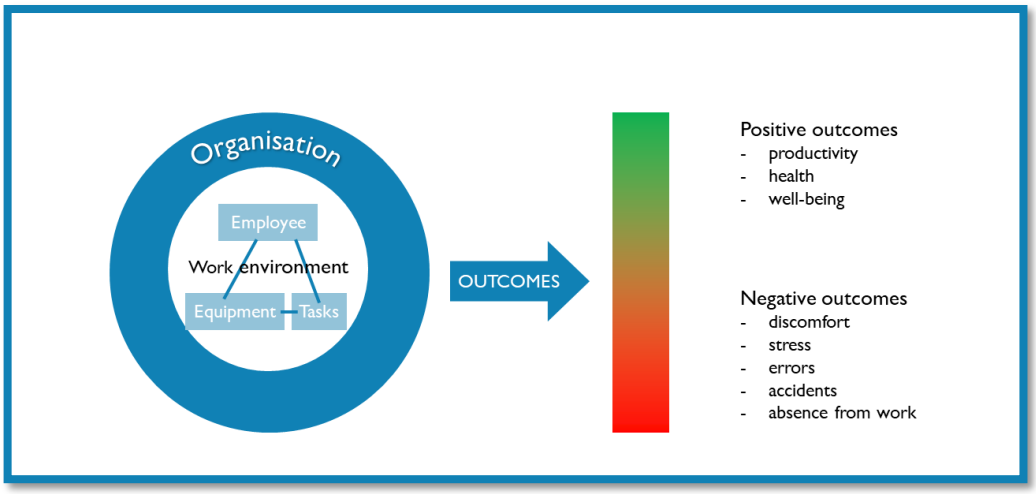
Ergonomics and accidents in cleaning work



CLEANING ERGONOMICS

ErgoClean, Cleaning ergonomics – to prevent occupational diseases and accidents

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Preface

The aim of the first part of the project was to map the situation of cleaning ergonomics, occupational diseases, and available materials.

To have that information, cleaner and supervisor surveys were carried out and existing training materials were mapped. The number and reasons for accidents and occupational diseases were tried to find out, but the information was available only from a few countries. To have more information about load of cleaning work, smart wear measurements were carried out.

In this report, survey results and smart wear measurements are presented.
The list of existing training materials is published on every partner website and on project website ergoclean.eu.

The results will be used to design the content of the guidance materials to be produced by the ErgoClean project. The aim is to develop materials for ergonomic training in cleaning and for the prevention of the most common occupational diseases and accidents.

In view of the relatively small-scale research, no scientific conclusions can be made for the time being.

Main findings

Cleaners and supervisors consider cleaning work as a good job. They feel cleaning work is important and meaningful.

Although cleaners and supervisors were mostly satisfied with their work, they recognised several stress factors. 70 % of cleaners felt that their work is physically demanding and 70 % of supervisors found their work mentally demanding. Only 7% of cleaners had not felt any body pains. Pain was felt especially in neck, shoulders, and lower back.

The work pace can cause stress and workload. Around one in two cleaners and supervisors are feeling busy on a daily or weekly basis. On the positive side, most respondents felt that they could influence the pace of work at least to some extent.

Surveys show that supervisors have more influence over their own work than cleaners. One in three cleaners felt that they had no influence at all on the content of their work, compared with only 6% of supervisors.

The survey results also show that cooperation with the facility management and space-users is needed to have better working conditions for cleaners. Cleanability, space planning, surface materials and their condition affect also work ergonomics.

The quick report images produced by the smart wear measurements help to visualise the muscle load. The red colour in the images draws attention to and highlights the muscle groups under load, the static nature of the muscle work in terms of the low number of micro-breaks and the number of elevated positions of the upper arms during the work.

The images can be used to justify the need for careful selection of the working method, tool and working style in situations where different alternative cleaning methods are available for removing dirt.

The measurements also highlighted the importance of correct tool use. Using a new tool can be initially more stressful than using a familiar tool. Therefore, when a new tool is introduced, its use should be practised so that the correct working method is adopted from the start.

Cleaning workloads are individual, but our measurements show that they are consistent and similar. The load is influenced, among other things, by the age of the person. Ergonomic working methods should be learned from the beginning of a career in order to avoid unnecessary strain on the body.

According to the measurements, the load on the thigh muscles was very low. In cleaning work, it would be useful to learn to use the strength of the leg muscles in the working movements and thus reduce the strain on the arms.

Attention should therefore be paid to working postures and to the way of working. In cleaning, repetitive work over a long period of time is a risk factor.

The quick report images illustrate how cleaning work should not be done. For example, one should not mop with a too long a tool handle or with too wide a mopping movement, or mop if a scrubber drier can be used.

However, when looking at the results, it is important to bear in mind that there are many factors that influence the choice of cleaning method. For example, this study did not investigate the cleaning performance of different methods or tools. In addition, not all muscle groups were included in the measurements, for example, the load on the back muscles was not measured.

These measurements were used to investigate the stress caused by individual working methods. In the future, it would be useful to investigate the load on the back as well as the load over the whole working day.

