily exposure four hour mark the standing is considered prolonged' (Health Council of the Netherlands, 2011).

The Health Council of the Netherlands based this definition on its research that concluded that health risks due to standing increase when a worker is standing on the job for on average more than 30 minutes a day, compared with a worker who does not stand at all on the job.

In Switzerland, the Federal Department of Economy, Education and Research considers standing prolonged if work is carried out while standing for more than 5 hours daily without the opportunity for regular sitting (SECO, 2016).

In the United States, based on the negative health effects of prolonged standing (Waters and Dick, 2014), the National Institute for Occupational Safety and Health (NIOSH) defines prolonged standing as:

- standing for 4 hours or more daily; and/or
- continuously standing for over 1 hour within these 4 hours.

6 Regulations and guidelines

This section summarises legislation relevant to constrained standing work, guidelines on maximum and recommended standing times at work and breaks. The guidelines include official guidelines from governmental bodies, guidelines from research organisations and ergonomics bodies and sectorial guidelines.

6.1 Regulations and directives relevant to constrained standing at work

6.1.1 EU legislation

EU safety and health legislation, implemented through Member State legislation, sets minimum standards, and some Member States set higher or more detailed requirements than others. Although prolonged constrained standing is not specifically covered by any EU safety and health regulations, in accordance with EU directives, all employers in the EU have *general duties to carry out risk assessments* and put in place preventive measures based on these assessments ([40]). In selecting the measures, employers should avoid risks if possible and adapt work to the worker. They must provide information, instruction and training and consult workers.

As well as the general requirements to prevent risks, the directives on work equipment ([41]), machinery ([42]), vibration ([43]) and personal protective equipment ([44]) are among those which may be relevant to preventing prolonged standing and improving the health and ergonomics in relation to standing work. Further information on how safety and health legislation could apply to prolonged standing is given in Box 4.

Box 4 Main EU legislation relevant to preventing prolonged standing

EU safety and health legislation, implemented by Member States, sets minimum standards, and some Member States set higher or more detailed requirements than others. The EU-OSHA website provides links to these pieces of legislation and to sites where national legislation and guidelines may be found ([45]).

The OSH Framework Directive (89/391/EEC) ([46]) requires employers to carry out risk assessments and put in place preventive measures, provide training and instruction, and ensure special protection to workers particularly sensitive to possible risks (e.g. if they already suffer from sciatica or knee problems and can stand for only short periods of time).

The Workplace Directive (89/654/EEC) ([47]) covers minimum requirements for the safety and health for workplaces. This includes suitable workstations, seating and restrooms with an adequate number of seats. The dimensions of the free unoccupied area at the workstation must be calculated to allow workers sufficient freedom of movement to perform their work. Pregnant women and nursing mothers must be able to lie down to rest in appropriate conditions.

The Display Screen Equipment Directive, (90/270/EEC) ([48]) sets minimum requirements. This includes requirements for suitable seating and the provision of breaks from display screen work.

([40]) https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1
([41]) https://osha.europa.eu/en/legislation/directives/3
([42]) https://osha.europa.eu/en/legislation/directives/directive-2006-42-ec-of-the-european-parliament-and-of-the-council
([43]) https://osha.europa.eu/en/legislation/directives/19
([44]) https://osha.europa.eu/en/legislation/directives/4
([45]) https://osha.europa.eu/en/safety-and-health-legislation
([46]) https://osha.europa.eu/en/legislation/directives/the-osh-framework-directive/1
([47]) https://osha.europa.eu/en/legislation/directives/2
([48]) https://osha.europa.eu/en/legislation/directives/5

The Use of Work Equipment Directive (2009/104/EC) ([49]) sets minimum safety and health requirements for the use of work equipment. Equipment includes desks, tables, supports and seating, including stools and chairs. It also covers items such as mats. Employers must ensure that equipment is suitable for the work to be carried out and can be used by workers without impairment to their safety or health. The workplace and position of workers while using work equipment and ergonomic principles must be taken into account. Workers must be given information and training in the use of work equipment and any hazards related to its use.

The Temporary or Mobile Construction Sites Directive (92/57/EEC) ([50]) includes provisions on rest areas.

The Machinery Directive (2006/42/EC) ([51]) covers safety in the design of machinery. Machinery must be designed using an ergonomic approach to minimise the discomfort, fatigue and psychological stress of the operator. The design must protect workers against mechanical hazards and reduce vibration hazards.

The Vibration Directive (2002/44/EC) ([52]) covers the identification and prevention of risks arising from vibration. When assessing the exposure, the employer must take into account working practices and working equipment. Particularly relevant to both standing and seated work is the prevention of exposure to WBV. Those particularly at risk of exposure include street car conductors, workers on sea vessels or other drivers who stand, and workers on moving platforms. Prolonged standing increases the risk from vibration (see sections 3.1.4 and 8.9 on WBV).

The Use of Personal Protective Equipment Directive 89/656/EEC ([53]) requires employers to provide protective equipment that should be appropriate for the risks involved, take account of ergonomic requirements and fit correctly. Protective footwear includes vibration-resistant shoes and removable instep protectors.

The Working Time Directive (2003/88/EC) ([54]) includes requirements on adequate daily rest time. Work should also take account of the general principle of adapting work to the worker with a view, in particular, to alleviating monotonous work and work at a predetermined work-rate, and of safety and health requirements, especially regarding breaks during working time.

The Manual Handling of Loads Directive (90/269/EEC) ([55]) covers the identification and prevention of manual handling risks. This must take account of the characteristics of the load, physical effort required, characteristics of the working environment and the requirements of the activity, as well as individual risk factors. When assessing the risks from standing work, manual handling risks should also be taken into account.

The Pregnant Workers Directive (92/85/EEC) ([56]) covers requirements on the assessment and prevention of risks to pregnant or breast feeding workers. The directive covers physical movements and postures, mental and physical fatigue and other types of physical and mental stress. This would include avoiding prolonged standing which presents a number of health issues (see sections 3.2 and 4.2).

The Equal Treatment at Work Directive (2000/78/EC) ([57]) includes the requirement that employers make reasonable accommodations to enable a person with a disability to have access to, or participate in, employment. For example, this could apply to a worker who has a health condition that means they cannot stand for any length of time to work, so may need a change to their tasks or workstation. (See also the requirement to protect sensitive workers in the OSH Framework Directive.)

([49]) https://osha.europa.eu/en/legislation/directives/3
([50]) https://osha.europa.eu/en/legislation/directives/15
([51]) https://osha.europa.eu/nl/legislation/directives/directive-2006-42-ec-of-the-european-parliament-and-of-the-council
([52]) https://osha.europa.eu/en/legislation/directives/19
([53]) https://osha.europa.eu/en/legislation/directives/4
([54]) https://osha.europa.eu/en/legislation/directives/directive-2003-88-ec
([55]) https://osha.europa.eu/en/legislation/directives/6
([56]) https://osha.europa.eu/en/legislation/directives/10
([57]) https://osha.europa.eu/en/legislation/directives/council-directive-2000-78-ec

European standards (known as European Norms (ENs) supplement these directives. These provide further details or information to enable the directives to be implemented and may also be relevant to standing work. A set of EN and labour standards issued by the International Organisation for Standardisation (ISO) for the protection of workers against work-related MSDs can be found in Appendix 3.

6.1.2 Member State OSH regulations and guidelines on regulations

Some Member States provide legislation or official guidance that is more specific. Some examples follow.

Sweden has a Statute Book on Ergonomics for the Prevention of Musculoskeletal Disorders General provisions on the prevention of MSDs that sets out more detailed provisions on employers' responsibilities under the Working Environment Act (Swedish Work Environment Authority, 1998). The provisions cover all movements and postures, stating that workstations, jobs and work environment conditions should be designed and arranged in such a way that risks of physical loads, both static and dynamic, which are dangerous to health or unnecessarily fatiguing or stressful are averted. The provisions include repetitive work, manual handling, work postures, ergonomic design of work equipment and areas, and the need for workers to change to different types of work and take breaks when they feel the need, so that they have adequate variation of movement and recovery. Employers must also assess the links between mechanical and psychosocial risk factors for MSDs.

The guidance states that the physical loads that the employer needs to identify may include static muscle work. The guidance also specifically mentions the disadvantages of only standing, stating that to reduce the load and provide suitable variation, some tasks can be performed in a sit-standing or sitting position. If the work cannot be performed in this way, it is important that there should at least be opportunity to sit down during breaks, e.g. when a shop assistant does not have any customers or for hotel receptionists and waiting staff. The guidance covers the risks from prolonged sitting and includes models for assessing sitting, standing and walking work postures.

In the Netherlands, based on the research by the Health Council of the Netherlands (2011) (see also Box 5), the approach of the Dutch Labour Inspectorate is that work should preferably be performed sitting rather than standing, unless there is no other option. Where standing work has to be performed, a worker may work standing for a maximum of 1 consecutive hour and a maximum of 4 hours per day, based on the guideline published in the Dutch handbook on sitting and standing at work (Lutgendorf and Peereboom, 2012).

The Dutch Labour Inspectorate uses the following definitions to mark the green zone or safe zone (Inspectie SZW, 2015) for prolonged standing when standing in a zone with a maximum radius of 1 m:

- continuous standing does not exceed 1 hour continuously; and/or
- standing time is less than 4 hours in a total day.

Box 5 The Health Council of the Netherlands: 'no safe threshold for standing'

The Health Council of the Netherlands concludes that it is not possible to indicate a safe threshold level below which no adverse health effects from working in a standing position can be expected. Their research indicates that low back complaints start to be seen in workers from 15 minutes of daily standing onwards, increasing from 30 minutes of daily standing onwards and increasing significantly from 2 hours daily standing an onwards (Health Council of the Netherlands, 2011). However, by combining the results of available longitudinal studies, the Health Council defines the time that a worker should be exposed to prolonged standing on a working day as preferably below a maximum of 4 hours and, within these 4 hours, no single period of uninterrupted standing should exceed a maximum of 1 hour.

Outside the EU, the UK regulations on the health and safety of workplaces (based on the 'workplaces' directive ([58])) refer to standing: if workers are able to perform their duties, or a substantial part of them, sitting down, employers must supply suitable seats (HSE, 2013b). The approved code of practice on the regulations requires employers to provide suitable seats for workers who have to stand to carry out their work, if the type of work gives them an opportunity to sit from time to time and provide suitable seats for workers to use during breaks (HSE, 2013b).

Regarding pregnancy and standing at work: in the Netherlands, pregnant women are considered to have an increased risk of premature birth due to standing work. The advice is to limit standing working from the 20th week to 2 hours a day and from the 30th week this is reduced to a maximum of 1 hour (Ministerie van Soziale Zaken en Werkgelegenheid, undated). In the United Kingdom, guidance on legislation based on the EU Pregnant Workers Directive lists prolonged sitting and standing as a risk to pregnant women (HSE, 2013a).

6.2 Other guidelines

6.2.1 General guidelines

In the United States, research by Cornell University (undated) recommends the following ratio for sitting, standing, and moving:

- sit for 20 minutes (66 %);
- stand for 8 minutes (27 %);
- move for 2 minutes (7 %).

Cornell University underlines in particular the importance of frequently alternating between different types of postures to avoid adverse health effects. The absolute standing time is not considered the most critical factor, but taking a posture break about every 20-30 minutes is considered key. Movement is important to get blood circulation going through the muscles.

In Canada, researchers assessed how a seated break inserted between bouts of prolonged standing would influence low back pain development, posture and movement. Participants stood for 45 minutes, were seated for 15 minutes and repeated this sequence. A total of 55 % of the participants reported low back pain when standing. A stand-to-sit ratio of 3:1 did not provide lasting recovery of low back pain from standing. Static standing postures caused tissue aggravation that was not resolved after 15 minutes of sitting. It was concluded that the ideal sit-to-stand ratio lies somewhere between 1:1 and 1:3 (Gallagher et al., 2014). Projecting these results on a working day and applying a 1:2 sit-to-stand ratio and including 10 % walking would result in the following division:

- sit for about 30 % of a working day (about 2.5 hours);
- stand for about 60 % (about 5 hours);
- walk for about 10 % (about 0.5 hour).

In Germany, the Committee on Occupational Safety and Health has set maximum daily standing times, which are divided in to four risk zones, up to 2.5 hours, low risk; 2.5-4 hours, elevated risk; over 4 hours and up to 5.5 hours, seriously elevated risk; and over 5.5 hours, high risk. Each level corresponds to ratios for sitting, standing and walking among other recommendations (see Table 7in section 6.3.2).

Switzerland's National Accident Insurance Fund's general advice for the working day is to:

- sit for about 60 % of the working day (about 5 hours);
- stand for about 30 % (about 2.5 hours);
- walk for about 10 % (about 0.5 hour).

In addition, they advise that these positions should be alternated as often as possible (Suva, 2005).

([58]) https://osha.europa.eu/en/legislation/directives/2

6.2.2 Sector guidelines and advice

The Dutch casino sector introduced the following daily schedule for croupiers ([59]):

- a worker does a maximum of six shifts at playing tables in a working day, with one shift lasting 45 minutes;
- within one shift, a worker stands for at least one third of the time and sits no more than two thirds of the time;
- after each shift, a worker has a 15-minute break in which walking is incorporated.

Applying these divisions to the working day results in:

- sitting for about 50 % of the working day(about 3 hours);
- standing for about 25 % (about 1.5 hours);
- breaks, including walking, for about 25 % (about 1.5 hours).

In the United States, the Association for Perioperative Registered Nurses (AORN) provides the following advice for caregivers on maximum standing times (Waters and Dick, 2015):

- caregivers should not stand for more than 2 hours continuously; and
- caregivers should not stand for more than for more than 30 % of the working day without some type of fatigue-reducing intervention, such as anti-fatigue mats, specially designed footstools, sit-stand stools or chairs, or supportive footwear;
- if the caregiver must wear a lead apron during prolonged standing (in the X-ray department), this should be limited to 1 hour.

As referred to in section 3.1.2, research in Switzerland, simulating a shift in a manufacturing plant, concluded that prolonged standing for more than 2 hours was considered likely to have detrimental effects on lower limb muscle fatigue (Garcia et al., 2015).

6.2.3 Advice on dynamic working

Advice in one publication suggests that introducing the ability to move around at the workstation in even quite a limited space of 1 m^2 can alleviate some effects of standing. This makes a difference in the mechanical load on musculoskeletal structures and allows ‘blood flow’ propulsion mechanisms to work correctly. If the available space is limited, this form of dynamic standing should be part of a prevention approach (Lutgendorf and Peereboom, 2012).

In addition, advice based on Canadian research by the Institute for Work and Health points out that the opposite of sitting is not standing — it is moving. Workers need control over how they work so that they can vary their posture, and the advice of the Institute for Work and Health’s (IWH) is that workers should ‘sit when they need to, stand when they want to, and walk or move when they can’ (IWH, 2018).

6.3 Indexes on prolonged standing

Several indexes based on recommendations, exposure times and health effects have been developed that incorporate risk levels for prolonged standing. They can be useful tools for risk assessment. Two examples are given below.

6.3.1 Prolonged Standing Strain Index

Halim and Omar (2015) developed the Prolonged Standing Strain Index (PSSI) to attempt to quantify the risk levels in standing jobs, taking into account other workplace factors (e.g. posture, injury, vibration, air quality) with minimum risk levels proposed. The PSSI provides an overall numerical score that can be used to assign risk for a specific job into a ‘safe’, ‘slightly unsafe’, or ‘unsafe’ category (see Table 6). This index could provide a marker for what could be considered prolonged.

([59]) vhp human performance, unpublished

Table 6 Prolonged Standing Strain Index (PSSI)

Rating criterion	Risk level	Description of standing
Safe	Low	≤ 1 hour continuous **and** ≤ 4 hours total
Slightly unsafe	Moderate	> 1 hour continuous **or** > 4 hours total
Unsafe	High	> 1 hour continuous **and** > 4 hours total

Source: Halim and Omar, 2015

The PSSI focuses on a 1-hour continuous mark or a 4-hour daily exposure mark, when exceeding one out of two marks, standing is considered to be prolonged standing. These thresholds are based on studies that report increased low back pain, physical fatigue, muscle pain, leg swelling, tiredness and body part fatigue. Significant evidence was found that standing at work (primarily on one spot) increases the risk of low back pain, cardiovascular problems and negative pregnancy outcomes.

6.3.2 Standing times by Germany's Committee on Occupational Safety and Health

The maximum daily standing times defined by Germany's Committee on Occupational Safety and Health (LASI) and their application to risk assessment are shown in Table 7 (Berger et al., 2009):

Table 7 The maximum daily standing times defined by Germany's Committee on Occupational Safety and Health (LASI)

Risk zone	Standing time	Comments
1	Up to 2.5 hours daily	▪ Low risk ▪ Standing time compared with sitting/walking time, maximum 33 % : 66 % ▪ Advice: sitting, 60 %; standing, 30 %; walking,10 % ▪ No preventive measures are needed
2	Between 2.5 and 4 hours daily	▪ Elevated risk ▪ Standing time compared with sitting/walking time, maximum 50 % : 50 % ▪ Advice: sitting, 60 %; standing, 30 %; walking, 10 % ▪ Preventive measures are advised
3	Between 4 and 5.5 hours daily	▪ Seriously elevated risk; not allowed for pregnant women after 5th month of pregnancy ▪ Standing time compared with sitting/walking time: > 50 % ▪ Advice: sitting, 60 %; standing, 30 %; walking, 10 % ▪ Preventive measures are needed
4	Over 5.5 hours daily	▪ High risk; not allowed for pregnant women after 5th month of pregnancy ▪ Standing time compared with sitting/walking time: > 75 % ▪ Advice: sitting, 60 %; standing 30 %; walking, 10 % ▪ Preventive measures are needed immediately

Source: Berger et al., 2009

6.4 Summary and conclusions on guidelines on prolonged constrained standing at work

6.4.1 Overview of guidelines

An overview of guidelines is shown in Table 8. Leaving aside guidelines from standing ([60]), the guidelines for prolonged continuous standing vary from 1 hour to 2 hours and for daily standing from 2.5 hours to 5 hours. The average guideline values are 1 hour 42 minutes for continuous prolonged standing and 4 hours 12 minutes for daily standing.

Table 8 Overview of guidelines on prolonged standing

Working position	Country											
	Netherlands [a]			Switzerland [b]			United States [c]			United Kingdom [d]		
	Max. (hours)		% of day	Max. (hours)		% of day	Max. (hours)		% of day	Max. (hours)		% of day
	Prolonged	Daily		Prolonged	Daily		Prolonged	Daily		Prolonged	Daily	
Sit	2	5										
Stand	1	4		2	5		2		30	2	4	
Walk or move												
Break from standing	Every 30 minutes											

Working position	Country and source											
	Switzerland [e]			Canada [f]			United States [g]			Netherlands [h]		
	Max. (hours)		% of day	Max. (hours)		% of day	Max. (minutes)		% of day	Max. (hours)		% of day
	Prolonged	Daily		Prolonged	Daily		Prolonged	Daily		Prolonged	Daily	
Sit		5	60		2.5	30	20		66	3		50
Stand		2.5	30		5	60	8		27	1.5		25
Walk or move		0.5	10		0.5	10	2		7	1.5 (move + break)		
Break from standing							Preferably every 8 minutes, but at least every 20-30 minutes					25 % of working time is break time

Sources: ([a]) Health Council of the Netherlands, 2011; ([b]) Garcia et al., 2015; ([c]) Waters and Dick, 2015; ([d]) Get Britain Standing ([61]); ([e]) Suva, 2005; ([f]) Gallagher et al., 2014; Cornell University Ergonomics Web, undated; ([h]) casino workers, vhp, unpublished.

6.4.2 Guidelines are characterised by duration and movement

The definitions and guidelines have two main characteristics of importance:

- *Duration with a distinction between continuous load and a total daily load*: the more prolonged the standing, the more health risks are involved.
- *Space to move around and being passive or dynamic while standing*: in this context, passive means standing on the spot and dynamic means lifting the feet and/or making small steps.

Concerning the *duration* of standing, the 1-hour (continuous standing) and 4-hour (daily total of standing) marks represent the most commonly used definitions.

Concerning being *passive or dynamic while standing*, there is a huge difference in health effects between prolonged standing on the same spot without lifting or moving the legs and feet and what can

([60]) Excluding Cornell University prolonged and daily totals because its focus is primarily on alternating postures and not per se on prolonged or daily totals.

[61] http://www.getbritainstanding.org/

be termed 'dynamic standing'. Dynamic standing means moving about. For moving around and being active, a space of as little as 1 m^2 could be sufficient (Lutgendorf and Peereboom, 2012) (see section 6.4.5).

6.4.3 Taking account of other postural loads and working conditions

It is important to remember that other factors in the workplace have an important influence on the impact of standing work, including whether or not manual handling is involved, the standing posture required, and if any twisting and turning movements are involved. Standing needs to be considered together with the impact of other working postures. If a worker is not standing they will be sitting, leaning (standing with back support, using a stool), walking or being mobile in another way (e.g. cycling). They may also be kneeling or squatting. There needs to be a balance between these different kinds of postures. Other aspects are factors such as the hardness of floors, mental workload or if a worker is pregnant (see Box 6 for examples). These aspects are usually not included when maximum limits (thresholds) for prolonged standing are formulated, but they are of importance and need to be taken into account.

Box 6 Examples of additional aspects relevant to prolonged standing time limits

In addition to the main considerations, of standing time duration and whether standing is passive or dynamic, there are other aspects that need to be taken into account:

- The type of tasks performed by the worker may differ (repetitive work, observation work, reaching, applying force, fine motor skills, lifting, pushing/pulling, visual tasks).
- The worker may be carrying weight. For example, X-ray assistants must wear a lead apron during prolonged standing, which increases the mechanical load on the legs, hips and back. This also applies to manual lifting while standing, for instance when moving boxes from a conveyer belt to a pallet.
- The workplace floor may be hard or soft and the type of shoes worn by workers may differ, which will influence the mechanical load. A softer substrate makes blood flow more easily than one that is firm. For example, safety shoes with an impenetrable sole usually are much stiffer than regular types of shoes.
- The worker may have support while standing. For example, if workers are standing at a production line and can lean backward against a low back support cushion every few minutes, both mechanical and physiological loads will decrease.
- Working environments may differ (e.g. in relation to foot, knee and leg space, type of floor, type of shoes, temperature, work surface, availability of standing support, availability of height-adjustable table, stool and/or chair).
- The level of mental workload of the job being performed should also be considered (rule-based work, skill-based work, knowledge-based work, machine-paced work).

6.4.4 MSD complaints may occur even when workers stand for less than the maximum recommended times

The guidelines suggest avoiding prolonged constrained standing at work for more than 1 hour continuously and/or for a total of more than 4 hours a day. However, setting maximum standing times does not rule out the possibility of workers developing complaints when standing times are below these limits. For example, based on two longitudinal studies (Anderson et al., 2007; Harkness et al., 2003):

- low back complaints are noticeable when standing daily from 15 minutes onwards and significantly increase from 30 minutes onwards;
- when standing for between 2 hours a day and up to 4 hours a day, low back complaints increase by 50 %.

Although up to 2-2.5 hours a day of standing may be considered 'low risk' in terms of workers describing 'feeling burdened' (de Langen and Peereboom, 2020c), when standing is performed for more than 4 hours a day, low back complaints increase by 100 % (Waters and Dick, 2015).
These findings suggest that there is a gradual scale involved in developing MSDs through prolonged constrained standing.

6.4.5 Moving within a limited area can reduce risk

Moving about produces a different mechanical load on the musculoskeletal structures (vertebrae, collateral ligaments, ankle, knee and hip joints). By moving about, these structures are better nourished from increased blood flow caused by movement and recovery is better. As well as a difference in the mechanical load on musculoskeletal structures, there is a substantial physiological difference between static and dynamic standing. This is closely related to three categories of force (*vis*) ([62]) that participate in venous blood return, depending on whether a force is acting from behind, laterally or in front of the (lower) leg blood mass. All three of these 'blood flow' propulsion mechanisms can function properly if a worker can move about in an area of just 1 m^2, especially the lateral force, which concerns, in particular, the venous muscular pump of the calf muscles (Lutgendorf and Peereboom, 2012).

Therefore, an approach where the worker moves about their workstation in a dynamic fashion, even if the available space is limited, results in a significantly lower load on mechanical structures than static standing. Although workers still need to be able to change posture and walk, sit and rest, this appears to be a significantly better way of working than standing still.

In addition, it is wrong just to alternate between prolonged static sitting and prolonged static standing while working, as the opposite of both of these postures is moving. Dynamic working is covered further in section 8.11.

6.4.6 Overall conclusions on guidelines on prolonged constrained standing at work

In addition to the clear-cut threshold numbers mentioned in Table 8, the following points need to be taken into account:

- From 15 minutes of daily standing onwards, complaints may occur; from 30 minutes onwards, more complaints may occur. It is therefore not advisable to formulate a 'safe threshold'.
- It is important to take breaks from standing, for instance every 8 minutes, but preferably at least every 20-30 minutes.
- It is important to alternate as much as possible between standing, sitting and walking/moving. Most sources indicate that about 30 % standing, 60 % sitting and 10 % walking/moving are considered appropriate.
- While formulating guidelines, it is wise to take into account the type of tasks performed, work environment factors and the level of mental workload.
- Concerning adverse pregnancy health outcomes, advice should be to limit working while standing from the 20th week to 2 hours a day and from the 30th week to a maximum of 1 hour a day.

In summary, based on the guidelines reviewed in the report, the advice is to focus primarily on the following:

- There is no 100 % safe maximum time for prolonged constrained standing. Complaints could occur when standing daily for 15 minutes or more.
- Avoid prolonged constrained standing at work:
  - for more than 1 hour continuously; and/or
  - for a total of more than 4 hours a day.

([62]) There are three types of force (*vis*) that participate in venous blood return: (1) *vis a tergo* (force acting from behind) corresponds to the residual force of propulsion in the left heart ventricle, (2) *vis a latere* (force acting from the side) involves mainly the venous muscular pump of the muscles (especially the calf muscles) and (3) *vis a fronte* (force acting from the front), which refers to the force of thoracic aspiration during inspiration.

- During the working day, alternate as much as possible between postures in the following proportions:
  - 30 % standing;
  - 60 % sitting;
  - 10 % walking/moving/cycling.
- If working while standing in a restricted area, if the worker can stand and move dynamically in an area greater than 1 m^2, this will reduce the risks.
- Other features of the work, working conditions or individual factors (working postures, tasks, flooring, pregnancy, etc.) must also be taken into account.
- In general, the advice to a worker should be 'sit when you need to, stand when you want to and walk or move when you can'.

Prolonged standing is defined as continuous standing on or near a specific spot. Dynamic standing means that there is a possibility to move about. In addition to a difference in the mechanical load on musculoskeletal structures, dynamic standing allows 'blood flow' propulsion mechanisms to work correctly, even if a worker moves about in an area of only 1 m^2. An approach to moving about a workstation in a dynamic fashion, even if the available space is limited, should therefore be part of any prevention approach.

Workers should 'sit when they need to, stand when they want to and walk or move when they can' (IWH, 2018).

7 Prevention strategy to avoid constrained standing work

The two main principles regarding the prevention of prolonged static standing are to:

- avoid prolonged standing where possible, and then follow a hierarchy of prevention measures;
- move more and stand still (and sit still) less, i.e. make work more dynamic.

To limit prolonged standing on the spot, the aim is to allow workers to alternate between different postures (standing, sitting, walking). Where static standing is carried out, the aim is to still change posture as much as possible within the standing position, and move about even within a small space. Added to this is a health promotion element, where workers are encouraged to move more at work and out of work.

This Chapter outlines the elements of a prevention strategy to avoid prolonged standing and promote active ways of working.

The general goal is to avoid prolonged constrained standing if possible, achieve a balance between standing, sitting and moving, and make work more dynamic and promote movement. As the use of prolonged, fixed postures should be avoided, standing should not just be replaced with sitting. The effects of prolonged standing can be eliminated or reduced through work organisation (for example, limiting time spent standing in the workplace) and workstation design, job design, flooring, and the provision of anti-fatigue mats and personal protective equipment.

As with all areas of risk management, actions to avoid prolonged standing should be implemented within a strategy that takes a systematic approach, uses risk assessment and follows a hierarchy of prevention measures, starting with asking whether or not the job, e.g. of a receptionist or bank teller, needs to be done standing. Box 7 outlines the EU approach to preventing MSDs and Box 8 summaries elements of the prevention hierarchy as applied to standing work. The prevention hierarchy begins with avoiding risks — which means questioning whether or not a job has to be done standing up at all, such as the work of receptionists, bank tellers or supermarket checkout workers.

The prevention strategy should ensure good workplace ergonomics and worker participation, with specific measures to avoid prolonged standing and promote moving more and standing less at work (i.e. making work more dynamic). Often workplace interventions are simple and low cost.

The prevention strategy should include the following:

- A **suitable ergonomic workstation and suitable environmental conditions** should be provided, including an appropriate chair, stool and workstation. Incorporating **adjustability** (of working height, seating, sit-stand workstations, cabins that swivel, etc.) is important for safe and comfortable working. There should be sufficient space to move and change standing posture when working standing up.
- **Organise work to limit standing**: the tasks to be performed should be balanced and possibilities should be provided for task rotation, breaks when needed, etc. Workers should be given sufficient control over their work, for example so they can alter how they work and take a break when needed, including minibreaks. It may be useful to establish maximum standing times.
- **An approach directed at active/dynamic work should be chosen** that allows movement while standing to work.
- **Additional measures to reduce risks if standing cannot be avoided** should be introduced, for example mats and cushioned insoles.
- Encourage consultation and **active worker involvement**: this is important for all aspects of a prevention strategy.

- **Promote healthy behaviour**: this could be done, for example, through raising awareness of and providing training in prolonged standing and back care. This will be ineffective unless implemented with the other abovementioned elements.
- **Implement organisational policies and practices**: this will help make sure that the strategy is put into practice (e.g. measures to allow workers to report problems with standing work).

These specific elements should be addressed in the prevention strategy using five steps: preparation, assessing risks, action planning, taking action and evaluation. The process should be systematic and ongoing, and follow three key principles: do what works for you — tailor what you do to your circumstances and do what is realistic; involve workers in each phase; show management support and commitment. EU-OSHA's practical guide to tackling psychosocial risks and MSDs in small business provides more information about applying a systematic prevention approach.

Box 7 The European approach to tackling MSD risks

- Avoid risks.
- Evaluate risks that cannot be avoided.
- Tackle the risks at source.
- Adapt work to the individual.
- Adapt to changing technology.
- Replace dangerous practices with what is safe or less dangerous.
- Develop a coherent overall prevention policy, addressing the whole load on the body.
- Use collective protective measures over individual protective measures, e.g. personal protective equipment.
- Give appropriate training and instruction for workers.
- Consult workers.
- Intervene early if a worker develops symptoms of MSDs and provide rehabilitation.

Box 8 A prevention hierarchy applied to prolonged standing

All of our postures and movements are dependent on the functioning of the musculoskeletal system, which is complex and made up of muscles, joints, tendons, ligaments, nerves, cartilage, bones and blood vessels. Impairments to the system are known as musculoskeletal disorders (MSDs). Work-related MSDs are mostly cumulative, resulting from repeated exposure to loads at work over a period of time, such as awkward or fixed postures, repetitive work or handling heavy loads (EU-OSHA, 2007).

8 Workplace ergonomics and risk prevention

The first question to ask is 'Does the work have to be done standing up?'

This chapter covers risk assessment and the general approach to designing the work and workstation to ensure it is suitable for the task being carried out and the person performing it, and includes advice on the ergonomics of workstations. Some specific issues, such as WBV, are also addressed. Further resources on prevention are given in Appendix 4.

8.1 Risk assessment

The prevention approach should be based on risk assessment. It is important to assess the full range of musculoskeletal risk factors, including prolonged standing, poor ergonomic postures, repetitive movements, manual handling and exposure to WBV, and to address them together in a comprehensive way. The first question to ask is 'Does the work have to be done standing up?' However, changes to the workplace or tasks may be necessary if seating is to be provided to restrict standing work.

Box 9 summarises the steps involved in risk assessment. A simple action plan can be made to implement the results of the risk assessment that sets out the hazards and the solutions, together with priorities for action, deadlines and responsibilities. An action plan template is given in Appendix 5.

Box 9 Risk assessment steps

Risk assessment provides a systematic approach to making changes in the workplace. It is based on the following steps (EU-OSHA, 2018):

- collecting information;
- identifying hazards;
- assessing the risks arising from those hazards;
- setting priorities and planning actions to eliminate or reduce the risks;
- monitoring and evaluating the actions taken;
- involving workers throughout the risk assessment process.

EU-OSHA's guide provides practical advice on applying these steps to preventing MSDs (EU-OSHA, 2018).

8.2 General approach for workstation ergonomics and work design

To prevent MSDs caused by prolonged standing, the workplace design must be adapted to the worker and the tasks and activities that they need to perform. The physical layout of the workstation, tools, placing of keys, controls and displays determine the body positions workers will assume when performing their tasks. If the workspace is inadequate for the task, workers will have less freedom to move around and refresh tired muscles and they may have to work in awkward positions. In a well-designed workplace, unfavourable working positions are avoided and the worker has the opportunity to choose from a variety of well-balanced working positions and to change between them frequently (CCOHS, 2016).

Within a preventive approach, the following generic ergonomic principles for standing work should be incorporated:

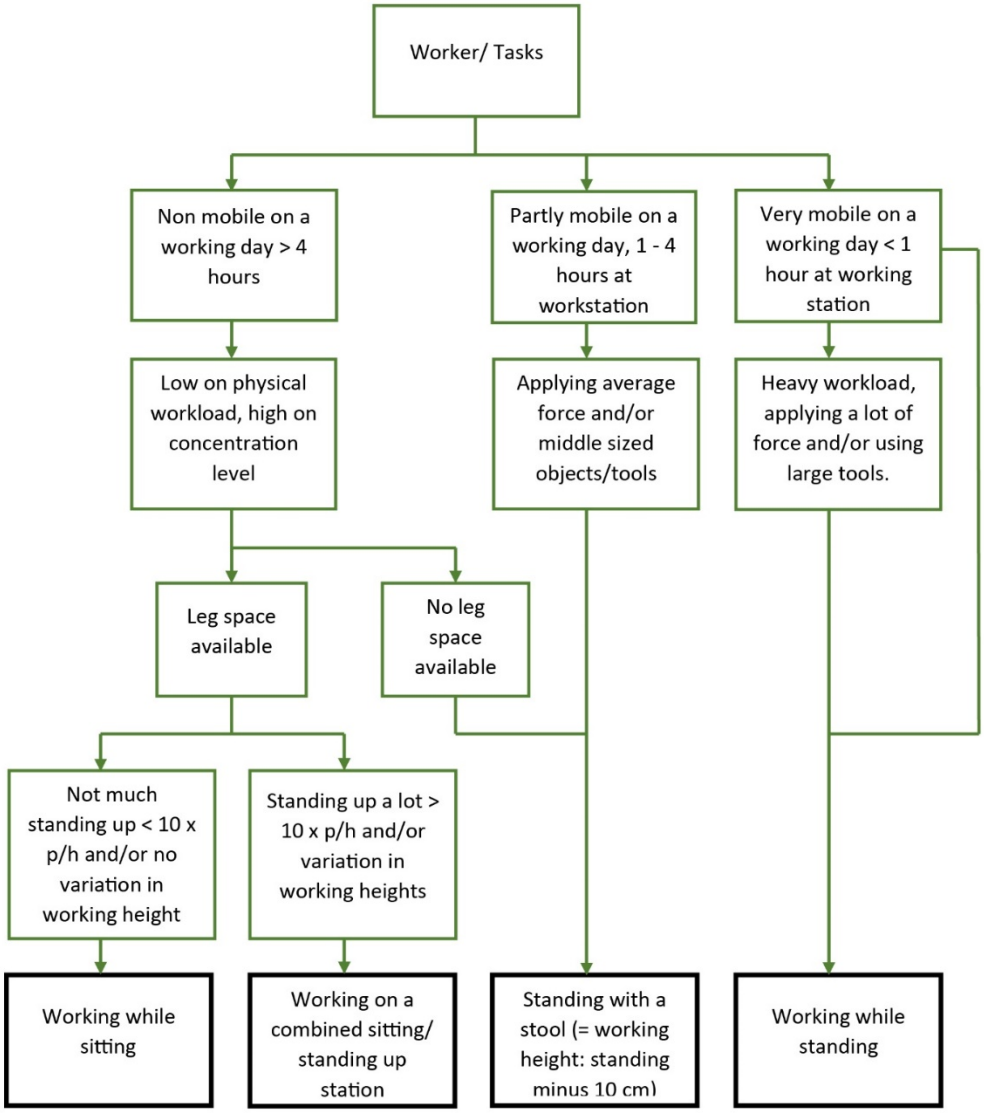
- **Sitting, standing and moving around**: workstation design and work organisation design that allow workers to alternate sufficiently between standing, using a stool, being seated on a chair and/or walking should be applied.
- **Working surface height**: workstations should be designed according to the tasks to be performed, for instance in micro-assembly work, a seated position is preferable, but standing is preferable if a task requires substantial force.

- **Adjustability**: workstations should be adjustable to take account of the varying sizes of workers.
- **Foot, knee and leg space**: the workstation should provide the correct leg, knee and foot space, regardless of the working position.
- **Reaching distance**: workstations should be designed to prevent workers from overreaching.
- **Viewing angle**: workstation design should allow comfortable viewing angles.

8.3 Deciding if work should be performed while sitting or standing

A correct workplace design helps to prevent unfavourable working positions. Figure 3 presents a basic tool to help decide whether a workstation should be sitting or standing. The tool was developed by vhp human performance for the Dutch government. Depending on the type and duration of the work, the chart enables decisions to be made between options of sitting, standing, a combination of the two or standing using a perching stool. (Figure 3 shows an example of a sitting workstation and a workplace for using a stool/support (Lutgendorf and Peereboom, 2012). External expertise should be obtained where necessary, especially in more complex work situations, in order to help the employer make the right choices.

Figure 3 Flow chart for making the right choice concerning sitting or standing



Source: ©vhp human performance

8.4 The nature of the work affects the preferred work height and workstation design

As the flowchart (Figure 3) indicates, the requirements of the workstation depend on the characteristics of the work being carried out, that is, whether it is industrial work, checkout work, counter work, visual display unit (VDU) work, etc. The workstation needs to be appropriate for the task, for example depending on whether fine motor skills, high-visibility tasks, applying force or reaching are required.

It is easier to apply force, for example, to chop something, standing than sitting; therefore the choice to sit or stand should take account of guidelines concerning applied force. If the work frequently requires force to be applied that exceeds 4.5 kg (45 N) it should be possible to stand to do this (Inspectie SZW, 2012). If any lifting is required, the equipment and workstation should be arranged to allow the object to be kept close to the body, and to keep twisting or stretching to a minimum.

When standing to work, different tasks require different work surface heights (CCOHS, 2016):

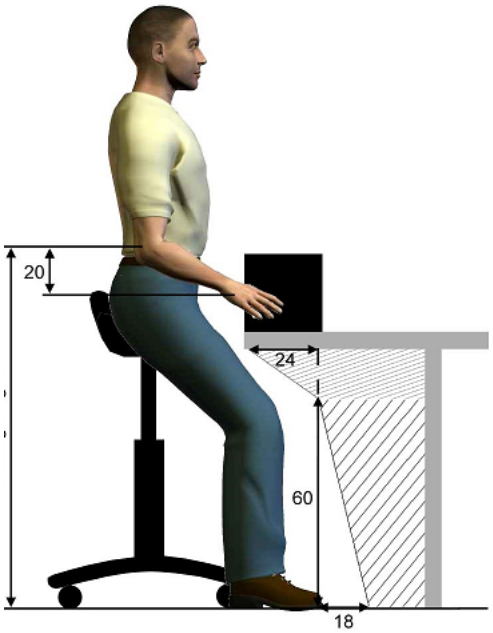
- precision work, such as writing or electronic assembly — about 5 cm above elbow height; elbow support is needed;
- light work, such as assembly line or mechanical jobs — about 5-10 cm below elbow height;
- heavy work, demanding downwards forces — from 20 to 40 cm below elbow height.

These are general guidelines, as preferred working height will vary according to a worker's height.

8.5 Allowing enough leg space

The workstation should provide the correct leg, knee and foot space, regardless of the working position, to prevent both awkward postures, muscle tension and unnecessary reaching, especially when working while operating foot pedals. Sufficient foot clearance space (15 cm) (CCOHS, 2016) is needed at the foot of a standing workstation to allow a person to stand close enough to the work surface to work comfortably. Figure 4 shows leg space requirements for workstations for working while perching (Lutgendorf and Peereboom, 2012).

Figure 4 Leg space and working height overview while working with a perching stool or saddle seat

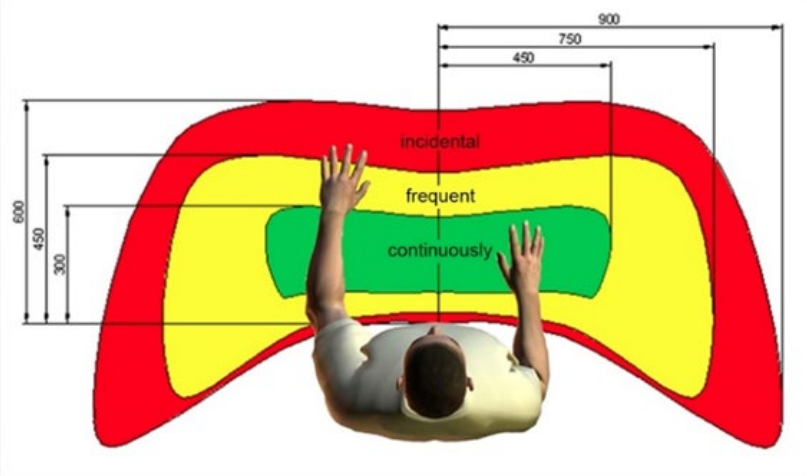


Note: measures in cm - Source: ©vhp human performance

8.6 Avoiding overreaching

Workstations should be designed to prevent workers from having to reach too far or too high. Work and equipment that is used frequently needs to be placed within easy reach to avoid awkward stretching and twisting which could lead to back pain or injury. The basic recommendations on reaching distances are given in Figure 5.

Figure 5 Reaching at a workstation while seated



Note: Green zone (< 30 cm), suitable for continuous activities; yellow zone (30-45 cm), suitable for frequent activities; red zone (> 45 cm), suitable for only incidental activities.

Source: ©vhp human performance

8.7 Viewing angle

Workstation design should allow comfortable viewing angles, where workers can look at screens, tools and objects without having to work in an awkward neck and/or trunk position. In particular, looking upwards, including while tilting the neck backwards, and looking sideways, including neck rotation, should be avoided.

8.8 Adjustable workstations and task control

When standing at a workstation it is important that it is at an ergonomically comfortable working height to avoid awkward postures. As workers vary greatly in height, employers need to look at their workforce. For 90 % of the population, the difference in height between small woman and tall men is approximately 40 cm (TU Delft, 2020). For example, a short woman could measure 1.50 m and a tall man could be over 2.00 m but they could work at the same type of working station. Clearly, a certain degree of adjustability is required if all workers are to have ergonomically safe working conditions. The ideal solution is to have height adjustable workstations, but steps or blocks could be used by shorter workers. Elbow height is the correct measure that should be used to adjust the height of the work according to body dimensions.

As has been mentioned, workstation design and work organisation design should allow workers to alternate regularly between standing, using a stool, being seated on a chair and/or walking. Enabling workers to take frequent microbreaks when they need to is also part of adapting work to the worker and taking account of individual differences and needs.

8.9 Preventing exposure to whole-body vibration

WBV is vibration from machines and/or vehicles that moves into the worker's body through the buttocks, back or feet (Government of Ontario, 2019). Standing on surfaces that vibrate, such as concrete crushers, drill platforms, vibratory separators or ships' decks will expose workers to the risk of WBV. The health risks from WBV increase when the level is high, exposures are long, frequent or regular, the dominant frequency is below 20 Hz and there are severe shocks or jolts in the vibration. As mentioned

in section 3.1.4, the risks of back pain from prolonged standing are increased if the worker is exposed to WBV at the same time, especially if postures are constrained, awkward or poor.

Employers have duties to assess exposure to WBV and take preventive measures. Measures to eliminate and minimise vibration exposure should be based on risk assessment and include the following (Safe Work Australia, 2016a,b; Martin et al., 2017; Government of Ontario, 2019):

- *At the source*: such measures include buying machines or vehicles designed to minimise vibration transmitted to the operator and redesigning tasks to permit remote operation of equipment or separating the vibrating equipment from the work area where the operator is standing. Alternatively, the employer could redesign the task so that vibrating equipment is not used at all, perform regular maintenance and calibration, and implement operation limits of the machinery.
- *Along the paths of the vibration*: for example, vibration dampened surfaces and/or vibration absorbers could be used or the source of the vibration could be isolated.
- *At the position of the worker*: such measures include using equipment that allows the worker to maintain a neutral, upright position, meaning that they do not have to overreach or twist; implementing regular work breaks, posture changes and/or job rotation; providing training, information and supervision on adjusting and using equipment; and implementing safe work procedures and standard operating procedures.

8.10 Job design

Basic principles of good job design for standing work include:

- the provision for worker training (on proper work practices and use of rest breaks);
- job rotation among groups of workers (moving workers from one job to another to shorten the time spent standing);
- widening job roles to give workers more and varied tasks to increase body positions and motions;
- the avoidance of extreme bending, stretching and twisting;
- appropriately paced work;
- allowing frequent rest breaks (standing work is tiring).

8.11 Dynamic work, breaks and exercise

Frequent breaks should be taken from continuous constrained standing, for instance every 8 minutes but preferably at least every 20-30 minutes.

Workers should sit when they need to, stand when they want to and walk or move when they can (IWH, 2018), because our next posture is the best posture.

Work design should allow workers to change between sitting, standing, leaning (standing with back support, using a stool) and walking. Workstations should also allow workers to adopt different postures when standing and allow dynamic standing, which means that there is a possibility to move about, even if only in a limited area.

There are many ways to stand (BAuA, 2008) (leaning forward, leaning backward, leaning sideways, on a stool, against a backrest, pelvis tilted forward with back support, pelvis tilted backwards without back support). Dynamic standing is addressed further in section 9.2 and tips for workers on dynamic standing are given in Chapter 9. As discussed in section 6.4, it appears that having just 1 m^2 to move around in can reduce the problems related to standing work (Lutgendorf and Peereboom, 2012). If sitting and standing for work, workers should change between the two frequently, for example every 30 minutes. Box 10 gives two simple examples of measure that make work more dynamic.

Box 10 Examples of measures that promote moving while working

- When moving cardboard boxes from a conveyer belt to a pallet, do not position the pallet 1 m from the conveyor belt but 2 m instead. This automatically introduces more activity because the worker takes one step with each box instead of standing on the same spot all the time (and twisting their back).
- Provide a saddle seat stool on wheels, allowing the worker to move around, instead of standing up all day. Such stools are often used by physiotherapists, but could be used in other work situations. However, make sure that such a stool does not introduce additional hazards. For example, the flooring needs to be appropriate or a mat may need to be used.

Guidelines on maximum standing times and breaks are given in Chapter 6; however, section 6.4 highlights the importance of taking frequent breaks from standing, for instance every 8 minutes but preferably at least every 20-30 minutes.

Work should be designed to provide workers with regular breaks during which they can sit, walk and stretch. Frequent short breaks, for example, are considered to be more effective for fatigue than one long break. In addition, workers should also be able to take microbreaks. As far as possible, decisions about when to take breaks should be under the control of the worker. Seating that is suitable and comfortable should be provided for breaks.

Workers should be encouraged to stretch as well as move. Workplace wellness programmes can be carried out during set break times that focus on reducing prolonged standing at work, stretching and increasing blood flow (OSHREPS, 2020). Walking is especially effective for increasing blood flow in the body, for instance by taking a walk at lunchtime. A competent person, such as a physiotherapist could be consulted to devise tailored exercises for the type of work and workers. It is useful for a competent trainer to provide workers with initial training in workplace exercise. Providing training programmes for selected workers who can then train and guide their colleagues can also be effective.

Dynamic working should be part of work design and embedded in an organisation's policies and culture. Work routines can be planned with exercise breaks, for example immediately before the lunch break. Any actions to promote physical activity or musculoskeletal health, such as back-care programmes, instruction in exercises or how to work dynamically, should form part of any wider workplace health promotion activities in the workplace.

More advice on dynamic work, breaks, exercises for workers and promoting physical activity is given in the EU-OSHA report on prolonged sitting (EU-OSHA, 2021a), an information sheet (EU-OSHA, 2021b) and an OSHwiki article (de Langen and Peereboom, 2020b). Additional exercises for standing work can be found through internet searches, for example (Trainer, 2019).

Dynamic standing means that there is a possibility to move about, even if available space is limited. There is a significant difference between prolonged standing on exactly the same spot and dynamic standing in terms of health effects, even if a worker moves about in only 1 m^2. Moving about the workstation in a dynamic fashion, even if the available space is limited, should be part of the prevention approach.

8.12 Ergonomic 'checkpoints' for standing and sitting workstations

The Ergonomic Checkpoints booklet prepared by the International Labour Office (ILO) in collaboration with the International Ergonomics Association (IEA) offers practical solutions for avoiding and improving standing workstations. Although some points are more specific to factory work, the general points are relevant to any workstation involving an element of standing work (Box 11).

Box 11 ILO/IEA ergonomic checkpoints for standing and sitting workstations

Checkpoint:	How to solve workstation issues:
▪ *Adjust the working height* for each worker at elbow level or slightly below	▪ For *seated workers*, work surface height should be around elbow level. Working height can be slightly below elbow level if forces need to be exerted downwards. If using a keyboard, the height at which the fingers operate should be at or slightly below elbow level. This is dependent on keyboarding abilities ▪ An exception should be made for high-precision work while sitting. In this case, the object can be raised slightly above elbow level to allow the worker to see the fine detail. In this case, provide armrests. A jig may also be required to support the object ▪ For *standing workers*, the hand height should be a little or somewhat below elbow level. For work requiring accuracy, elbow height can be chosen. In light assembly work or packing of large items, the hand height should be about 10-15 cm lower than elbow level. When the use of very strong force is needed, an even lower height is appropriate so as to allow the use of body weight. However, too low a work height should be avoided because it can cause lower back pain ▪ Where possible, use an *adjustable work table*, for example a lift-table with a hydraulic device for raising or lowering the table height ▪ *Use a platform* or a similar flat structure under tables, work surfaces or work items to raise the working hand height. Use platforms under the feet or chair to lower the actual working height in relation to elbow level. These adjustments are extremely effective
▪ Make sure that the workplace accommodates the needs of *smaller workers*.	▪ Purchase machines and equipment with adjustable work surface height. Then adjust the height to suit smaller workers ▪ Replace controls (although this might be relatively difficult once machines are bought) and materials so that they are within easy reach of smaller workers. If the same controls and materials are dealt with by taller workers, make sure that they are still within easy reach of taller workers ▪ Use platforms for smaller workers so that the hand position of these workers becomes higher and they can easily reach controls and materials. Ensure that the stand does not present a tripping and falling hazard ▪ Use a foot-stand or a mobile platform to enable workers to reach particular controls or materials which are difficult for them to reach
▪ Make sure that the workplace accommodates the needs of *taller workers*.	▪ Check overall space clearance of all workstations and passageways for the largest worker, and increase clearance where necessary ▪ Check knee and leg clearance of workstations used by the largest worker. If knee and leg clearance is too narrow, consider how the clearance can be expanded. Raise the work table height or expand the work table size, for example ▪ Mark all unsafe clearances with bright colours and warning signs
▪ Place *frequently used materials*, tools and controls within easy reach	▪ Place frequently used tools and controls within the primary hand movement area. This is between 15 cm and 40 cm from the front of the body and within 40 cm from the side of the body at elbow height ▪ Place all frequently used materials within this primary hand movement area or at the margin of this area.

Checkpoint:	How to solve workstation issues:
	▪ When materials are supplied in boxes or bins, or on pallets or racks, they should be placed within easy reach and at around elbow height ▪ For similar workstations, organise the placing of tools, controls, materials and other work items in a good combination with each other. For example, when several kinds of material are collected at the same time or one after another, place them in the same area in different bins. Standardise the location of all these items based on the opinions of the workers ▪ If appropriate, divide the work table surface into subtask areas so that different operations are done sequentially
▪ Provide a *stable multi-purpose work surface* at each workstation.	▪ At each workstation provide a stable work surface of appropriate size where a variety of tasks can be done, including preparation, main tasks, recording, communication and maintenance-related tasks. Such a surface is usually available when the work requires a work table, but tends to be neglected when the main operations do not require a table ▪ Avoid a makeshift work surface or an unsteady surface. Work done on it becomes frustrating and of low quality ▪ The thickness of the work surface should be not more than 5 cm. This is necessary to secure knee space underneath. Therefore avoid putting drawers or under-table shelves in front of the seated worker where the legs are positioned ▪ In the case of a VDU workstation, a work surface is needed, in addition to the keyboard space, for preparation, document holding, writing and maintenance
▪ Make sure that workers can *stand naturally*, with weight on both feet, and perform work close to and in front of the body	▪ Arrange all important and frequent operations so that they are carried out close to and in front of the body, and around or slightly below elbow level. Make sure that the work table or working height close to and in front of the body is free from obstacles ▪ Make sure that these frequent operations can be performed without raising the elbow high or bending or twisting the body long enough to cause discomfort ▪ Provide adjustable workstations when used by different workers or where different tasks are carried out. If adjustable workstations are impractical, provide platforms or other means to adjust the working height to each worker. Use lifting and tilting arrangements if needed
▪ Allow workers to *alternate standing and sitting* at work as much as possible	▪ Provide sitting workplaces for workers performing tasks requiring precision or detailed inspection of work items, and standing workplaces for workers performing tasks requiring body movements and greater force ▪ Assign work tasks so that the worker can do these different tasks by alternating standing and sitting while at work. For example, preparation while standing and sitting, power tool work while standing, inspection and recording while sitting ▪ If the main tasks are done at standing workstations, then allow occasional sitting (e.g. for watch keeping, recording or at the end of a series of work tasks) ▪ If the main tasks are done in a sitting posture, then opportunities should be provided for occasional communicating with other

Checkpoint:	How to solve workstation issues:
	workers or monitoring work results, or after completing one or a few work cycles ▪ If appropriate, organise job rotation so that the same worker can go through different jobs alternating standing and sitting ▪ If alternating standing and sitting at work is not at all possible, insert short breaks to allow for the change
▪ *Provide standing workers with chairs or stools* for occasional sitting	▪ Provide a chair or stool near each standing worker. If there is no immediate space for this purpose near the workstation, put chairs or stools or a bench near a group of workers ▪ See if workers are using makeshift chairs for occasional sitting. Formally allow workers to use chairs when they need it ▪ Check if part of the tasks assigned to the standing worker can be done while sitting (e.g. some preparatory tasks or keeping watch over the machine operation). Arrange for occasional sitting work, where possible

Source: International Labour Office and International Ergonomics Association, 2010

8.13 Seating and perches

'Perching' stools that can be used in a semi-standing position can help to avoid prolonged standing. Staff supervising the public in art museums often use them, so that they can change between standing, perching and walking. Foldaway stools or perching sticks that can be easily carried may be useful in some circumstances.

Chairs, stools or perching stools provided to limit standing should be easily adjustable and comfortable. They should be suitable for the work being carried out. For example, various tasks are performed in laboratory work that require a selection of different laboratory chairs with different height adjustment options being provided — regular lift for low benches/tables and high lift with a foot ring for laboratory benches (90 cm) and sit-stand chairs should also be provided (NTNU, undated).

Lean-on or stand seats can be used in some circumstances, for example for fashion retail cash register work (see section 10.3 for further details.) However, the work is still tiring ([63]) and these seats are suitable only when it is impracticable to use conventional seating, and when machinery and the workstation does permit knee space (HSE, 2011). The stool needs to be suitable and the work surface height lower than for standing at a standing work surface. Such seats should still be adjustable in height and arranged to take part of the body's weight. Particular attention should be paid to ensuring such seats are stable and comfortable under the conditions of use.

Specialised wheeled sliding or suspended seats can be useful when employees need to move frequently from one machine or location to another. Fixed, foldaway seats may be more appropriate where space does not allow for common chair dimensions. The design can be swing-out or flap-down and such seats can be tucked away when out of use (HSE, 2011). Other examples of specialist seating to avoid standing are given in Chapter 10. Whether seating is conventional or specialised, workers should be given training about its features and how to adjust them.

Seating must also be useable in the workspace. It is no good providing seating if the workspace layout or the tasks restrict its use.

It is important not to just substitute prolonged standing for prolonged sitting (see also section 8.14 on sit-stand desks).

([63]) Modint provides a working conditions catalogue for fashion shops, with g on purchasing a stand stool (in Dutch) (available at: https://www.modintarbocatalogus.nl/mode-interieur/fysieke-belasting/aanschaf-van-een-stasteun/).

8.14 Sit-stand office desks — not a panacea

Sit-stand desks are becoming increasingly popular and they can be a helpful in introducing postural change into office work. They allow a change of posture from sitting, or perching on a perching stool if provided, to standing. However, it is important not to substitute prolonged standing for prolonged sitting. When changing between sitting and standing work, you are moving between two static postures, and frequent breaks for moving and walking should be incorporated into sit-stand work routines. When sit-stand desks are used, workers should also change frequently between sitting and standing EU-OSHA, 2021a).

8.15 Measures to reduce the effects of prolonged constrained standing

There are various measures that can help to reduce the effects of prolonged standing where standing cannot be avoided. For example, the use of anti-fatigue mats or placing carpeting on the floor does not eliminate sore feet by itself, but, when combined with proper work design and quality footwear, it should improve working conditions.

8.15.1 Foot rests

Foot rails and individual footstools, to support one foot, interchangeably, allow posture change while standing.

8.15.2 Flooring

The type of flooring used in the workplace has an equally important influence on comfort, especially on tender feet. Hard, unyielding floors, like concrete, are the least comfortable surface to work on, and can be covered with mats. Walking on a hard floor is similar to the impact of a hammer pounding the heel at every step. Wood, cork, carpeting, or rubber — anything that provides some elasticity — are generally more gentle on workers' feet. Moreover, softer floor coverings reduce fatigue and improve safety by reducing slips and falls on slippery floors. However, thick foam-rubber mats should be avoided. Too much cushioning can cause fatigue and increase the risk of tripping. Mats should also have slanted edges to help prevent tripping (Workers Health and Safety Centre, undated; CCOHS, 2016).

8.15.3 Anti-fatigue mats

There are two options to alleviate foot discomfort where resilient floors are not practical (King, 2002; CCOHS, 2020a). One is footwear with thick insulating soles and shock-absorbing insoles. Anti-fatigue matting is the other option. Anti-fatigue mats absorb the shock due to walking and this cushioning effect reduces foot fatigue. When standing on the spot, the mats encourage subtle movement of the leg and calf muscles, which in turn promotes an easier flow of blood back to the heart reducing foot fatigue (King, 2002). However, the use of matting requires caution because mats can lead to tripping and falling accidents when installed improperly or if they become damaged.

Another type of floor covering, anti-slip matting, can also be useful to increase foot comfort and safety and Box 12 provides a checklist for their selection. However, workers may find that their feet burn and feel sore, because the non-slip properties of anti-slip matting cause their shoes to grab suddenly on the flooring, making their feet slide forward inside the shoes. Friction inside the shoes produces heat, which creates discomfort. Non-slip resilient insoles can reduce this discomfort (see section 8.15.5).

Box 12 Checklist for selecting an anti-fatigue mat

There are many types of mats that are sold as 'anti-fatigue' mats. When choosing a mat, consider:

- The purpose of the mat: anti-slip or other mats are not the same as anti-fatigue mats. Choose a mat that matches your needs best.
- The thickness of the mat: softer and thicker may not always be better. Choose a mat that provides some elasticity, but is not so soft that a person feels they cannot stand comfortably.
- The environment the mat will be used in: this will influence the choice of mat.
- Mats should not slip or create a trip hazard.
- Mats should have sloped edges: sloped edges reduce the trip hazard, and allow carts to roll over them more easily.
- Mats may need to be cleaned: in some areas, such as those used for food preparation, being able to adequately clean the mats will be important.

Source: CCOHS, 2020a

8.15.4 Footwear

The health effects of prolonged standing can also be reduced by wearing adequate footwear. Footwear should ensure adequate arch and heel support, shock absorption and cushioning, as well as providing comfort to the wearer. They should not change the shape of the foot and there should be sufficient room to move the toes. Heels should be no higher than 5 cm (Canadian Women's Health Network, 2006). In jobs requiring protective footwear, this should be suitable and comfortable ([64]) and if worn by women it should be designed for women. Workers should be consulted and given a choice. Dress codes should allow for wearing comfortable shoes. Shock-absorbing insoles can also help for standing and walking on hard surfaces. Box 13 gives a checklist for choosing footwear.

Box 13 A checklist for choosing footwear for standing work

Good footwear should have the following qualities:

- The inner side of the shoe must be straight from the heel to the end of the big toe.
- The shoe must grip the heel firmly.
- The forepart must allow freedom of movement for the toes.
- The shoe must have a fastening across the instep to prevent the foot from slipping when walking.
- The shoe must have a low, wide-based heel; flat shoes are recommended. Small heels (63.5 mm to 84 mm for a men's size 43, scaled to other sizes) are recommended.
- Workers buying footwear for work should:
  - not expect that footwear that is too tight will stretch with wear;
  - have both feet measured when buying shoes — feet normally differ in size;
  - buy shoes to fit the bigger foot;
  - buy shoes late in the afternoon when feet are likely to be swollen to their maximum size;
  - ask a doctor's advice if properly fitting shoes are not available;
  - consider using shock-absorbing insoles where the job requires walking or standing on hard floors.

Source: CCOHS, 2020b

([64]) https://osha.europa.eu/en/legislation/directives/4

8.15.5 Insoles

Cushioned insoles that support the foot arch can also provide some relief for standing work and Box 14 provides an example. To support a worker to continue to work following a specific work-related MSD, the employer could pay for or contribute to the cost of individual, bespoke insoles, if recommended by a doctor or physiotherapist.

Box 14 Insoles for packing manufacturer workers

All of our postures and movements are dependent on the functioning of the musculoskeletal system, which is complex and made up of muscles, joints, tendons, ligaments, nerves, cartilage, bones and blood vessels. Impairments to the system are known as musculoskeletal disorders (MSDs). Work-related MSDs are mostly cumulative, resulting from repeated exposure to loads at work over a period of time, such as awkward or fixed postures, repetitive work or handling heavy loads (EU-OSHA, 2007).

8.15.6 Support stockings and compression socks

Support stockings provide support to the muscles and blood vessels of the lower leg, reducing oedema/swellings and promoting blood circulation. Alternatives are support tights or well-padded socks. Support stockings are especially important for workers with a tendency towards venous insufficiency. Thick, well-padded socks are useful for those workers experiencing heel pain while standing.

Healthcare advice should be sought over the use and choice of compression socks. They may not be advisable for people with an underlying health condition, particularly, heart conditions. Factors to consider when choosing compression socks include the sock's material (e.g. breathable), the compression level required, whether the compression is gradient or uniform and the size, length and fit of the sock. They need to be used properly and properly cared for. At the end of the day the socks should be removed so that the body can rest and relax (Nurse Theory, undated).

8.16 Including all workers

Employers should keep in mind that many workers work away from a fixed workplace some or all of the time. Employers need to take this into account during their risk assessments, and apply the principles of being able to alternate between standing and sitting and moving around, for example, by ensuring that workers have access to seating and are able to take breaks from standing. This may involve liaising with other employers or the owners of other buildings where their employees are working. Work should permit breaks from constantly standing and walking, and this should apply to the use of 'self-employed' or contract workers, such as care staff working in the community or delivery staff.

8.17 Interventions for older workers or workers with an existing musculoskeletal condition

Employers have duties to protect the health and safety of more vulnerable workers. The first priority should be to make work safer, healthier and easier for the entire workforce. However, older workers or workers with a chronic musculoskeletal condition may need additional measures. This includes providing additional support for worker requirements and enhancing workplace adjustability and workplace design. Individual accommodations for someone who has problems standing for prolonged periods of time could be, depending on the work they do, the use of a portable perching stool, more frequent breaks or job rotation (EU-OSHA, 2016, 2021c).

However, a workplace that is already designed to promote good musculoskeletal health reduces the need for the individual adjustments (Woolf, 2019). Measures that make a workplace more ergonomic for all workers and avoid unnecessary constrained standing, e.g. through adequate breaks, micro-breaks and the possibility to sit and walk, can prevent an individual with a chronic MSD from having to exit early from the workforce.

A worker recuperating from an MSD and who cannot work standing for any length of time and needs to be put on 'light duties' should not be given only work that involves continuous sitting, as the lack of movement is likely to be detrimental to their recovery.

8.18 Early intervention

Workers should be encouraged to report any problems associated with standing work, so that they can be addressed as soon as possible and before they become worse. Addressing problems promptly is likely to save time and money (EU-OSHA, 2021c).

8.19 Training, communication and worker participation

Employers must provide information, instruction and training to workers on the hazards in their work and measures to avoid risks. For example, workers need instruction and training on setting up workstations, adjusting any adjustable equipment and dynamic work methods. If workers are to be encouraged to exercise, initial instruction in the exercises from a competent person is recommended.

All employers in the EU have legal obligations to consult workers on health and safety. Studies (EU-OSHA, 2012a) show that worker participation consistently appears as a key factor for the successful identification of problems and implementation of practical solutions, regardless of the size or type of workplace or type of problem. Involving workers is important as it uses their experience of how work is carried out in practice and what the problems are. This helps to identify and prioritise the most important issues to address and find practical solutions. It also creates a sense of ownership of the changes being implemented. The active participation of workers is important for determining ergonomic solutions (Copsey et al., 2021).

Workers should be involved in identifying hazards and solutions, and the implementation and monitoring of solutions. Workers should also be encouraged to report early any health and safety problems related to prolonged sitting — the sooner problems are acted on, the easier they are to deal with.

Body mapping and hazard mapping (EU-OSHA, 2020b) are two interactive techniques that can be useful for identifying and discussing risk factors for MSDs and other hazards. Body mapping involves workers marking on outlines of the front and back of the body where they have aches and pain, and then discussing the results. Hazard mapping involves workers marking hazards on a plan or drawing of their workplace. Further information on worker participation is provided by EU-OSHA (2012b).

9 Tips for workers to reduce discomfort from standing to work

Workers can use solutions (such as wearing appropriate shoes, wearing supporting socks, using anti-fatigue mats, using stools or chairs), they can following guidelines (Chapter 8), use checklists presented in this chapter and can talk to their managers about the outcomes and they can focus on dynamic active work (section 8.11), especially concerning alternating between sitting and standing.

It is important to report any musculoskeletal symptoms or hazards promptly to the employer and not to wait to seek medical help. The earlier the intervention for an MSD the easier it is both to address at work and to treat it. Speaking to others may show that it is a common problem. If you have a condition that makes it difficult for you to stand, you should discuss accommodations that could be made to your work with your employer. A trade union, if there is one, can also provide support to raise issues with an employer and investigate the problem and what measures may be needed.

9.1 Basic steps for workers

The basic steps for workers include ([65]):

- adjusting your working height to a comfortable level, using elbow height as a reference;
- organising your working area to give you as much room as possible to change position and move about;
- organising your work so what you do and use most frequently is in easy reach;
- always stand facing the object of your work and keep your body close to the work;
- using a foot rail or portable footrest to shift body weight from both legs to one leg or the other leg;
- using a seat whenever possible, or at least when the work process allows for rest
- avoiding:
    - reaching behind the shoulder line. Shifting feet to face the object is the recommended way;
    - overreaching beyond the point of comfort;
    - reaching above shoulder line.

([65]) These steps are based on information from the following sources: Canadian Women's Health Network (2006), Arbocatalogus Agrarische en Groene sectoren (2020), CCOHS (2020b), de Langen and Peereboom (2020c) and Occupational Health Clinics for Ontario Workers (undated).

- ensuring your feet are as comfortable as possible by following the advice on footwear in section 8.15 and Box 13;
- using supportive socks, which may help, but seeking medical advice on their use is advisable (see section 8.15.6);
- adopting an active work posture; this means keeping the knees loose and slightly bent, and keeping the abdominal muscles slightly contracted to avoid a hollow back;
- taking frequent breaks to stretch and move if you are able to;
- preferably taking a break from continuous standing at least every 20-30 minutes and not exceeding 1 hour of continuous standing without a break.

9.2 Tips for dynamic working — The best posture is our next posture

Constrained postures, including prolonged standing, are tiring and contribute to health problems. It is preferable to vary between sitting, standing and moving around when you work — ideally, standing when you want to, sitting when you need to and moving when you can — both at work and at home.

- If your workstation permits, vary between sitting, standing and/or perching, and switch frequently between the different postures.
- Vary your standing posture and move around as much as possible (see below).
- If you are able to, take frequent breaks to stretch and move — frequent short breaks are better than longer less frequent ones.
- Do not just sit on your breaks; try to move around, walk and stretch as well.
- When sitting to rest, you can still do a few exercises, for example shoulder lifts or neck stretches, or rocking your pelvis back and forward.
- On production lines, move away from your workstation and do exercises for 5 minutes twice a day in between scheduled breaks.
- When exercising, include:
    - stretching exercises — they relax muscles and enhance blood flow;
    - exercises that provoke contractions of large muscle groups, preferably leg muscles (walking, cycling, knee bends or squats), as these are particularly effective at enhancing blood flow; examples of simple exercises that could be performed at work can be found on the internet (e.g. Trainer, 2019).

9.3 Move while standing

When standing in a restricted area, it is preferable to take small steps instead of standing still in one place. This way, standing becomes more dynamic and healthier as it keeps the muscle pump in the blood vessels of the legs active. A better approach is to place a few things out of reach so you are forced to walk short distances. If working in a small floor area:

- occasionally shift weight from one leg to another;
- try to move about and make small steps — Dutch casino workers call this ‘table dancing’; even if you can move only a little, it is important to do this;
- use a stool if you have one to take the weight off your legs occasionally;
- avoid back bending and rotating to pick tools or supplies; it is better to take one step to do this than not to move at all;
- try to walk at least once an hour, even if this is a short walk, and do some stretching if possible.

9.4 Vary your standing posture

Even when you are standing, you need to vary your posture, as ‘our next posture is the best posture’. Work should offer sufficient variation not only between standing, walking and sitting but also during standing. There are many ways to stand (BAuA, 2008), including leaning forwards, leaning backwards,

leaning sideways, on a stool, against a backrest, with the pelvis tilted forwards with back support and with the pelvis tilted backwards without back support. While standing at work, there are various ways to change your standing posture:

- rock your pelvis back and forwards;
- avoid reaching sideways by making small side steps instead;
- push your ribcage forwards and backwards or to the side while standing;
- stretch your neck every now and again by pushing your head back;
- when leaning forward, support yourself on the desk or work surface;
- lean back in a relaxed fashion against the back rest in the rear standing position;
- gyrate your hips occasionally while standing;
- move and shift your weight from one leg to another;
- set your (smartphone) timer to 15 minutes and do three knee bends every 15 minutes.

10 Prevention practice for different sectors and jobs

In addition to the general guidance on work design and workstation ergonomics in Chapter 8, this chapter provides examples of advice for specific work sectors and types of work. Although sector specific, often the approaches could be applied to other work situations.

10.1 Factory and production work

General ergonomic guidelines applicable to workstations in factory work are given in section 8.12 in Box 11.

10.1.1 Metallurgy industry

Spanish guidelines on standing for metalworkers (Herramental, 2018) provide the following tips:

- adjust the height of the task to the type/level of exertion;
- alternate your posture to facilitate movement;
- use a separate or integrated footrest;
- change the position of your feet to spread the weight of the load.

10.1.2 Correct layout for a standing workstation in a wine production facility

In the Dutch health and safety catalogue for wine production (ARBOcatalogus wijn, undated), a best practice for a standing workplace at a mixer is illustrated. The mixer is open at the bottom so the worker can place their feet under the mixer, enabling them to stand up straight. The height at which the raw materials are supplied can be adjusted to the correct height for the worker. As the goods are placed a short way from the worker, instead of directly next to them, this reduces the likelihood that workers will twist their back to lift the goods, and increases the chance that they will take a step to handle the goods. As well as avoiding the twisting movement, this means that the worker is not constantly standing still, but is standing more dynamically.

10.2 Sit-stand service counter workstations

Guidance on standing at work at service counters and counter design that is based on risk assessment is provided by the Occupational Safety and Health Branch of the Labour Department (2018) in Hong Kong. The key points include:

- For work that can be done sitting, employers shall, so far as reasonably practicable, provide chairs for employees so that they can sit at work.
- Where employees are unable to work in a sitting position owing to the nature of work or work environment constraints, employers shall assess the health risks of the standing work to the employees and take appropriate preventive measures to safeguard their health.

- Employers shall arrange job rotation, if practical, to allow employees to change their working postures while performing work of a different nature.
- Employers shall remind employees to wear suitable and supportive shoes. The employees' shoes shall be able to maintain the shape of the foot and provide support for the arch of the foot; have adequate space to allow movement of toes; have shock-absorbing insoles, and have low heels (not higher than 5 cm or 2 inches).

A checklist to evaluate the ergonomics of service counter workstations is given in Box 15.

Box 15 Checklist — ergonomics of a service counter workstation and working area

- *Sitting and standing are both possible*. To enable regular changes of body postures, alternating between standing and sitting at work should be encouraged.
- *Provide a chair*, keeping in mind:
  - the backrest should be height adjustable;
  - the seat pan should be padded and free from sharp edges;
  - the seat height should be adjustable so as to cater for different users;
  - when the employee is seated, their feet should be firmly placed on the floor or on a footrest;
  - most of the work should be done at or slightly below elbow level;
  - the seat base should be stable; if the work requires the body to change direction frequently, the chair should be the type that can swivel;
  - there should be adequate space behind the chair; the employee should be able to move and stand up freely.
- *Counter height* should be at or slightly below elbow level. The employee should be able to rest their elbows and move their arms freely above the work surface while the shoulders are relaxed.
- *Frequently used equipment* should be positioned within easy reach to reduce the need for overstretching and stooping of the body.
- *Adequate leg room* under the counter should be provided.
- A *footrest should be provided* if the employee's feet cannot be placed flat on the floor. Footrests should be stable, of an appropriate size and have a non-slip surface.
- *Resilient flooring* (e.g. wood or carpet) should be installed to reduce the stress on the legs. If it is not practicable to install resilient flooring, shock-absorbing mats should be placed at working locations where employees have to stand frequently. These mats must not cause any tripping or falling hazard.
- *Workers with special needs* should be catered for. For example:
  - the body size of individual employees should be considered and the counter must allow a workers of smaller or larger size and pregnant employees to move and stand up freely.
  - a larger seat should be provided if necessary.

Source: Occupational Safety and Health Branch, Labour Department, 2018

10.3 Supermarket checkouts and fashion retail

10.3.1 Supermarket checkouts

Staff at supermarket checkouts should not have to stand continuously to work. Although checkout workers will need to stand to safely handle heavier items, they should be able to swap between standing and sitting when they need to. Apart from an ergonomically designed checkout workstation that allows sitting, measures to limit prolonged standing include task rotation, regular breaks, microbreaks and adequate information and training. It is important to organise the checkout workstation and equipment so that work can be done seated without creating other musculoskeletal problems. When sitting to work, the customer bags their purchases, which also reduces the workload on the worker.

Australia provides guidance on safe design and healthy work practices for checkout workstations in retail (Department of Consumer and Employment Protection, 2005). The guide suggests that the work can carried out alternating between sitting and standing by using a standing height counter and a high chair and footrest, which are both height adjustable. However, the risk of getting on and off the high chair in this specific situation should be considered. An additional advantage of a standing height counter is that the worker is working at eye-level with the customer. A risk assessment checklist from the guide that covers standing is presented in Box 16. Standing should not just be replaced by prolonged sitting, and further advice on supermarket checkouts is given the EU-OSHA report on prolonged sitting (2021a).

Box 16 Checklist for supermarket checkout workstation design and layout

Standing workstation

- Is the height of the checkout workstation between elbow and hip height?
- Are shopping bags located so that the operator can adopt a comfortable upright position and so that worker does not have to lift a full shopping bag onto the checkout counter?
- Is the floor surface soft or, if it is hard, is there anti-fatigue matting?

Seated workstation

- Is the height of the checkout workstation at approximately the elbow height of the user?
- Has the thickness of the work surface been reduced as far as is practicable to ensure sufficient leg clearance?
- Is the chair height adjustable through a suitable range?
- Has the chair got a suitable back support?
- Is there an adjustable footrest?
- Can the operator get on and off the chair safely and unimpeded?
- Does the conveyor belt allow the operator to slide articles across the scanner onto another belt or area?

Seated and standing workstations

- Is the equipment, such as scales, scanner and electronic payment machine, within easy reach?
- Is storage of articles (e.g. bags, rubbish bin) underneath the workstation minimal, to allow unimpeded leg clearance?
- Is the floor surface non-slip?
- Is there enough workspace around the checkout workstation for the operator to complete tasks unimpeded?
- Is through traffic minimal?
- Working posture — Can work be completed in an upright supported posture? If there is any forward reaching further than 30 cm from the body, reaching above shoulder height, bending below mid-thigh height, twisting or sideways bending by the operator, then work cannot be completed in an upright supported posture.

Duration and frequency of task

- Does the worker have the opportunity to complete a variety of tasks?
- Does the worker take regular breaks?
- Does the worker take microbreaks?
- Can the operator avoid sitting or standing for prolonged periods of time?
- Force applied — Is the handling of heavy items minimised by strategies such as scan cards, handheld scanners, price look-up (PLU) codes or detachable tickets?
- Can the operator slide, rather than lift, loaded shopping bags?
- Has lifting from a seated position been minimised/eliminated?
- Is minimal force required to move items across the scanner?
- Work organisation — Has task rotation and/or job enlargement been implemented?
- Skills and experience — Is the operator familiar with the task?
- Have the operators received adequate training? Training should include elements such as optimal work posture, use of scan cards/handheld scanners, task rotation, taking breaks, micro pause, propping, changing positions.

Individual factors

- Have the individual characteristics of the operators been considered, e.g. age, gender, physical dimension, pregnancy and any disabilities or other conditions?

Source: Department of Consumer and Employment Protection, 2005.

10.3.2 Checkouts in retail fashion shops

Detailed Dutch guidance on safety and health in the fashion retail sector includes a basic checklist on whether cash register work should be standing or sitting (Modint, 2020). The main options are outlined below:

- If the worker is very mobile and moving about a lot, they should stand at a cash register.
- If the worker is at the register more than 1 hour, or more than 4 hours total per day, seating or a stool should be available. If they are:
  - getting up more than 10 times per hour, they should stand at the cash register and sit/walk in between;
  - getting up less than 10 times per hour, they should sit at the cash register and stand/walk in between.

The guide also provides the design dimensions for ergonomic standing, sitting and sit-stand cash registers. The sit-stand cash register uses a height-adjustable perching seat and a raised footrest, where an option is to perch with one leg on the floor, and one leg resting on the footrest. It also provides advice on reach distances and ergonomic seating dimensions.

The Dutch ‘arbocatalogue’ for the sector also provides specifications of a standing support stool for checkout work, pointing out that the working height will need to be lower (10 cm) than a standing work surface height; even using a standing support, the physical strain remains high and a normal chair should be made available if possible ([66]). The specifications for the stand stool are:

- free leg and foot room between 24 and 42 cm;
- height adjustment range (with gas spring) between 65 and 90 cm;
- a support surface of at least 20 × 20 cm;
- the angle of the support surface tilted forward 20 to 30 degrees from vertical;
- wheels are on a cross base and braked.

([66]) Modint provides a working conditions catalogue for fashion shops, with advice on purchasing a stand stool (in Dutch) (available at: https://www.modintarbocatalogus.nl/mode-interieur/fysieke-belasting/aanschaf-van-een-stasteun/).

10.4 Agricultural and green sectors

10.4.1 Worker checklist for standing work

The Dutch agricultural and green sectors provide a checklist with reminders for workers before they start a task involving standing (Arbocatalogus Agrarische en Groene sectoren, 2020). As a daily reminder, the checklist should be printed out and placed so that workers can view it from their workstations. The checklist acts as a 'last minute risk analysis' and provides the following advice:

- Before you start working, organise your workstation.
- Use a stool or an anti-fatigue mat.
- Alternate between tasks.
- Wear comfortable shoes that provide support.
- Work in an active working position.

10.4.2 Ergonomic advice on alternating sitting and standing

The ILO, in collaboration with the IEA, provides ergonomic checkpoints for agricultural work that are practical and easy-to-implement (ILO and IEA, 2014). The checkpoint on work methods that alternate standing and sitting is shown in Box 17.

Box 17 ILO/IEA checkpoint on alternating between standing and sitting in agricultural work

Checkpoint

- Choose work methods that alternate standing and sitting, and try to avoid bending and squatting postures as much as possible.

Why

- Alternate standing and sitting while working. Changing work postures can allow particular groups of muscles to rest after working, so as to avoid overuse. Muscle fatigue can be prevented, and the quality of work will be improved.
- Continuing a single posture is strenuous. Continuous standing will cause pains in the shins, feet and back, and then may affect the whole body.
- Long periods of sitting will increase strain on the low back, and so can cause low back pains. It is particularly important to avoid strenuous work postures such as bending and squatting. These postures place a strain on the back and cause pains, making you prone to mistakes and accidents. Frequent changes of work posture can help prevent such strains and pains.

How

- Provide a chair or stool close to your working position. In a standing position, you can sit on the stool by simply leaning. Choose light materials to make such a chair easy to move.
- Vary the jobs carried out by one farmer so as to change his or her work posture.
- Minimise bending postures while working. Various tools will help you. For digging or cultivating, choose tools with long handles.

Ways to promote cooperation

- Exchange ideas and experiences of practical solutions with your neighbours. Find an opportunity to work together with your neighbours to vary jobs and to avoid a single strenuous work posture.

Some more hints

- Standing stools or chairs should be appropriate in size, and portable.
- Large, heavy stools may disturb your work. If it is difficult to alternate standing and sitting, just try to provide standing workers with chairs for occasional sitting, and provide seated workers with an additional space where some secondary tasks can be done while standing.

Points to remember

- Continuing a single working posture for long periods is disadvantageous to your health.

Find a way to alternate standing and sitting for greater efficiency and comfort.

Source: ILO and IEA, 2014

10.5 Airport security personnel

A Dutch research project based on objective measurement and the reported experiences of security guards (Sociaal Fonds Particuliere Beveiliging, 2016), found the following measures to be most effective:

- standing support (80 % of the security guards found this to be a good solution);
- anti-fatigue mats;
- task rotation: alternating every 15 minutes between welcoming passengers (standing on a mat or using a stool), screen work (seated), working at X-ray machines (standing on a mat), checking bags (standing on a mat) and performing body searches (being mobile).

10.6 Health care and dentistry

10.6.1 Advice on avoiding awkward postures for carers

Where tasks have to be carried out standing, then avoiding awkward postures, such as being bent over, is very important. The Dutch website 'stay employable.nl' provides practical advice for carers, such as the tips presented in Table 9 on static workload (Gezond and Zeker, 2020), with short descriptions and pictures of situations from practice with the corresponding guidelines, as well as tips and tricks for specific situations, including static standing.

Table 9 Examples from the practice guideline concerning static workload for carers

Situation	Situation	Situation	Situation	Situation
Washing a client in bed	Treating a wound for over 1 minute	Bathing a client who is seated	Showering a client who is seated	Showering a client who is lying down
Electrically adjustable high/ low bed must be used	Electrically adjustable high/low table or stool must be used	Electrically adjustable high/low bath must be used	Electrically adjustable high/low chair must be used	Electrically adjustable high/low stretcher must be used

Source: Gezond and Zeker, 2020

10.6.2 Compression socks for nurses

Special socks and lower leg hose-type sleeves can provide the correct amount of compression to aid circulation and reduce muscle fatigue. In this way, compression stockings can prevent legs from getting tired and achy. They can also ease swelling in the feet and ankles, as well as helping to prevent and treat varicose veins. Compression socks can be worn as a kind of sleeve and support the whole lower leg; in this way a greater effect on the calf muscles — which are important blood pumps — is achieved. Often, best practices are shared on formal, as well as more informal, platforms targeting specific professions, such as this example for nurses (Nurse Theory, undated), where an evaluation of nine different types of compression socks led to a shortlist of preferred features, to help individuals make the right choice:

- proven improvement of blood flow throughout both feet *and* calves;
- compression takes place throughout the entire sock;
- feet and lower legs remain comfortably warm throughout the day;
- made of selected materials that provide a natural resistance to bacteria;
- made of selected materials that minimise wicking moisture and that dry quickly;
- non- or anti-slip.

10.6.3 Chest support for surgeons

One of the main problems that surgeons face during surgical procedures is their awkward standing up body posture, often accompanied by repetitive movements of the upper extremities, increased muscle activity, and prolonged static head and back postures. In addition, surgeons are so focused during surgery that they tend to neglect their posture. These observations suggest that supporting the

surgeon's body during surgical procedures might be advantageous. Several inventions by industrial designers specifically targeting surgeons, such as chest support devices, have been developed in collaboration with an academic hospital in the Netherlands. Electromyography (EMG) showed a significant decrease in muscle activity in the back and calf muscles when a chest support was used (Albayrak et al., 2007).

10.6.4 Seating for dental hygienists

If seating is provided, it needs to be correctly designed for the job in hand. It is possible for dental hygienists to sit to work, but only if the seating provides support to the back and elbows to help them to avoid awkward and tiring postures without restricting the movements required to perform their work. ASSTSAS, a joint trade union-management safety organisation, designed a seat to allow dental hygienist to sit while working. This was a mobile gel stool and elbow (but not arm) support with forward lumbar support. The elbow supports are cushioned, round and flat, and they remain stable regardless of where the elbows drop. They are movable on a horizontal axis and follow the movements of the arms while remaining in place when they are left. The elbow rests are fixed under the seat of a clinical stool and their height and tension are adjustable (ASSTSAS, 2007).

10.7 Hairdressers

10.7.1 Using a saddle stool

Hairdressing is characterised by standing work, but it is an example of work that does not need to be carried out standing all the time. By providing a saddle stool on wheels, h airdressers can alternate between standing, perching and sitting. This helps to prevent both lower limb and back MSDs. as well

The requirements for a saddle stool for hairdressing work are presented in Box 18 (de Langen and Peereboom, 2020c) and by following these, hairdressers stand less during work.

Box 18 What demands must the hairdresser's bicycle meet?

What demands must the hairdresser's bicycle meet?

- The hairdresser's bicycle is provided with a seat in the form of a bicycle saddle or pony saddle. For small hairdressers, the hairdresser's bicycle with bicycle saddle offers more possibilities to adjust the height properly.
- The hairdresser's bicycle with bicycle saddle can also be used as a standing support (this does not apply to the hairdresser's bicycle with pony saddle).
- The hairdresser's bicycle is not equipped with a backrest, unless it stimulates an active position (the dynamic backrest).
- The hairdresser's bicycle must be easily and continuously adjustable. The seat adjustment range is at least 60 to 80 cm above the floor. In specific situations, a customised tailor-made hairdresser's bicycle (with a different setting range) may be necessary.
- The seat can be rotated relative to the frame.

If the hairdresser's bicycle is mounted on the floor behind the pump seat, it must be rotatable in both directions at an angle of at least 135 degrees around the pump seat.

Source: Healthy Hairdresser, undated

A Belgian brochure for hairdressing on preventing MSDs includes photos of how to work using a saddle stool in practice and examples of stools (Federal Public Service Employment, Labour and Social Dialogue, 2013). It also includes a design for a basin where the worker can wash a client's hair while perching or standing, and illustrations of simple exercises.

Ullman (2014) provides some basic tips for hairdressers for the times when they are standing, which included: changing standing position from time to time and sitting, walking or stretching between clients.

10.8 Kitchen and catering work

10.8.1 Tackling leg complaints among catering staff through task rotation

Catering staff complained of lower leg tiredness and aching. A body mapping exercise showed various workers were suffering from the same symptoms. To tackle this, jobs were reallocated in the canteen, so that all staff could get a break from constant standing tasks ([67]).

10.8.2 An adjustable workbench for preparing dishes in professional kitchens

Kitchen staff often stand for long periods of time and carry out fast-paced work involving frequently repeated movements. It is important that work is done at the correct working height for different workers, but it is also possible to provide a sit-stand work bench to allow suitable tasks to be done in different postures.

This Dutch brochure (TNO, 2014) describes a workbench that can be easily adjusted between a work height of 76.5 cm and 110 cm using electric buttons, enabling every cook to work at the optimum height, depending on their height and the type of work being carried out. There is ample leg room under the table, so that the work can also be done seated or using a perching stool. Precision work (where the view of the work is important) requires the workbench to be set at a greater height, whereas for work requiring strength the height should be set lower. The workbench is on castors, which can also be immobilised, so it can be moved around quickly and easily.

The same brochure shows how a simple block placed benea th a chopping board can raise the working height for a taller worker (TNO, 2014).

10.9 Casino croupiers

In the Netherlands, casino workers at gaming tables were experiencing neck and shoulder MSDs from seated work, due to frequent reaching for playing cards and chips, and low back pain from standing. However, the workers preferred to sit as they found this less tiring. To tackle these problems, a daily sit-stand work schedule was introduced:

- A croupier works for 45 minutes at a gaming table and then has a rest of 15 minutes, with a maximum of six of these 45-minute shifts at the playing tables in a working day.
- During the 45-minute shift, the croupier stands for a minimum of 15 minutes before sitting, and stands for a maximum of 30 minutes in total (for example 15 minutes' standing, 15 minutes' sitting, 15 minutes' standing).
- After each shift, the croupier has a 15 minute break, which includes walking.

This work method ensures that both too much sitting and too much standing are avoided.

The table managers make sure that the schedules are followed. In addition, a consultation hour was introduced ([68]). Workers with questions about their working conditions and sit-stand schedules or who are beginning to have health problems are invited to an ergonomic consultation hour to get advice and — if needed — counselling on which treatment they should choose. The consultation hour is independent and no information on individuals is shared with the management. Over time, the MSD problems have been reduced significantly. The results of the consultations have also led to the introduction of specific on-the-job training and enabled those workstations presenting problems to be spotted and the issues addressed.

([67]) Unpublished
([68]) Unpublished intervention by vhp human performance.

11 Conclusions and policy pointers

11.1 Conclusions for the workplace

Prolonged constrained standing is related to various serious health problems, including lower back pain, pain in the legs, foot and heel disorders, cardiovascular problems and fatigue. Although many jobs in Europe involve prolonged constrained standing, some entirely unnecessarily, much can be done to organise work to avoid and limit it and improve ergonomics and working conditions if standing work is performed. The factors identified in this report include the following:

- The most commonly used definitions of prolonged standing are more than 1 hour of continuous standing and/or a total of more than 4 hours of standing in a day.
- Unnecessary constrained standing should be avoided.
- Our next posture is the best posture. A good motto is 'sit when you need to, stand when you want to and walk or move when you can' (IWH, 2018). When standing is necessary, standing on a fixed spot should be substituted by more active or dynamic standing. A minibreak to move around every 30 minutes is important.
- The general approach to avoiding prolonged constrained standing at work should be through a prevention strategy that avoids unnecessary constrained standing, ensures good workplace ergonomics to limit standing and improve standing work, promotes movement at work and ensures worker participation. Adjustability of workstations, options to work in a variety of ways and workers being able to take breaks from standing work when needed are important. Finally, if constrained standing cannot be avoided, there are measures to alleviate its negative health effects, such as mats and cushioned insoles.
- As with all MSDs, early reporting of problems related to prolonged standing is important.

Key elements to be included in the prevention strategy are given in Box 19.

Box 19 Key elements that should be included in the prevention strategy

- **Provide a suitable ergonomic workstation and environmental conditions**, including an appropriate chair, stool and workstation: incorporating **adjustability** (of working height, seating, sit-stand workstations, cabins that can swivel, etc.) is important for safe and comfortable working. There must be sufficient space to be able to move and change standing posture when working standing up.
- **Organise work to limit standing**: balance the tasks to be performed and provide possibilities for task rotation, breaks when needed, etc., and give workers sufficient control over how they work, so that they can alter how they work and take a break when needed, including minibreaks. It may be useful to establish maximum standing times.
- **Choose an approach directed at active/dynamic work**: the approach should allow movement while standing to work.
- **Introduce additional measures to reduce risks if standing cannot be avoided**: for example, mats and cushioned insoles could be provide.
- **Encourage consultation and active worker involvement**: this is important for all aspects of the strategy.
- **Promote healthy behaviour**: this could be done for example through raising awareness of and providing training in prolonged standing and back-care programmes. This measure will be ineffective unless it is implemented together with the other elements mentioned previously.
- **Implement organisational policies and practices**: this is essential for ensuring that the prevention strategy is put into practice; for example, there should be measures in place so that workers can report problems with standing work.

11.2 Pointers for policy-makers

11.2.1 Prevention strategy and practice

- For the sustainability of work over the work-life course, prolonged static standing needs to be avoided if possible and reduced for all age groups.
- More dynamic ways of working, and alternating between standing, sitting and walking need to be promoted.
- Many workplace interventions are simple and low cost; however, employers must be provided with information to understand the basics. Good practices need to be shared.
- Guidelines on workstations and active working are needed, preferably sector- and subsector-specific guidelines. This includes simple, sector-specific resources for MSEs.
- Age and gender issues should be included in prevention approaches. One size does not fit all, especially when it comes to the ergonomics of standing work. More attention needs to be given to prevention of risks in constrained static standing jobs in which women predominate.
- Standing is not the opposite of sitting — moving is. Standing should not be just substituted for sitting in interventions to limit prolonged sitting.

11.2.2 Gaps in knowledge and research tools

- Improved data are needed on the extent of constrained standing work and MSDs linked to constrained standing work. Data need to distinguish between constrained standing and walking. Gender-disaggregated data are needed.
- More research is needed on the cause-effect relationship between exposure to prolonged standing and health problems.
- There is a need for research on the right mix of sitting, standing and walking, as well as more research on the effects of alternating postures and taking microbreaks. This needs to take account of the type of work and gender.
- With regard to pregnancy, more information is needed on the effects on the foetus, as well as on ergonomic and fatigue issues for the woman.
- Improved tools to assess prolonged constrained standing and static standing postures are needed.

11.3 Overall conclusions

Tackling prolonged standing at work is part of making work more sustainable. Work should provide good ergonomic working conditions, and work and workstations should be designed to avoid prolonged constrained standing if possible. If standing work is carried out, workers should be able to move around, stretch and vary their posture when standing and also to vary between standing, sitting and perching. They need to be able to take breaks to sit and move when needed. There are many simple and low-cost steps that MSEs can easily take to avoid and improve standing work.

Remember:
Our next posture is the best posture! Sit when you need to, stand when you want to and walk or move when you can.

12 References

Albayrak, A., van Veelen, M. A., Prins, J. F. et al., 'A newly designed ergonomic body support for surgeons', *Surgical Endoscopy*, 2007, Vol. 21, pp. 1835-1840. Available at: https://doi.org/10.1007/s00464-007-9249-1

Andersen, J. H., Haahr, J. P. and Frost, P., 'Risk factors for more severe regional musculoskeletal symptoms: a two-year prospective study of a general working population', *Arthritis & Rheumatology*, 2007, Vol. 56, No 4, pp. 1355-1364. Available at: https://doi.org/10.1002/art.22513

Arbocatalogus, Agrarische en Groene Sectoren, 'Staand werk' ['Standing work'], 2020. Available at: https://agroarbo.nl/catalogus/staand-werk/

Arbocatalogus Wijn, 'Juiste inrichting stawerkplek bij productie', undated. Available at: http://arbocatalogus.wijn.nl/arbo/Infobladen/staand_werk/juiste_inrichting_stawerkplek_bij_productie.php

ASSTSAS (Association paritaire pour la santé et la sécurité du travail du secteur affaires sociales), *Guide de prevention des troubles musculosquelettiques (TMS) en clinique dentaire* [*Prevention of work-related musculoskeletal disorders (MSDs) in dental clinics*], ASSTSAS, Montreal, 2007. Available at: https://asstsas.qc.ca/sites/default/files/publications/documents/Guides_Broch_Depl/GP50_TMS_cliniques_dentaires.pdf

BAuA (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin), *Up and down — Up and down: How dynamic sitting and standing can improve health in the office*, 2008. Available at: https://www.baua.de/DE/Angebote/Publikationen/Praxis/A65.html?__blob=publicationFile&v=9

Berger, H., Caffier, G., Schuiltz, K. and Trippler D., *Bewegungsergonomische Gestaltung von andauernder Steharbeit* [*Ergonomic design of continuous standing work*] (in German), LV50, LASI, Wiesbaden, Germany, 2009. Available at: https://lasi-info.com/publikationen/lasi-veroeffentlichungen?tx_ikanoslasipublications_publications%5Baction%5D=show&tx_ikanoslasipublications_publications%5Bcontroller%5D=Publication&tx_ikanoslasipublications_publications%5Bpublication%5D=34&cHash=8d25d41bcc1c5ce090d56f0ca627ce20

Brendler, C., Sauter, M. and Liebers, F., 'Stehen während der Arbeit und geschwollene Beine', Gemeinsame Jahrestagung der Deutschen Gesellschaft für Medizinische Soziologie (DGMS) und der Deutschen Gesellschaft für Sozialmedizin und Prävention (DGSMP), *Gesundheitswesen* 2019, Vol. 81, 670. Available at: https://doi.org/10.1055/s-0039-1694372

Canadian Women's Health Network, 'Preventing work-related injuries: Standing on the job', 2006. Available at: http://cwhn.ca/en/node/44781

CCOHS (Canadian Centre for Occupational Health and Safety), 'Working in a standing position — Basic information', OSH Answers Fact Sheet, 2016 Available at: https://www.ccohs.ca/oshanswers/ergonomics/standing/standing_basic.html

CCOHS (Canadian Centre for Occupational Health and Safety), 'Anti-fatigue mats', 2020a. Available at: https://www.ccohs.ca/oshanswers/ergonomics/mats.html

CCOHS (Canadian Centre for Occupational Health and Safety), 'Foot comfort and safety at work', 2020b Available at: https://www.ccohs.ca/oshanswers/prevention/ppe/foot_com.html

CDC (Centers for Disease Control and Prevention), '*2015 National Health Interview Survey (NHIS) — Public Use Data Release*', 2016. Available at: https://www.cdc.gov/nchs/nhis/index.htm

Chandrasakaran A., Chee, H. L., Rampal, K. G. and Tan, G. L. E., 'The prevalence of musculoskeletal problems and risk factors among women assembly workers in the semiconductor industry', *Medical Journal of Malaysia*, 2003, Vol. 58, No, 5, pp. 657-666. Available at: http://www.e-mjm.org/2003/v58n5/Musculoskeletal_Problems.pdf

Chee H. L. and Rampal K. G., 'Work-related musculoskeletal problems among women workers in the semiconductor industry in Peninsular Malaysia', *International Journal of Occupational and Environmental Health*, 2004, Vol. 10, No 1, pp. 63-71. Available at: https://www.tandfonline.com/doi/abs/10.1179/oeh.2004.10.1.63

Copsey, S., Anyfantis, I. and Buckle P., 'Carrying out participatory ergonomics', OSHwiki, 2021. Available at: https://oshwiki.eu/wiki/Carrying_out_participatory_ergonomics

Cornell University Ergonomics Web, 'Sitting and standing at work', undated. Available at: http://ergo.human.cornell.edu/cuesitstand.html

de Langen, N. and Peereboom, K., 'Musculoskeletal disorders and prolonged static sitting', OSHwiki, 2020a. Available at: https://oshwiki.eu/wiki/Musculoskeletal_disorders_and_prolonged_static_sitting

de Langen, N. and Peereboom, K., 'Promoting moving and exercise at work to avoid prolonged standing and sitting', OSHwiki, 2020b Available at https://oshwiki.eu/wiki/Promoting_moving_and_exercise_at_work_to_avoid_prolonged_standing_and_sitting

de Langen, N. and Peereboom, K., 'Musculoskeletal disorders and prolonged static standing', OSHwiki, 2020c. Available at: https://oshwiki.eu/wiki/Musculoskeletal_disorders_and_prolonged_static_standing

de Langen, N. and Peereboom, K., 'Musculoskeletal lower limb disorders', OSHwiki, 2020d. Available at: https://oshwiki.eu/wiki/Musculoskeletal_lower_limb_disorders

Department of Consumer and Employment Protection, *Industry guidance document: Checkout workstations in retail — safe design and work practices*, Department of Consumer and Employment Protection, Government of Western Australia, West Perth, 2005. Available from: https://www.commerce.wa.gov.au/sites/default/files/atoms/files/checkout_design.pdf

EC (European Commission), *Europe 2020 — A European strategy for smart, sustainable and inclusive growth*, 2010. Available at: https://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf

EC (European Commission), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on an EU strategic framework on health and safety at work 2014-2020, COM(2014) 332 final, 2014. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0332

EC (European Commission), Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Safer and healthier work for all — Modernisation of the EU occupational safety and health legislation and policy, COM(2017) 12 final, p. 9, 2017. Available at https://ec.europa.eu/social/BlobServlet?docId=16874&langId=en

EU-OSHA (European Agency for Safety and Health at Work), *Work-related musculoskeletal disorders (MSDs): An introduction*, E-Facts 9, 2007. Available at: https://osha.europa.eu/en/publications/e-facts/efact09/view

EU-OSHA (European Agency for Safety and Health at Work), *OSH in figures: Work-related musculoskeletal disorders in the EU — Facts and figures*, 2010. Available at: https://osha.europa.eu/en/publications/osh-figures-work-related-musculoskeletal-disorders-eu-facts-and-figures

EU-OSHA (European Agency for Safety and Health at Work), *Worker participation practices: A review of EU-OSHA case studies*, 2012a. Available at: https://osha.europa.eu/en/publications/worker-participation-practices-review-eu-osha-case-studies/view

EU-OSHA, (European Agency for Safety and Health at Work), *Worker participation in occupational safety and health — A practical guide*, 2012b, Available at: https://osha.europa.eu/en/publications/worker-participation-occupational-safety-and-health-practical-guide/view

EU-OSHA (European Agency for Safety and Health at Work), *New risks and trends in the safety and health of women at work: European Risk Observatory — Literature review*, 2013, Available at: https://osha.europa.eu/en/publications/reports/new-risks-and-trends-in-the-safety-and-health-of-women-at-work

EU-OSHA (European Agency for Safety and Health at Work), *The ageing workforce: Implications for occupational safety and health — A research review*, 2016, Available at: https://osha.europa.eu/en/publications/ageing-workforce-implications-occupational-safety-and-health-research-review-0/view

EU-OSHA (European Agency for Safety and Health at Work), *Healthy workers, thriving companies — A practical guide to wellbeing at work*, 2018. Available at: https://osha.europa.eu/en/publications/healthy-workers-thriving-companies-practical-guide-wellbeing-work/view

EU-OSHA (European Agency for Safety and Health at Work), *Work-related musculoskeletal disorders: Prevalence, costs and demographics in the EU*, 2019. Available at: https://osha.europa.eu/en/publications/msds-facts-and-figures-overview-prevalence-costs-and-demographics-msds-europe/view

EU-OSHA (European Agency for Safety and Health at Work), *Preventing musculoskeletal disorders in a diverse workforce: risk factors for women, migrants and LGBTI workers*, 2020a Available at: https://osha.europa.eu/en/publications/preventing-musculoskeletal-disorders-diverse-workforce-risk-factors-women-migrants-and/view

EU-OSHA (European Agency for Safety and Health at Work), *Body and hazard mapping in the prevention of musculoskeletal disorders (MSDs)*, 2020b. Available at: https://osha.europa.eu/en/publications/body-and-hazard-mapping-prevention-musculoskeletal-disorders-msds/view

EU-OSHA (European Agency for Safety and Health at Work), *Prolonged static sitting at work — health effects and good practice advice*, 2021a. Available at: https://osha.europa.eu/en/publications/prolonged-static-sitting-work-health-effects-and-good-practice-advice/view

EU-OSHA (European Agency for Safety and Health at Work), Get moving at work, 2021b. Available at: https://osha.europa.eu/en/publications/get-moving-work/view

EU-OSHA (European Agency for Safety and Health at Work), Working with chronic musculoskeletal *disorders — Good practice advice*, 2021c. Available at: https://osha.europa.eu/en/publications/working-chronic-msds-good-practice-advice/view

EU-OSHA (European Agency for Safety and Health at Work) 'Practical tools and guidance on musculoskeletal disorders — Hazards', 2021d. Available at: https://osha.europa.eu/en/themes/musculoskeletal-disorders/practical-tools-musculoskeletal-disorders?f%5B0%5D=field_hazards%3A4409

Eurofound (European Foundation for the Improvement of Living and Working Conditions), *Fourth European Working Conditions Survey*, 2007. Available at: https://www.eurofound.europa.eu/publications/report/2007/working-conditions/fourth-european-working-conditions-survey

Eurofound, (European Foundation for the Improvement of Living and Working Conditions), 'Fifth Working Conditions Survey — 2010', 2010. Available at: https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/fifth-european-working-conditions-survey-2010

Eurofound (European Foundation for the Improvement of Living and Working Conditions), 'Sixth European Working Conditions Survey: 2015', 2015. Available at: https://www.eurofound.europa.eu/surveys/european-working-conditions-surveys/sixth-european-working-conditions-survey-2015

Eurostat, 'Sit at work? You are one of 39 %', 2019. Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190305-1

Federal Public Service Employment, Labour and Social Dialogue, *Prévention des troubles musculosquelettiques (TMS) pour le coiffeur* [*Prevention of musculoskeletal disorders (MSD) for the hairdresser*], 2013. Available at: http://www.emploi.belgique.be/publicationDefault.aspx?id=39688

Gallagher, K. M., Campbell, T. and Callaghan, J. P., 'The influence of a seated break on prolonged standing induced low back pain development', *Ergonomics*, 2014, Vol. 57, No 4, pp. 555-562. Available at: https://doi.org/10.1080/00140139.2014.893027

Garcia, M.-G., Läubli, T. and Martin, B. J., 'Long-term muscle fatigue after standing work', *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 2015, Vol. 57, No 7, pp. 1162-1173. Available at: https://doi.org/10.1177/0018720815590293

Gerhardsson, L. and Lillienberg, L., *Guidelines for assessment of working and environmental risks during pregnancy*, The Sahlgrenska University Hospital, Gothenburg, 2020. Available at: https://www.amm.se/wp-content/uploads/2020/12/Guidelines-for-assessment-of-working-and-environmental-risks-during-pregnancy.pdf

Gezond and Zeker, 'Statische belasting', 2015. Available at: https://www.blijfinzetbaar.nl/wp-content/uploads/2018/02/Gezond-en-Zeker-Blijf-inzetbaar-poster-praktijkrichtlijn-statische-belasting-1.pdf

Government of Ontario, 'Whole-body vibration', Government of Ontario, 2019. Available at: https://www.ontario.ca/page/whole-body-vibration

Halim, I. and Omar, A. R., 'A review on health effects associated with prolonged standing in the industrial workplaces', *International Journal of Recent Research and Applied Studies*, 2011, Vol. 8, No 1, pp. 14-21. Available at: www.arpapress.com/Volumes/Vol8Issue1/IJRRAS_8_1_03.pdf

Halim, I. and Omar, A. R., 'Development of prolonged standing strain index to quantify risk levels of standing jobs, *International Journal of Occupational Safety and Ergonomics*, 2015, Vol. 18, No 1, pp. 85-96. Available at: https://doi.org/10.1080/10803548.2012.11076917

Harkness E. F., Macfarlane G. J., Nahit E. S., Silman A. J. and McBeth J., 'Risk factors for new-onset low back pain amongst cohorts of newly employed workers', *Rheumatology*, 2003, Vol. 42, No 8, pp. 959-968. Available at: https://academic.oup.com/rheumatology/article/42/8/959/1774115

Hazards, 'Standing problem', *Hazards*, 91, 2005. Available at: http://www.hazards.org/standing/

Health Council of the Netherlands, *Gezondheidsraad* [*Standing, kneeling and squatting work*], Health Council of the Netherlands, The Hague, 2011. Available at: https://www.gezondheidsraad.nl/documenten/adviezen/2011/12/23/staand-geknield-en-gehurkt-werken

Health Service Executive, 'Backache and pain in pregnancy', Health Service Executive, Ireland, 2018. Available at: https://www2.hse.ie/conditions/child-health/back-ache-and-pain-in-pregnancy.html

Healthy Hairdresser, 'De Kappersfiets', undated. Available at: https://healthyhairdresser.nl/gezond-werken-regels/inrichting/kappersfiets

Herramental, '4 Recomendaciones para Realizar Trabajos de Pie', 2018. Available at: https://www.herramental.com.mx/4-recomendaciones-para-realizar-trabajos-de-pie/

HSE (Health and Safety Executive), *Seating at Work*, 2011. Available at: https://www.hse.gov.uk/pUbns/priced/hsg57.pdf

HSE (Health and Safety Executive), *New and expectant mothers who work — A brief guide to your health and safety*, 2013a. Available at: https://www.hse.gov.uk/pubns/indg373.pdf

HSE (Health and Safety Executive), *Workplace health, safety and welfare: Workplace (Health, Safety and Welfare) Regulations 1992 — Approved Code of Practice and guidance*, 2013b. Available at: http://www.hse.gov.uk/pubns/priced/l24.pdf

HSE (Health and Safety Executive), 'Work-related illness — Type of illness (LFSILLTYP)', 2020. Available at: https://www.hse.gov.uk/statistics/lfs/lfsilltyp.xlsx

ILO and IEA (International Labour Office and International Ergonomics Association), *Ergonomic checkpoints: Practical and easy-to-implement solutions for improving safety, health and working conditions,* International Labour Office, Geneva, 2010. Available at: https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/instructionalmaterial/wcms_178593.pdf

ILO and IEA (International Labour Office and International Ergonomics Association), *Ergonomic checkpoints in agriculture,* International Labour Office, Geneva, 2014. Available at: https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/instructionalmaterial/wcms_176923.pdf

INRS (Institut National de la Recherche et de la Sécurité), 'Lombalgie: Statistique', 2018. Available at: http://www.inrs.fr/risques/lombalgies/statistique.html

Inspectie SZW, *Basis inpectiemodule Fysieke belasting — Werkplekinrichting*, 2012. Available at: https://www.inspectieszw.nl/publicaties/richtlijnen/2012/06/15/bim-fysieke-belasting-werkplekinrichting

Inspectie SZW, *Basisinspectiemodule Fysieke belasting — Werkhouding*, 2015. Available at: https://www.inspectieszw.nl/publicaties/richtlijnen/2015/06/15/bim-fysieke-belasting-werkhouding

IWH (Institute for Work and Health), 'Workers who stand on the job most of the time are at greater risk of heart disease than workers who predominantly sit', *At Work*, Issue 90, 2017. Available at https://www.iwh.on.ca/newsletters/at-work/90/standing-too-long-at-work-carries-twice-the-risk-of-heart-disease-as-sitting-too-long

IWH (Institute for Work and Health), *Sitting or standing? Which is best?*, 2018. Available at: https://www.youtube.com/watch?v=DXRZLJ8fh5w&feature=youtu.be

King, P. M. 'A comparison of the effects of floor mats and shoe in-soles on standing fatigue', *Applied Ergonomics,* 2002, Vol. 33, No 5, pp. 477-484. Available at: https://doi.org/10.1016/s0003-6870(02)00027-3

Lutgendorf, M. and Peereboom, K., *Zittend en staand werken - Richtlijnen voor een goede inrichting van de werkplek (Arboinformatie-08)* [*Sitting and standing work Guidelines for good workplace design (Arboinformatie-08)*] 6th revised edition, SDU Publishers, The Hague, 2012.

Martin, J., Budavölgyi, A., Lászlóffy, M. and Kudász, F., 'Vibration', OSHwiki, 2017. Available at: https://oshwiki.eu/wiki/Vibration

McCulloch, J., 'Health risks associated with prolonged standing', *Work*, 2002, Vol. 19, pp. 201-205.

Messing K., Tissot F. and Stock S., 'Distal lower-extremity pain and work postures in the Quebec population', *American Journal of Public Health*, 2008, Vol. 98, No 4, pp. 705-713. Available at: https://ajph.aphapublications.org/doi/10.2105/AJPH.2006.099317

Messing, K., Stock, S., Côté, J. and Tissot, F., 'Is sitting worse than static standing? How a gender analysis can move us toward understanding determinants and effects of occupational standing and walking', *Journal of Occupational and Environmental Hygiene*, 2015, Vol. 12, No 3, pp. D11-D17. Available at: https://doi.org/10.1080/15459624.2014.987388

Ministerie van Soziale Zaken en Werkgelegenheid, 'Staand Werk', undated. Available from: https://www.arboportaal.nl/onderwerpen/statische-werkhouding-staan

Modint, *Arbocatalogus: Retail mode, schoenen en sport* [*Working conditions catalogue for fashion shops*], 2020. Available at: https://www.inretail.nl/Uploaded_files/Zelf/arbocatalogus-retail-mode-schoenen-sport.902396.pdf

NHS Plus and RCP FOM (Royal College of Physicians Faculty of Occupational Medicine), *Physical and shift work in pregnancy: Occupational aspects of management — A national guideline*, RCP, London, 2009. Available from: https://www.nhshealthatwork.co.uk/images/library/files/Clinical%20excellence/Pregnancy-FullGuidelines.pdf

NTNU (Norwegian University of Science and Technology), 'Ergonomics in the laboratory', undated. Available at: https://innsida.ntnu.no/wiki/-/wiki/English/Ergonomics±in±the±laboratory

Nurse Theory, '9 best compression socks for nurses', undated. Available at: https://www.nursetheory.com/best-compression-socks/

Occupational Health Clinics for Ontario Workers, *Working on your feet*, undated. Available at: https://www.ohcow.on.ca/edit/files/general_handouts/WorkingonYourFeet.pdf

Occupational Safety and Health Branch, Labour Department, *Guidance notes on standing at work and service counter design*, Labour Department, Government of Hong Kong, 2018. Available at: https://www.labour.gov.hk/eng/public/oh/GN_Standing_at_work_en.pdf

OHS Reps, 'Working standing up', 2020. Available at: https://www.ohsrep.org.au/working_standing_up

Okunribido, O., *Lower limb MSD — Scoping work to help inform advice and research planning*, Health and Safety Executive, Buxton, United Kingdom, 2009. Available at: https://www.hse.gov.uk/research/rrpdf/rr706.pdf

Palmer, K. T., Bonzini, M., Harris, E. C., Linaker, C. and Bonde, J. P., 'Work activities and risk of prematurity, low birth weight and pre-eclampsia: an updated review with meta-analysis', *Occupational & Environmental Medicine*, 2013, Vol. 70, No 4, pp. 213-222. Available at: https://doi.org/10.1136/oemed-2012-101032

Paul, J. A. and Frings-Dresen, M. H. W., 'Standing working posture compared in pregnant and non-pregnant conditions', *Ergonomics*, 1994, Vol. 37, No 9, pp. 1563-1575. Available at: https://doi.org/10.1080/00140139408964934

RCP FOM (Royal College of Physicians Faculty of Occupational Medicine), *Advising women with a healthy, uncomplicated, singleton pregnancy on: prolonged standing at work and the risk of miscarriage, preterm delivery and small for gestational age*, undated. Available at: https://www.nhshealthatwork.co.uk/images/library/files/Clinical%20excellence/6223_Pregnancy_info_standing.pdf

Safe Work Australia, *National Hazard Exposure Worker Surveillance: Exposure to biomechanical demands, pain and fatigue symptoms and the provision of controls in Australian workplaces*, Canberra, 2011. Available at: https://www.safeworkaustralia.gov.au/doc/national-hazard-exposure-worker-surveillance-exposure-biomechanical-demands-pain-and-fatigue

Safe Work Australia, *Guide to managing risks of exposure to whole-body vibration in workplaces*, 2016a. Available at: https://www.safeworkaustralia.gov.au/system/files/documents/1703/guidetomanagingrisksofexposuretowholebodyvibration.docx

Safe Work Australia, *Whole-body vibration information sheet*, 2016b. Available from: https://www.safeworkaustralia.gov.au/system/files/documents/1703/wholebodyvibrationinformationsheet.pdf

SECO, *Stehen bei der Arbeit*, Staatssekretariat für Wirtschaft SECO, 2016. Available at: https://www.bundespublikationen.admin.ch/cshop_mimes_bbl/8C/8CDCD4590EE41EE697F69D6CF6B0600F.pdf

Sisto T, Reunanen A, Laurikka J, Impivaara O, Heliövaara M, Knekt P, Aromaa A. 'Prevalence and risk factors of varicose veins in lower extremities: mini-Finland health survey', *European Journal of Surgery*, 1995, Vol 161, No 6, pp 405-14. Available at: https://pubmed.ncbi.nlm.nih.gov/7548376/

Smith, P., Ma, H., Glazier, R. H., Gilbert-Ouimet, M. and Mustard, C., 'The relationship between occupational standing and sitting and incident heart disease over a 12-year period in Ontario, Canada', *American Journal of Epidemiology*, 2018, Vol. 187, No 1, pp. 27-33. Available at: https://academic.oup.com/aje/article/187/1/27/4081581

Snijder, C. A., Brand, T., Jaddoe, V., Hofman, A., Mackenbach, J. P., Steegers, E. A. P. and Burdorf, A., 'Physically demanding work, fetal growth and the risk of adverse birth outcomes. The Generation R Study', *Occupational & Environmental Medicine*, 2012, Vol. 69, No 8, pp. 543-550. Available at: https://doi.org/10.1136/oemed-2011-100615

Sociaal Fonds Particuliere Beveiliging, *Resultaat onderzoek bij aanbevelingen statijden, 2015/2016*, 2016. Available at: https://www.beveiligingsbranche.nl/upload/bestanden/Downloads/Rapport%20resultaat%20onderzoek%20bij%20aanbevelingen%20statijden.pdf

Suva, *Sitzen oder stehen? Ergonomische Gestaltung von Arbeitsplätzen* [*Sit or stand? Ergonomic design of workplaces*] (in German), Suva, Luzern, 2005. Available at: http://www.sohf.ch/Themes/Ergo/44075_D.pdf

Swedish Work Environment Authority, *Ergonomics for the prevention of musculoskeletal disorders: Provisions of the Swedish National Board of Occupational Safety and Health on Ergonomics for the Prevention of Musculoskeletal Disorders, together with the Board's general recommendations on the implementation of the provisions*, 1998. Available at: https://www.av.se/globalassets/filer/publikationer/foreskrifter/engelska/ergonomics-for-the-prevention-of-musculoskeletal-disorders-afs-2012-2.pdf

Tabatabaeifar, S., Frost, P., Andersen, J. H., Jensen, L. D., Thomsen, J. F. and Svendsen, S. W., 'Varicose veins in the lower extremities in relation to occupational mechanical exposures: a longitudinal study', *Occupational & Environmental Medicine*, 2015, Vol. 72, No 5, pp. 330-337. Available at: https://doi.org/10.1136/oemed-2014-102495

Tissot, F., Messing, K and Stock S., 'Standing, sitting and associated working conditions in the Quebec population in 1998', *Ergonomics*, 2005, Vol. 48, No 3, pp. 249-269. Available at: https://doi.org/10.1080/00140130512331326799

TNO, *Haute cuisine op geode hoogte*, 2014 Available at: https://www.fysiekebelasting.tno.nl/cms/content/assets/uploads/2018/01/111TNOgl_Horeca_web.pdf

Trainer, G., 'How to stand for long periods without getting back pain', Netdoctor, 2019. Available at: https://www.netdoctor.co.uk/healthy-living/a26730/how-stand-for-long-periods-without-getting-back-pain/

Tüchsen, F., Krause, N., Hannerz, H., Burr, H. and Kristensen, T. S., 'Standing at work and varicose veins', *Scandinavian Journal of Work, Environment & Health*, 2000, Vol. 26, No 5, pp. 414-420. Available at: https://doi.org/10.5271/sjweh.562

TU Delft, 'DINED/Anthropometry in design', 2020. Available at: https://dined.io.tudelft.nl/en

Ullman, R., '6 New habits for hairdressers who stand all day' Modern Salon, 2014. Available at: https://www.modernsalon.com/368146/6-new-habits-for-hairdressers-who-stand-all-day

Vad, M. V., Frost, P., Rosenberg, J., Andersen, J. H. and Svendsen, S. W., 'Inguinal hernia repair among men in relation to occupational mechanical exposures and lifestyle factors: a longitudinal study', *Occupational & Environmental Medicine*, 2017, Vol. 74, No 11, pp. 769-775. Available at: https://doi.org/10.1136/oemed-2016-104160

Waters, T. R. and Dick, R. B., 'Evidence of health risks associated with prolonged standing at work and intervention effectiveness', *Rehabilitation Nursing*, 2015, Vol. 40, No 3, pp. 148-165. Available at: https://doi.org/10.1002/rnj.166

Wittig, P., Nöllenheidt, Ch. and Brenscheidt, S., *Grundauswertung der BIBB/BAuA-Erwerbstätigenbefragung 2012*, BAuA, Dortmund/Berlin/Dresden, 2013. Available at: https://www.baua.de/DE/Angebote/Publikationen/Berichte/Gd73.pdf?__blob=publicationFile&v=2

Woolf, A., 'Working with rheumatic and musculoskeletal diseases (RMDs)', OSHwiki, 2019. Available at: https://oshwiki.eu/wiki/Working_with_rheumatic_and_musculoskeletal_diseases_(RMDs)

Workers Health & Safety Centre, *Prolonged standing: Taking the load off*, undated. Available at: http://www.whsc.on.ca/Files/Resources/Hazard-Resource-Lines/Prolonged-Standing-WHSC-Resource-Line

Yeomans, L., *An update of the literature on age and employment*, Health and Safety Executive, Buxton, United Kingdom, 2011. Available at: http://www.hse.gov.uk/research/rrpdf/rr832.pdf

13 Abbreviations

BAuA	Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (German Federal Institute for Occupational Safety and Health)
BIBB	Bundesinstitut für Berufsbildung (German Federal Institute for Vocational Education and Training)
EN	European Norm
EU	European Union
EU-OSHA	European Agency for Safety and Health at Work
EWCS	European Working Conditions Survey
HSE	Health and Safety Executive
ILO	International Labour Office
ISO	International Organisation for Standardisation
IWH	Institute for Work and Health
LASI	Länderausschuss für Arbeitsschutz und Sicherheitstechnik (German Federal Committee on Occupational Safety and Health)
MSD	musculoskeletal disorder
MSEs	micro and small enterprises
NIOSH	National Institute for Occupational Safety and Health
OSH	occupational safety and health
PSSI	Prolonged Standing Strain Index
VDU	visual display unit
WBV	whole-body vibration

Appendix 1 Methodology

The study explored what prolonged standing is, the health effects and prevention practice to avoid and reduce the risks. To do this, it addressed the following research questions:

1. Which types of MSDs are to what extent caused by prolonged static postures while standing?
2. Which types of non-MSD health complaints are to what extent caused by prolonged static postures while standing?
3. In what way do MSD-type complaints and non-MSD-type complaints interfere with, and consequently strengthen or weaken, each other's effects?
4. What definition of standing should be used in order to understand the cause-effect relation in a proper manner?
5. What can be considered a 'safe' threshold exposure times for guidelines on standing?
6. Which prevention practice approach is successful, to what extent and how does this relate to the type(s) of MSD and/or non-MSD complaints that have been identified?
7. Which types of prevention practice approach are focusing on promoting physical activity are considered successful?
8. Which target audiences can best be approached with which type of prevention strategies?

Regarding questions 1-6, a study was performed on 107 of selected sources of information that had been identified (listed in Appendix 2). Regarding prevention practice and guidelines, reference was also made to grey literature and campaigns. The results were incorporated into a cause-health effect model for both MSD and non-MSD health effects (section 4.6).

Regarding questions 7 and 8, a prevention practice overview was conducted, focusing on avoiding prolonged constrained standing. This provides an overview of good practice recommendations in relation to avoiding prolonged standing work and promoting dynamic standing and working.

A number of these prevention practices have been included in the report and additional resources on prevention practice were identified using the four steps listed below:

1. Gathering available and known sources containing knowledge and/or tools on (prolonged) standing and promoting physical activity at work. This included the following sources:
   - the results of a consultation of EU-OSHA focal points on MSD prevention tools;
   - resources identified for the EU-OSHA toolbox with practical resources for MSDs prevention (EU-OSHA, 2021d);
   - consultation of OSH specialists, including vhp human performance (Netherlands), NOFER (Poland), (BIT Bochum (BRD), EUROGIP (France), IKEI (SP), Oxford research (Denmark), Norway, Sweden, Latvia, Finland, Poland) and OMFI (Hungarian Institute of Occupational Health (Hungary)) and other specialists in European Economic Area (EEA) countries.
   - ETUI and ETUC (trade union bodies) and similar contacts in countries including the United States, Australia and New Zealand, Institute of Work and Health (IWH) Canada, INRS (France), DGUV (Germany), INSSBT (Spain), OSHA and NIOSH (United States). The Dutch Labour Foundation (Netherlands), BAuA (Germany), Central Institute for Labour Protection (CIOP) (Poland), National Research Centre for the Working Environment (NRCWE) (Denmark), National Institute for Safety and Hygiene at Work (INSHT) (Spain), Työterveyslaitos (Finnish Institute of Occupational Health (FIOH)) (Finland), Hellenic Institute for Occupational Health and Safety (ELINYAE) (Greece), HSE (United Kingdom) were also consulted.
2. Additional extensive internet searches were performed using an agreed keywords strategy. The following search terms were used:
   - standing, static standing, types of standing, prolonged constrained standing, sedentary, seated.

   Combined with and/or search-term combinations comprising:
   - MSD, musculoskeletal disorders, lower limb disorders, back problems, upper limb disorders, health complaints, pain, cardiovascular disorders, diabetes, mortality, physical activity at work,

exercise at work, physical activity at work, prevention practice, dynamic office work, risks in the workplace, guidelines, retail work, factory/production line work, construction work, office work, occupational safety, stretching, breaks, health-promotion, workstation design, woman/female workers, MSE, good practice recommendations, work organisation, job rotation, (office) chair, stool, support, tasks, work equipment, reach envelope, (sit/stand) table, adjustable, design for all, anthropometrics, human size, (active) lifestyle. Note that meniscus knee type of MSDs are much more related to turning and twisting knees as this occurs in squatting and kneeling rather than related to standing.

To prevent mixing up causes and effects kneeling and squatting are excluded in this report.

Within the search context the following issues were specifically taken into account:

- specific jobs known for working while standing, such as: teaching staff, production line workers, installation, service workers, policeman, retail staff, catering/waiting staff, machine operators, assembly line workers, construction workers, checkout operators, hairdressers/barbers, dental staff, casino croupiers, traffic wardens, postal workers/sorters, bar/hospitality staff, industrial ticket collectors, laundry staff, museum staff, healthcare workers, nursery staff, library assistants, reception staff, meeter-greeters, warehouse staff, canvassers, cleaners, bank staff, flight attendants, janitorial staff, maintenance workers, cabin staff with ferry operators, personal trainers, security workers, dockers, laboratory technicians, leather cutters, baggage handlers, gardeners, order pickers, hair stylists, hotel desk clerks, florists;
- influences of gender-specific issues relevant to women workers and working while standing
- actions focused on standing workstations (work organisation, breaks, tasks, work equipment, exercise and stretching at work, workplace health promotion, etc.);
- steps employers can take to encourage more active lifestyles in workers both at work and outside the workplace;
- more dynamic ways of standing to allow for postural change and ways of reducing long periods of time spent standing without a break;
- introduction or facilitation of a more active workplace situation (sit-stand, use adjustability);
- suitability for telework (working at home);
- issues related to prolonged standing and inactivity in schools;
- identifying advice that is suitable for both MSEs and larger companies, and in particular, simple steps that MSEs could take that would be practical and easy-to-implement.

3. To identify any gaps and examine good practice guidance and recommendations on avoiding and minimising the risks from prolonged constrained standing at work, members of the Centre for Registration of European Ergonomists (CREE) network and national experts in EU countries were consulted. This helped to guarantee that prevention practice was included from ~~both~~ a broad spectrum of EU Member States.

4. Consultation of experts and quality control on the cause-effect model, preventive measures and on the formulated guidelines on prolonged seated work (thresholds).

Assessments on the suitability of the gathered prevention practices for MSEs were performed. This included checking they:

- secured the involvement of workers;
- were cost effective;
- were time effective;
- required the minimum amount of paperwork;
- were low on text and high on pictures and images;
- did not require experts for deployment;
- were easy to apply;
- produced quick and simple results;
- satisfied statutory requirements.

Appendix 2 Sources of evidence used for the health effects of prolonged constrained sitting model

The model presented in section 3.3 and Figure 2 is based on a short review of the 107 scientific publications listed below.

Aldington, S., Pritchard, A., Perrin, K., James, K., Wijesinghe, M. and Beasley, R., 'Prolonged seated immobility at work is a common risk factor for venous thromboembolism leading to hospital admission', *Internal Medicine Journal*, 2008, Vol. 38, pp. 133-135. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1445-5994.2007.01597.x

Andersen, J. H., Haahr, J. P. and Frost, P., 'Risk factors for more severe regional musculoskeletal symptoms: A two-year prospective study of a general working population', *Arthritis & Rheumatism*, 2007, Vol. 56, No 4, pp. 1355-1364. Available at: https://doi.org/10.1002/art.22513

Bailey D. P. and Locke C. D., 'Breaking up prolonged sitting with light-intensity walking improves postprandial glycemia, but breaking up sitting with standing does not', *Journal of Science and Medicine in Sport/Sports Medicine Australia*, 2015, Vol. 18, No 3, pp. 294-298. Available at: https://pubmed.ncbi.nlm.nih.gov/24704421/

Bener, A., El-rufaie, O. F., Siyam, A., Abuzeid, M. S. O., Toth, F. and Lovasz, G., 'Epidemiology of low back pain in the United Arab Emirates', *APLAR Journal of Rheumatology,* 2004, Vol. 7, No 3, pp. 189-195. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1479-8077.2004.00093.x

Biswas, A., Oh, P. I., Faulkner, G. E., Bajaj, R. R. Silver, M. A., Mitchell, M. S. and Alter, D. A., 'Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis', *Annals of internal medicine*, 2015, Vol. 162, No 2, pp. 123-132. Available at: https://www.ncbi.nlm.nih.gov/pubmed/25599350

Bonde, J. P., Jørgensen, K. T., Bonzini, M. and Palmer, K. T., 'Miscarriage and occupational activity: a systematic review and meta-analysis regarding shift work, working hours, lifting, standing, and physical workload', *Scandinavian Journal of Work, Environment & Health*, 2012, Vol. 39, No 4, pp. 325-334. Available at: https://www.ncbi.nlm.nih.gov/pubmed/23235838

Brocklebank, L. A., Falconer, C. L., Page, A. S., Perry, R. and Cooper, A. R., 'Accelerometer-measured sedentary time and cardiometabolic biomarkers: A systematic review' *Preventive Medicine*, 2015, Vol. 76, pp. 92-102. Available at: https://www.sciencedirect.com/science/article/pii/S0091743515001206?via%3Dihub

Brulin, C., Gerdle, B., Granlund, B., Höög, J., Knutson, A. and Sundelin, G., 'Physical and psychosocial work-related risk factors associated with musculoskeletal symptoms among home care personnel', *Scandinavian Journal of Caring Sciences,* 1998, Vol. 12, No 2, pp. 104-110. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1471-6712.1998.tb00483.x

Buckley, J. P., Mellor, D. D., Morris, M. and Joseph, F., 'Standing-based office work shows encouraging signs of attenuating post-prandial glycaemic excursion', *Occupational & Environmental Medicine,* 2014, Vol. 71, No 2, pp.109-111. Available at: https://oem.bmj.com/content/71/2/109

Buman, M. P., Winkler, E. A. H., Kurka, J. M., Hekler, E. B., Baldwin, C. M., Owen, N., Ainsworth, B. E., Healy, G. N. and Gardiner, P. A., 'Reallocating time to sleep, sedentary behaviors, or active behaviors: Associations with cardiovascular disease risk biomarkers, NHANES 2005-2006', *American Journal Epidemiology,* 2014, Vol. 179, pp. 323-34. Available at: https://academic.oup.com/aje/article/179/3/323/104536

CCOHS (Canadian Centre of Occupational Health and Safety) , 'Working in a standing position — Basic information', OSH Answers Fact Sheets, 1997-2020. Available at: https://www.ccohs.ca/oshanswers/ergonomics/standing/standing_basic.html

Chandrasakaran A., Chee, H. L., Rampal, K. G. and Tan, G. L. E., 'The prevalence of musculoskeletal problems and risk factors among women assembly workers in the semiconductor industry', *Medical Journal of Malaysia*, 2003, Vol. 58, No 5, pp. 657-666. Available at: http://www.e-mjm.org/2003/v58n5/Musculoskeletal_Problems.pdf

Chastin S. F. M., Mandrichenko, O., Helbostadt, J. L. and Skelton, D. A., 'Associations between objectively-measured sedentary behaviour and physical activity with bone mineral density in adults and older adults, the NHANES study', *Bone*, 2014, Vol. 64, pp. 254-262. Available at: https://www.sciencedirect.com/science/article/abs/pii/S8756328214001446?via%3Dihub

Chastin, S. F. M., Mandrichenko, O. and Skelton, D., 'The frequency of osteogenic activities and the pattern of intermittence between periods of physical activity and sedentary behaviour affects bone mineral content: the cross-sectional NHANES study', *BMC Public Health*, 2014, Vol. 14, 4. Available at: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-14-4

Chastin, S. F. M., Egerton, T., Leask, C. and Stamatakis, E., 'Meta-analysis of the relationship between breaks in sedentary behaviour and cardiometabolic health. *Obesity*, 2015, Vol. 23, No 9, pp. 1800-1810. Available at: https://onlinelibrary.wiley.com/doi/full/10.1002/oby.21180

Chau, J. Y., Grunseit, A. C., Chey, T., Stamatakis, E., Brown, W. J., Matthews, C. E., Bauman, A. E. and van der Ploeg, H. P., 'Daily sitting time and all-cause mortality: A meta-analysis', *PLoS ONE*, 2013, Vol. 8, No 11, e80000. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0080000

Chau, J. Y., Grunseit, A., Midthjell, K., Holmen, J., Holmen, T. L., Bauman, A. E. and Van der Ploeg, H. P., 'Sedentary behaviour and risk of mortality from all-causes and cardiometabolic diseases in adults: evidence from the HUNT3 population cohort', *British Journal of Sports Medicine,* 2015, Vol. 49, No 11, pp. 737-742. Available at: https://bjsm.bmj.com/content/49/11/737

Chee H. L. and Rampal K. G., 'Work-related musculoskeletal problems among women workers in the semiconductor industry in Peninsular Malaysia', *International Journal of Occupational and Environmental Health*, 2004, Vol. 10, No 1, pp. 63-71. Available at: https://www.tandfonline.com/doi/abs/10.1179/oeh.2004.10.1.63

Chen, S.-M., Liu, M.-F., Cook, J., Bass, S. and Lo, S. K., 'Sedentary lifestyle as a risk factor for low back pain: a systematic review', *International Archives of Occupational and Environmental Health*, 2009, Vol. 82, No 7, 797-806. Available at: https://doi.org/10.1007/s00420-009-0410-0

Church, T. S., Thomas, D. M., Tudor-Locke, C., Katzmarzyk, P. T., Earnest, C. P., Rodarte, R. Q., Martin, C. K., Blair, S. N. and Bouchard, C., 'Trends over 5 decades in U.S. occupation-related physical activity and their associations with obesity', *PLoS ONE*, 2011, Vol. 6, No 5, e19657. Available at: https://journals.plos.org/plosone/article/comments?id=10.1371/journal.pone.0019657

Cong, Y. J., Gan, Y., Sun, H. L., Deng, J., Cao, S. Y., Xu, X. and Lu, Z. X., 'Association of sedentary behaviour with colon and rectal cancer: a meta-analysis of observational studies', *British Journal of Cancer*, 2014, Vol. 110, pp. 817-826. Available at: https://www.nature.com/articles/bjc2013709

Costigan, S. A., Barnett, L., Plotnikoff, R. C. and Lubans, D. R., 'The health indicators associated with screen-based sedentary behaviour among adolescent girls: a systematic review', *Journal of Adolescent Health*, 2013, Vol. 52, pp. 382-392. Available at: https://www.jahonline.org/article/S1054-139X(12)00324-2/fulltext

De Rezende, Rey-López, J. P., Matsudo, V. K. R. and Luiz, O. do C., 'Sedentary behavior and health outcomes among older adults: A systematic review', *BMC Public Health*, 2014, Vol. 14, 333. Available at: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-14-333

De Rezende, Rodrigues Lopes, M., Rey-López, J. P., Matsudo, V. K. R., & Luiz, O. do C., 'Sedentary behavior and health outcomes: An overview of systematic reviews', *PLoS ONE*, 2014, Vol. 9, No 8, e105620. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0105620

Dogra S. and Stathokostas L., 'Sedentary behavior and physical activity are independent predictors of successful aging in middle-aged and older adults', *Journal of Aging Research*, 2012, Vol. 20, pp. S250-S51. Available at: https://www.hindawi.com/journals/jar/2012/190654/

Drury, C. G., Hsiao, Y. L., Joseph, C., Joshi, S., Lapp, J. and Pennathur, P. R., 'Posture and performance: sitting vs. standing for security screening', *Ergonomics*, 2008, Vol. 51, No 3, pp. 290-307. Available at: https://doi.org/10.1080/00140130701628790

Dunstan, D. W., Salmon, J., Owen, N., Armstrong, T., Zimmet, P. Z., Welborn, T. A., Cameron, A. J., Dwyer, T. Jolley, D. and Shaw, J. E., 'Associations of TV viewing and physical activity with the metabolic syndrome in Australian adults', *Diabetologia*, 2005, Vol. 48, pp. 2254-2261. Available at: https://link.springer.com/article/10.1007%2Fs00125-005-1963-4

Dunstan, D. W., Kingwell, B. A., Larsen, R., Healy, G. N., Cerin, E., Hamilton, M. T., Shaw, J. D., David A. Bertovic, D. A., Zimmet, P. Z., Salmon, J. and Owen, N., 'Breaking up prolonged sitting reduces postprandial glucose and insulin responses', *Diabetes Care*, 2012, Vol. 35, No 5, pp. 976-983. Available at: https://care.diabetesjournals.org/content/35/5/976

Edwardson, C. L., Gorely, T., Davies, M. J., Grey, L. J., Khunti, K., Wilmot, E. G., Yates, T. and Biddle, S. J. H., 'Association of sedentary behaviour with metabolic syndrome: a meta-analysis', *PLoS ONE*, 2012, Vol. 7, No 4, e34916. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0034916

Ford, E. S. and Caspersen, C. J., 'Sedentary behaviour and cardiovascular disease: a review of prospective studies', *International Journal of Epidemiology*, 2012, Vol 41, pp. 1338-1353. Available at: https://europepmc.org/article/pmc/pmc4582407

Gracia-Marco, L., Rey-Lopez, J. P., Santaliestra-Pasias, A. M., Jimenez-Pavon, D., Diaz, L. E., Moreno, L. A. and Vicente-Rodriguez, G., 'Sedentary behaviours and its association with bone mass is adolescents: the HELENA cross-sectional study'. *BMC Public Health*, 2012, Vol. 12, pp. 867-880, Available at: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-12-971

Greer, A. E., Sui, X., Maslow, A. L., Greer, B. K. and Blair, S. N., 'The effects of sedentary behavior on metabolic syndrome independent of physical activity and cardiorespiratory fitness'. *Journal of Physical Activity and Health*, 2015, Vol. 12, pp. 68-73. Available at: https://www.ncbi.nlm.nih.gov/pubmed/25760431

Grontved A. and Hu F. B., 'Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: a meta-analysis', *JAMA*, 2011, Vol. 305, No 23, pp. 2448-2455. Available at: https://jamanetwork.com/journals/jama/fullarticle/900893

Gupta, N., Stordal Christiansen, C., Hallman, D. M., Korshoj, M., Gomes Carneiro, I. and Holtermann, A., 'Is objectively measured sitting time associated with low back pain? A cross-sectional investigation in the NOMAD study'. *PLoS ONE*, 2015, Vol. 10, No 3, e0121159. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4373888/

Hallman, D. M., Gupta, N., Mathiassen, S. E. and Holtermann, A., 'Association between objectively measured sitting time and neck-shoulder pain among blue-collar workers'. *International Archives of Occupational and Environmental Health*, 2015, Vol. 88, pp. 1031-1042. Available at: https://www.researchgate.net/publication/272186384_Association_between_objectively_measured_sitting_time_and_neck-shoulder_pain_among_blue-collar_workers

Hamer M., Stamatakis E. and Mishra G. D., 'Television- and screen-based activity and mental well-being in adults', *American Journal of Preventive Medicine*, 2010, Vol. 38, No 4, pp. 375-80. Available at: https://www.ajpmonline.org/article/S0749-3797(10)00010-3/fulltext

Hamer M. and Stamatakis E., 'Screen-based sedentary behavior, physical activity, and muscle strength in the English longitudinal study of ageing', *PLoS ONE*, 2013, Vol. 8, No 6, e66222. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0066222

Hamer M., Coombs N. and Stamatakis E., 'Associations between objectively assessed and self-reported sedentary time with mental health in adults: an analysis of data from the Health Survey for England', *BMJ Open*, 2014, Vol. 4, No 3, e004580. Available at: https://bmjopen.bmj.com/content/4/3/e004580

Harkness E. F., Macfarlane, G. J., Nahit, E. S., Silman, A. J. and McBeth, J., 'Risk factors for new-onset low back pain amongst cohorts of newly employed workers', *Rheumatology,* 2003, Vol. 42, No 8, pp. 959-968. Available at: https://academic.oup.com/rheumatology/article/42/8/959/1774115

Health Council of the Netherlands, *Standing, kneeling and squatting work*, Health Council of the Netherlands, The Hague, 2011, publication No 2011/41. Available at: https://www.gezondheidsraad.nl/documenten/adviezen/2011/12/23/staand-geknield-en-gehurkt-werken

Healy, B., Levin, E., Perrin, K., Weatherall, M. and Beasley, R., 'Prolonged work- and computer-related seated immobility and risk of venous thromboembolism', *Journal of the Royal Society of Medicine*, 2010, Vol. 103, pp. 447-454. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2966881/

Healy, G. N., Wijndaele, K., Dunstan, D. W., Shaw, J., Salmo, J., Zimmet, P. Z. and Owen, N., 'Objectively measured sedentary time, physical activity, and metabolic risk — The Australian Diabetes, Obesity and Lifestyle Study (AusDiab)'. *Diabetes Care*, 2008, Vol. 31, pp. 369-371. Available at: https://care.diabetesjournals.org/content/31/2/369

Healy, G. N., Matthews, C. E., Dunstan, D. W., Winkler, E. A. H. and Owen, N. 'Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06', *European Heart Journal,* 2011, Vol. 32, No 5, pp. 590-597. Available at: https://academic.oup.com/eurheartj/article/32/5/590/426997

Healy, G. N., Winkler, E. A. H., Brakenridge, C. L., Reeves, M. M. and Eakin, E. G., 'Accelerometer-derived sedentary and physical activity time in overweight/obese adults with type 2 diabetes: Cross-sectional associations with cardiometabolic biomarkers', *PLoS ONE*, 2015, Vol. 10, No 3, e0119140. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4361561/

Healy, G. N., Winkler, E. A. H., Owen, N., Anuradha, S. and Dunstan, D. W., 'Replacing sitting time with standing or stepping: associations with cardio-metabolic risk biomarkers', *European Heart Journal*, 2015, Vol. 36, pp. 2643-2649. Available at: https://doi.org/10.1093/eurheartj/ehv308

Henson, J., Yates, T., Biddle, S. J. H., Edwardson, C. L., Khunti, K., Wilmot, E. G., Grey, L. J., Gorely, T., Nimmo, M. A. and Davies, M. J., 'Associations of objectively measured sedentary behaviour and physical activity with markers of cardiometabolic health', *Diabetologia*, 2013, Vol. 56, No 5, pp. 1012-1020. Available at: https://doi.org/10.1007/s00125-013-2845-9

Henson, J., Edwardson, C. L., Morgan, B., Horsfield, M. A., Bodicoat, D. H., Biddle, S. J. H., Gorely, T., Nimmo, M. A., McCann, G. P., Khunti, K., Davies, M. J. and Yates, T., 'Associations of sedentary time with fat distribution in a high-risk population', *Medicine & Science in Sports & Exercise*, 2015, Vol. 47, No 8, pp. 1727-1734. Available at: https://doi.org/10.1249/MSS.0000000000000572

Hou J. Y. and Shiao J. S., 'Risk factors for musculoskeletal discomfort in nurses', *Journal of Nursing Research*, 2006, Vol. 14, No 3, pp. 228-236. Available at: https://journals.lww.com/jnr-twna/Abstract/2006/09000/Risk_Factors_for_Musculoskeletal_Discomfort_in.8.aspx

Ijmker, S., Huysmans, M. A., Blatter, B. M., van der Beek, A. J., van Mechelen, W. and Bongers, P. M., 'Should office workers spend fewer hours at their computer? A systematic review of the literature', *Occupational & Environmental Medicine*, 2017, Vol. 64, pp. 211-222. Available at: https://www.ncbi.nlm.nih.gov/pubmed/17095550

Kabrhel, C., Varraso, R., Goldhaber, S. Z., Rimm, E. and Camargo, C. A. Jr., 'Physical inactivity and idiopathic pulmonary embolism in women: prospective study', *BMJ*, 2011, Vol. 434, d3867. Available at: https://www.ncbi.nlm.nih.gov/pubmed/21727169

Katzmarzyk P. T., 'Standing and mortality in a prospective cohort of Canadian adults', *Medicine & Science in Sports & Exercise*, 2014, No 46, Vol. 5, pp. 940-946. Available at: https://journals.lww.com/acsm-msse/Fulltext/2014/05000/Standing_and_Mortality_in_a_Prospective_Cohort_of.12.aspx

Lee, J., Kuk, J. L. and Ardern, C. I., 'The relationship between changes in sitting time and mortality in post-menopausal US women', *Journal of Public Health*, 2015, Vol. 38, No 2, pp. 270-278. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4894483/

Lee, P. H. and Wong, F. K. Y., 'The association between time spent in sedentary behaviors and blood pressure: A systematic review and meta-analysis', *Sports Medicine*, 2015, Vol. 45, pp. 867-880. Available at: https://www.ncbi.nlm.nih.gov/pubmed/25749843

Levine J. A., 'Nonexercise activity thermogenesis (NEAT): Environment and biology', *American journal of physiology Endocrinology and Metabolism,* 2004, Vol. 286, No 5, pp. E675-E685. Available at: https://journals.physiology.org/doi/full/10.1152/ajpendo.00562.2003

Liu, M., Wu, L. and Yao, S., 'Dose-response association of screen time-based sedentary behaviour in children and adolescents and depression: a meta-analysis of observational studies', *British Journal of Sports Medicine*, 2015, Vol. 50, No 20, pp. 1-8. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26552416

Lynch, B. M., 'Sedentary behavior and cancer: a systematic review of the literature and proposed biological mechanisms', *Cancer Epidemiology, Biomarkers & Prevention*, 2010, Vol. 19, No 11, pp. 2691-2709. Available at: https://www.ncbi.nlm.nih.gov/pubmed/20833969

Manninen, P., Heliövaara, M., Riihimäki, H. and Suomalainen, O., 'Physical workload and the risk of severe knee osteoarthritis', *Scandinavian Journal of Work, Environment and Health*, 2002, Vol. 2, No 1, pp. 25-32. Available at: https://www.sjweh.fi/show_abstract.php?abstract_id=643

Marshall, P. W. M., Patel, H. and Callaghan, J. P., 'Gluteus medius strength, endurance, and co-activation in the development of low back pain during prolonged standing', *Human Movement Science*, 2011, Vol. 30, No 1, pp. 63-73. Available at: https://doi.org/10.1016/j.humov.2010.08.017

Matthews, C. E., George, S. M., Moore, S. C., Bowles, H. R., Blair, A., Park, Y., Troiano, R. P., Hollenbeck, A. and Schatzkin, A., 'Amount of time spent in sedentary behaviors and cause-specific mortality in US adults', *The American Journal of Clinical Nutrition*, 2012, Vol. 95, No 2, pp. 437-445. Available at: https://academic.oup.com/ajcn/article/95/2/437/4576797

Matthews, C. E., Moore, S. C., Sampson, J., Blair, A., Xiao, Q., Keadle, S. K., Hollenbeck, A. and Park, Y., 'Mortality benefits for replacing sitting time with different physical activities', *Medicine & Science in Sports & Exercise*, 2015, Vol. 47, pp. 1833-1840. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4515413/

McCulloch, J., 'Health risks associated with prolonged standing', *Work*, 2002, Vol. 19, No 2, pp. 201-205. Available at: https://content.iospress.com/articles/work/wor00255

McManus, A. M., Ainslie, P. N., Green, D. J., Simair, R. G., Smith, K. and Lewis, N., 'Impact of prolonged sitting on vascular function in young girls', *Experimental Physiology*, 2015, Vol. 100, pp. 1379-1387. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26370881

Messing K., Tissot F. and Stock S., 'Distal lower-extremity pain and work postures in the Quebec population', *American Journal of Public Health*, 2008, Vol. 98, No 4, pp. 705-713. Available at: https://ajph.aphapublications.org/doi/10.2105/AJPH.2006.099317

Nelson-Wong, E., Gregory, D. E., Winter, D. A. and Callaghan, J. P., 'Gluteus medius muscle activation patterns as a predictor of low back pain during standing', *Clinical Biomechanics*, 2008,Vol. 23, No 5, pp. 545-553. Available at: https://doi.org/10.1016/j.clinbiomech.2008.01.002

Patel, A. P., Hildebrand, J. S., Campbell, P. T., Teras, L. R., Craft, L. L., McCullough, M. L. and Gapstur, S. M., 'Leisure-time spent sitting and site-specific cancer incidence in a large US cohort', *Cancer Epidemiology, Biomarkers & Prevention*, 2015, Vol. 24, No 9, pp. 1350-1359. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26126627

Peddie, M. C., Bone, J. L., Rehrer, N. J., Skeaff, C. M., Grey, A. R. and Perry, T. L., 'Breaking prolonged sitting reduces postprandial glycemia in healthy, normal-weight adults: a randomized crossover trial', *American Journal of Clinical Nutrition*, 2013, Vol. 98, No 2, pp. 358-366. Available at: https://www.ncbi.nlm.nih.gov/pubmed/23803893

Perry, L. S., 'Standing up: redesigning the workplace to address obesity', *Professional Safety*, 2012, Vol. 57, No 6, pp. 77-84. Available at: https://www.onepetro.org/journal-paper/ASSE-12-06-77

Petersen, C. B., Bauman, A., Gronbaek, M., Helge, J. W., Thygesen, L. C. and Tolstrup, J. S., 'Total sitting time and risk of myocardial infarction, coronary heart disease and all-cause mortality in a prospective cohort of Danish adults', *International Journal of Behavioral Nutrition and Physical Activity*, 2014, Vol. 11, 13. Available at: https://www.ncbi.nlm.nih.gov/pubmed/24498933

Petreanu, V., Seracin, A. and Iordache, R., 'Musculoskeletal disorders in visual display unit (VDU) tasks', OSHwiki, 2020. Available at: https://oshwiki.eu/wiki/Musculoskeletal_disorders_in_visual_display_unit_(VDU)_tasks

Pope D. P., Hunt, I.M., Birrell, F. N, Silman, A. J. and MacFarlane, G. J., 'Hip pain onset in relation to cumulative workplace and leisure time mechanical load: a population based case-control study', *Annals of the Rheumatic Diseases*, 2003, Vol. 62, No 4, pp. 322-326. Available at: https://ard.bmj.com/content/62/4/322

Pronk, N. P., Katz, A. S., Lowry, M. and Payfer, J. R., 'Reducing occupational sitting time and improving worker health: The Take-a-Stand Project 2011', *Preventing Chronic Disease*, 2012, Vol. 9, E154. Available at: https://www.cdc.gov/pcd/issues/2012/11_0323.htm

Proper K. I., Singh, A. S., van Mechelen, W. and Chinapaw, M. J. M., 'Sedentary behaviors and health outcomes among adults: A systematic review of prospective studies', *American Journal of Preventive Medicine,* 2011, Vol. 40, No 2, pp. 174-182. Available at: https://www.ajpmonline.org/article/S0749-3797(10)00608-2/fulltext

Pulsford, R. M., Stamatakis, E., Britton, A. R., Brunner, E. J. and Hillsdon, M., 'Associations of sitting behaviours with all-cause mortality over a 16-year follow-up: the Whitehall II study', *International Journal of Epidemiology*, 2015, Vol. 44, No 6, pp. 1909-1916. Available at: https://doi.org/10.1093/ije/dyv191

Rockette-Wagner, B., Edelstein, S., Venditti, E. M., Reddy, D., Bray, G. A., Carrion-Petersen, M. L., Dabelea, D., Delahanty, L. M., Florez, H., Franks, P. W., Montez, M. G., Rubin, R. and Kriska, A. M., 'The impact of lifestyle intervention on sedentary time in individuals at high risk of diabetes', *Diabetologia*, 2015, Vol. 58, pp. 1198-1202. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4417075/

Roelofs, A. and Straker, L., 'The experience of musculoskeletal discomfort amongst bank tellers who just sit, just stand or sit and stand at work', *Ergonomics Journal of South Africa,* 2002, Vol. 14, No 2, pp. 11-29. Available at: https://www.researchgate.net/publication/238659045_The_experience_of_musculoskeletal_discomfort_amongst_bank_tellers_who_just_sit_just_stand_or_sit_and_stand_at_work

Roffey, D. M., Wai, E. K., Bishop, P., Kwon, B. K. and Dagenais, S., 'Causal assessment of occupational standing or walking and low back pain: results of a systematic review', *The Spine Journal*, 2010, Vol. 10, No 3, pp. 262-272. Available at: https://www.thespinejournalonline.com/article/S1529-9430(10)00007-0/fulltext

Sandmark H., Hogstedt C. and Vingard E., 'Primary osteoarthrosis of the knee in men and women as a result of lifelong physical load from work', *Scandinavian Journal of Work, Environment & Health*, 2000, Vol. 26, No 1, pp. 20-25. Available at: https://www.sjweh.fi/show_abstract.php?abstract_id=505

Schmid D. and Leitzmann M. F., 'Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis', *Journal of the National Cancer Institute*, 2014, Vol. 106, No 7. Available at: https://doi.org/10.1093/jnci/dju098

Schmid, D., Ricci, C. and Leitzmann, M. F., 'Associations of objectively assessed physical activity and sedentary time with all-cause mortality in US adults: the NHANES study', *PLoS ONE*, 2015, Vol. 10, No 3, e0119591. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4358950/

Smith L., Thomas E. L., Bell J. D. and Hamer, M., 'The association between objectively measured sitting and standing with body composition: a pilot study using MRI', *BMJ Open*, 2014, Vol. 4, No 6, e005476. Available at: https://bmjopen.bmj.com/content/4/6/e005476

Stamatakis, E., Chau, J. Y., Pedisic, Z., Bauman, A., Macniven, R., Coombs, N. and Hamer, H., 'Are sitting occupations associated with increased all-cause, cancer, and cardiovascular disease mortality risk? A pooled analysis of seven British population cohorts', *PLoS ONE*, 2013, Vol. 8, No 9, e73753. Available at: https://doi.org/10.1371/journal.pone.0073753

Stamatakis, E., Rogers, K., Ding, D., Berrigan, D., Chau, J., Hamer, M. and Bauman, A., 'All-cause mortality effects of replacing sedentary time with physical activity and sleeping using an isotemporal substitution model: a prospective study of 201,129 mid-aged and older adults', *International Journal of Behavioral Nutrition and Physical Activity*, 2015, Vol. 12, 121. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26419654.

Teychenne M., Ball K. and Salmon J., 'Physical activity, sedentary behavior and depression among disadvantaged women', *Health Education Research*, 2010, Vol. 25, No 4, pp. 632-644. Available at: https://academic.oup.com/her/article/25/4/632/575258

Teychenne, M., Costigan, S. A. and Parker, K., 'The association between sedentary behaviour and risk of anxiety: A systematic review', *BMC Public Health*, 2015, Vol. 15, 513. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26088005

Thorp, A. A., Owen, N., Neuhaus, M., & Dunstan, D. W., 'Sedentary behaviors and subsequent health outcomes in adults', *American Journal of Preventive Medicine*, 2011, Vol. 41, No 2, pp. 207-215. Available at: https://www.ncbi.nlm.nih.gov/pubmed/21767729

Thorp A. A., Kingwell, B. A., Owen, N., and Dunstan, D. W., 'Breaking up workplace sitting time with intermittent standing bouts improves fatigue and musculoskeletal discomfort in overweight/obese office workers', *Occupational & Environmental Medicine,* 2014, Vol. 71, No 11, pp. 765-771. Available at: https://oem.bmj.com/content/71/11/765

Thorp A. A., Kingwell, B. A., Sethi, P., Hammond, L., Owen, N. and Dunstan, D. W., 'Alternating bouts of sitting and standing attenuate postprandial glucose responses', *Medicine & Science in Sports & Exercise*, 2014, Vol. 46, No 11, pp. 2053-2061. Available at: https://journals.lww.com/acsm-msse/Fulltext/2014/11000/Alternating_Bouts_of_Sitting_and_Standing.3.aspx

Thosar, S. S., Bielko, S. L., Mather, K. J., Johnston, J. D. and Wallace, J. P., 'Effect of prolonged sitting and breaks in sitting time on endothelial function', *Medicine & Science in Sports & Exercise*, 2015, Vol. 47, pp. 843-849. Available at: https://www.ncbi.nlm.nih.gov/pubmed/25137367

Tikkanen, O., Haakana, P., Pesola, A. J., Häkkinen, K., Rantalainen, T., Havu, M., Teemu, P. and Finni, T., 'Muscle activity and inactivity periods during normal daily life', *PLoS ONE*, 2013, Vol. 8, No 1, e52228. Available at: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0052228

Tremblay, M. S., LeBlanc, A. G., Kho, M. E., Saunders, T. J., Larouche, R., Colley, R. C., Goldfield, G. and Gorber, S. C., 'Systematic review of sedentary behaviour and health indicators in school-aged children and youth', *International Journal of Behavioral Nutrition and Physical Activity*, 2011, Vol. 8, 98. Available at: https://www.ncbi.nlm.nih.gov/pubmed/21936895

Vallance, J. K., Winkler, E. A. H., Gardiner, P. A., Healy, G. N., Lynch, B. M. and Owen, N., 'Associations of objectively-assessed physical activity and sedentary time with depression: NHANES (2005-2006)', *Preventive Medicine*, 2011, Vol. 53, No 4-5, pp. 284-288. Available at: https://doi.org/10.1016/j.ypmed.2011.07.013

Van den Bossche, S. N. J. and Smulders, P. G. W. 'De Nationale Enquête Arbeidsomstandigheden 2003', 2003, Available at: https://www.monitorarbeid.tno.nl/dynamics/modules/SFIL0100/view.php?fil_Id=52

Van der Ploeg, H. P., Chey, T., Korda, R. J., Banks, E. and Bauman, A., 'Sitting time and all-cause mortality risk in 222 497 Australian adults', *Archives of Internal Medicine*, 2012, Vol. 172, No 6, 494. Available at: https://doi.org/10.1001/archinternmed.2011.2174

Van der Ploeg, H. P., Chey, T., Ding, D., Chau, J. Y., Stamatakis, E. and Bauman, A. E., 'Standing time and all-cause mortality in a large cohort of Australian adults', *Preventive Medicine*, 2014, Vol. 69, pp. 187-191. Available at: https://doi.org/10.1016/j.ypmed.2014.10.004

Van der Ploeg, H. P., Moller, S. V., Hannerz, H., van der Beek, A. J. and Holtermann, A., 'Temporal changes in occupational sitting time in the Danish workforce and associations with all-cause mortality: results from the Danish work environment cohort study'. *International Journal of Behavioral Nutrition and Physical Activity*, 2015, Vol. 12, 71. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26031453

Van Uffelen, J. G. Z., Wong, J., Chau, J. Y., et al., 'Occupational sitting and health risks'. *American Journal of Preventive Medicine*, 2010, Vol. 39, No 4, pp. 379-388. Available at: https://doi.org/10.1016/j.amepre.2010.05.024

Van Uffelen, J. G., van Gellecum, Y. R., Burton, N. W., Peeters, G., Heesch, K. C. and Brown, W. J., 'Sitting-time, physical activity, and depressive symptoms in mid-aged women', *American Journal of Preventive Medicine*, 2013, Vol. 45, pp. 276-281. Available at: https://www.ncbi.nlm.nih.gov/pubmed/23953353

Vingard E., Alfredsson L. and Malchau H., 'Osteoarthrosis of the hip in women and its relation to physical load at work and in the home', *Annals of the Rheumatic Diseases,* 1997, Vol. 56, No 5, pp. 293-298. Available at: https://ard.bmj.com/content/56/5/293

Wahlström, J., 'Ergonomics, musculoskeletal disorders and computer work', *Occupational Medicine*, 2005, Vol. 55, No 3, pp. 168-176. Available at: https://doi.org/10.1093/occmed/kqi083

Waters, T. R. and Dick, R. B. 'Evidence of health risks associated with prolonged standing at work and intervention effectiveness. *Rehabilitation Nursing*, 2014, Vol. 40, No 3, pp. 148-165. Available at: https://doi.org/10.1002/rnj.166

West, J., Perrin, K., Aldington, S., Weatherall, M. and Beasley, R., 'A case-control study of seated immobility at work as a risk factor for venous thromboembolism', *Journal of the Royal Society of Medicine*, 2008, Vol. 101, pp. 237-243. Available at: https://www.ncbi.nlm.nih.gov/pubmed/18463279

Wijndaele, K., Healy, G. N., Dunstan, D. W., Barnett, A. G., Salmon, J., Shaw, J. E., Zimmet, P. Z. and Owen, N., 'Increased cardiometabolic risk is associated with increased TV viewing time', *Medicine & Science in Sports & Exercise*, 2010, Vol. 42, pp. 1511-1518. Available at: https://www.ncbi.nlm.nih.gov/pubmed/20139784.

Wilmot E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Grey, L. J., Khunti, K., Yates, T. and Biddle, S. J. H., 'Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis', *Diabetologia*, 2012, Vol. 55, No 11, pp. 2895-2905. Available at: https://link.springer.com/article/10.1007%2Fs00125-012-2677-z

Yoshimura N., Nishioka, S., Kinoshita, H., Hori, N., Nishioka, T., Ryujin, M., Mantani, Y., Miyake, M., Coggon, D. and Coope, C., 'Risk factors for knee osteoarthritis in Japanese women: heavy weight, previous joint injuries, and occupational activities', *Journal of Rheumatology*, 2004, Vol. 31, No 1, pp. 157-162. Available at: https://www.ncbi.nlm.nih.gov/pubmed/14705235

Zhai, L., Zhang, Y. and Zhang, D., 'Sedentary behaviour and the risk of depression: a meta-analysis', *British Journal of Sports Medicine*, 2015, Vol. 49, pp. 705-709. Available at: https://www.ncbi.nlm.nih.gov/pubmed/25183627

Zhou, Y., Zhao, H. and Peng, C., 'Association of sedentary behavior with the risk of breast cancer in women: update meta-analysis of observational studies', *Annals of Epidemiology*, 2015, Vol. 25, No 9, pp. 687-697. Available at: https://www.ncbi.nlm.nih.gov/pubmed/26099193

Appendix 3 EU standards and norms

The directives referred to in the report are complemented by of a set of European Norms (ENs) and labour standards issued by the International Organisation for Standardisation (ISO) for the protection of workers against work-related MSDs. Those norms and standards comprise areas such as general design principles, safety of machinery, physical environment, physical workload, mental workload, workplace and equipment design, visual information and display terminals and software, displays and controls and personal protective equipment. There are many standards available and most of them are directed towards specific work environments.

Concerning prolonged standing the following generic orientated standards are considered especially appropriate:

- DIN EN 614-1 Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles
- DIN EN 614-2 Safety of machinery — Ergonomic design principles — Part 2: Interactions between the design of machinery and work tasks
- EN 1005-4:2005(E) EN Safety of machinery — Human physical performance — Part 4: Evaluation of working postures and movements in relation to machinery
- ISO 11226:2000(E) Ergonomics — Evaluation of static working postures
- NEN-EN 14386:2002 Ergonomic design principles of mobile machinery — Part 1: Ride on mobile machinery
- DIN EN ISO 14738 Safety of machinery — Anthropometric requirements for the design of workstations at machinery

DIN EN 614-1 applies to the interactions between operators and machinery when installing, operating, adjusting, maintaining, cleaning, dismantling, repairing or transporting equipment, and outlines the principles to be followed in taking the health, safety and well-being of the operator into account.

DIN EN 614-2 establishes the ergonomics principles and procedures to be followed during the design process of machinery and operator work tasks. It deals specifically with task design in the context of machinery design, but the principles and methods may also be applied to job design.

EN 1005-4:2005 emphasises that, with respect to working postures, the work should offer sufficient variation between and within standing, standing and walking. Awkward postures, such as kneeling, squatting and crouching, should be avoided whenever possible. It is also highlights that measures meant to induce variations of posture should not lead to monotonous repetitive work.

ISO 11226 is directed at OSH specialists and focuses on specific joint positions related to static postures.

NEN-EN 14386:2002 Ergonomic design principles of mobile machinery concerns standing work focused at, for instance, working in cabins or on platforms of mobile machinery in cranes, in transport, forestry and agriculture.

DIN EN ISO 14738 establishes principles for deriving dimensions from anthropometric measurements and applying them to the design of workstations at non-mobile machinery. It is based on current ergonomic knowledge and. anthropometric measurements. This international standard specifies the body's space requirements for equipment during normal operation in sitting and standing positions.

Appendix 4 Resources for preventing prolonged constrained standing

Table 10 provides some examples of guides, tools and tips on ergonomics and MSD prevention in general, and advice on prolonged standing work. It includes examples from public health and OSH organisations. The suitability of each resource for small organisations is indicated, although most resources provide something relevant to small organisations. Further resources are available through the EU-OSHA MSDs practical tools and guidance database ([69]), and resources aimed at limiting sitting work and creating more physically active workplaces are also given in the EU-OSHA report on prolonged sitting (EU-OSHA, 2021a).

Table 10 Resources and further information

Country	Resource example	Description	Target audience	MSE friendly?
Guides and tools: general ergonomics and MSDs				
Canada	MSD Toolbox/Institute for Work and Health ([70])	This tool box contains examples of worksheets, surveys and hazard identification tools for MSD risk assessment and prevention	Employers	Yes
Canada	Canadian Association of University Teachers/Factsheet — working in a static position ([71])	Provides simple guidance on static positions, good workstation design and behaviour	Employers, workers	Yes
EU	EU-OSHA/Healthy workers, thriving companies — a practical guide to wellbeing at work ([72])	Brochure on MSDs and their prevention	Employers, OSH professionals	Yes
EU	Practical tools and guidance on musculoskeletal disorders/EU-OSHA ([73])	This database contains links to resources on ergonomics and preventing MSDs. The resources come from across Europe and worldwide	Employers and workers	Yes

([69]) https://osha.europa.eu/en/themes/musculoskeletal-disorders/practical-tools-musculoskeletal-disorders
([70]) https://www.iwh.on.ca/tools-and-guides/msd-prevention-series
([71]) https://www.caut.ca/docs/default-source/health-safety-fact-sheets/working-in-a-static-position.pdf?sfvrsn=8
([72]) https://osha.europa.eu/en/publications/healthy-workers-thriving-companies-practical-guide-wellbeing-work/view
([73]) https://osha.europa.eu/en/themes/musculoskeletal-disorders/practical-tools-musculoskeletal-disorders

Country	Resource example	Description	Target audience	MSE friendly?
International	International Labour Office and the International Ergonomics Association ([74])	Ergonomic 'checkpoints' for 134 different work situations providing practical and easy-to-implement solutions, including for avoiding prolonged standing	Employers, OSH professionals	Yes
France	MSD Toolbox/INRS — French national research institute on OSH ([75])	Brochures, posters, videos and tools	OSH professionals	No
New Zealand	Accident Compensation Corporation ([76])	Booklet on workstation ergonomics with advice, tips and exercises	Workers	Yes
Spain	Posturas de trabajo (work postures)/INSST ([77])	Various resources on improving work postures can be accessed from this web page	Employers	
Sweden	Ergonomics for the prevention of musculoskeletal disorders/Swedish Work Environment Authority ([78])	Practical, systematic and simple guidance to assess the suitability of workstations. Includes guidance on standing work	Employers	Yes
Advice and tips on standing work				
Belgium	Standing for a long time and what to do about it ([79])	Web page giving simple advice avoiding risks from standing work	Employers	Yes
Canada	Preventing work-related injuries: standing on the job/ Canadian Women's Health Network ([80])	Simple, practical advice on the health and safety of standing work	Workers	Yes
Canada	Sitting or standing? Which is best?/Institute for Work and Health ([81])	Video that raises awareness about the negative health effects of prolonged sitting and prolonged standing	All	Yes

([74]) https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/instructionalmaterial/wcms_178593.pdf
([75]) http://www.inrs.fr/media.html?refINRS=Anim-136
([76]) https://www.acc.co.nz/assets/injury-prevention/7c64fe79b0/acc7213-work-safe-work-well.pdf
([77]) https://www.insst.es/riesgos-ergonomicos-carga-de-trabajo-posturas-de-trabajo
([78]) https://www.av.se/globalassets/filer/publikationer/foreskrifter/engelska/ergonomics-for-the-prevention-of-musculoskeletal-disorders-afs-2012-2.pdf
([79]) http://www.ergonomiesite.be/langdurig-staan/
([80]) http://cwhn.ca/en/node/44781
([81]) https://www.iwh.on.ca/videos-and-presentations

Country	Resource example	Description	Target audience	MSE friendly?
Canada	Foot comfort and safety at work/Canadian Centre for Occupational Health and Safety (CCOHS) ([82])	Practical guidance that includes advice on flooring and selecting footwear	Employers	Yes
Canada	Anti-fatigue mats/ CCOHS ([83])	Practical advice on anti-fatigue mats	Employers	Yes
Canada	Working in a Standing Position - Working in Standing/Sitting Positions/CCOHS ([84])	Short ergonomic guidance on the ergonomics of a standing workstation that allows sitting	Employers	
Canada	Working in a Standing Position - Basic Information ([85])	Practical advice on standing work	Employers and workers	
EU	Musculoskeletal disorders and prolonged static standing/OSHwiki ([86])	Article on prolonged standing including advice to avoid it	Employers	Yes
EU	Practical tools and guidance on MSDs (filtered for exercises)/EU-OSHA ([87])	This database contains links to resources on exercises suitable for the workplace. The resources come from across Europe and worldwide	Employers and workers	Yes
Germany	How workplaces for standing up should look ([88])	Basic rules including a checklist	Employers	No
Germany	Fit-karten/BAuA ([89])	Pack of playing card-sized cards on how to deal with standing on the job. Available for various jobs (hairdressers, working in bakeries, roof top workers)	Workers	Yes

([82]) https://www.ccohs.ca/oshanswers/prevention/ppe/foot_com.html
([83]) https://www.ccohs.ca/oshanswers/ergonomics/mats.html
([84]) https://www.ccohs.ca/oshanswers/ergonomics/standing/sit_stand.html
([85]) https://www.ccohs.ca/oshanswers/ergonomics/standing/standing_basic.html
([86]) https://oshwiki.eu/wiki/Musculoskeletal_disorders_and_prolonged_static_standing
([87]) https://osha.europa.eu/en/themes/musculoskeletal-disorders/practical-tools-musculoskeletal-disorders?f%5B0%5D=field_prevention_measures%3A4395
([88]) https://www.bghm.de/arbeitsschuetzer/fachinformationen/ergonomie-und-arbeitsplatzgestaltung/sitz-und-steharbeitsplaetze/
([89]) https://www.baua.de/DE/Angebote/Publikationen/Schriftenreihe/Forschungsberichte/2003/pdf/Fb982-Auszug.pdf?__blob=publicationFile&v=3

Country	Resource example	Description	Target audience	MSE friendly?
Sweden	Sit/stand approach with focus on gender perspective/ Swedish Working Conditions authority ([90])	Animated YouTube film on how to deal with gender differences and prevent MSDs. The example case shows a man and a woman working in a fish factory	Employers, OSH experts	Yes
United Kingdom	Standing problem/Hazards Magazine ([91])	Article that discusses the health and safety issues of standing work and prevention measures	Workers, worker representatives	Yes
Advice on movement and exercise				
Canada	Change it up!/Centre of Research Expertise for the Prevention of Musculoskeletal Disorders ([92])	Two page flyer how to change between postures on the job and how to include micro breaks	Employers, workers	Yes
France	Poster with exercises/Prévendos ([93])	Ready-to-go poster that just needs printing focusing on non-office work	Employers	Yes
Estonia	Poster with exercises/ Tööinspektsioon ([94])	Ready-to-go poster that just needs printing focusing on exercise, regardless of the job performed	Employers	Yes
EU	Promoting moving and exercise at work to avoid prolonged standing and sitting/ OSHwiki ([95])	Article describing why work should be more active and providing practical advice	Employers	Yes

([90]) https://youtu.be/xurUaIBMa8Y?list=PLEIRHW0U5qeqN4qt2rgZ74OKVssxWBcji
([91]) http://www.hazards.org/standing/
([92]) https://www.msdprevention.com/userContent/documents/Resource%20Pool/Quick%20Start%20Guide/QSG%206-Change%20it%20up%20March%2029%202019.pdf
([93]) https://prevendos.lu/wp-content/uploads/2015/09/Poster_Prevendos_Pour_votre_bien_%c3%aatre_08052015_FR.pdf
([94]) https://issuu.com/tooinspektsioon/docs/v6imlemisplakat_seisev_too
([95]) https://oshwiki.eu/wiki/Promoting_moving_and_exercise_at_work_to_avoid_prolonged_standing_and_sitting

Appendix 5: Action plan template

Hazard/risk/ problem	Priority	Actions/ Solutions	Responsibility/ Those involved	Budget/ Resources	Deadline/ Timeline	Evaluation

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The European Agency for Safety and Health at Work (EU-OSHA) contributes to making Europe a safer, healthier and more productive place to work. The Agency researches, develops, and distributes reliable, balanced, and impartial safety and health information and organises pan-European awareness raising campaigns. Set up by the European Union in 1994 and based in Bilbao, Spain, the Agency brings together representatives from the European Commission, Member State governments, employers' and workers' organisations, as well as leading experts in each of the EU Member States and beyond.

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