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Ergonomics in the work system

Ergonomics examines the interactions between man and other parts of the operating system and applies the theoretical principles, knowledge, and methods of ergonomics to optimise human well-being and the efficiency of the operating system.

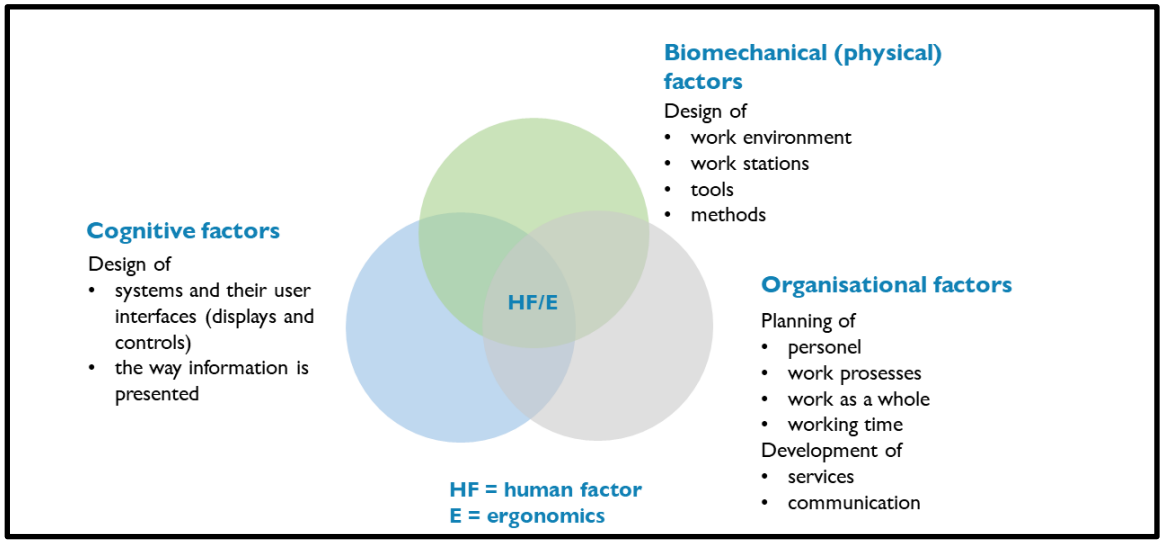
Ergonomics is often divided to biomechanical (physical), cognitive, and organisational ergonomics (Fig. 1).

Biomechanical (physical) ergonomics focuses on the development of the working environment, work equipment, workstations and working methods from an individual perspective. The development of the interaction between the human being and the physical environment must take into account, for example, working movements, working postures, and load handling.

The key areas of cognitive ergonomics include mental workload, decision-making, quality performance, work stress and human-computer interaction.

Organisational ergonomics focuses on reconciling the needs of staff, work and working time systems.

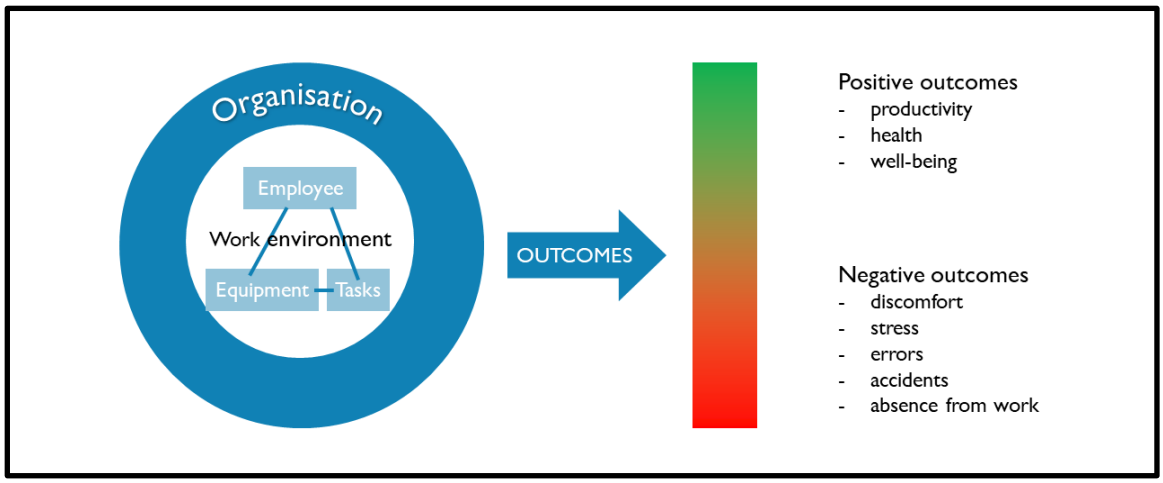
Figure 1. What is ergonomics?



Reference: The figure drawn according to the model of International Ergonomics Association (https://iea.cc/about/what-is-ergonomics/).

Work organisation affects ergonomics. A work system consists of an employee, work tasks and tools in the work environment. Working is a process that can lead to positive or negative outcomes (Fig. 2). Negative outcomes can appear in the form of discomfort, stress, errors, accidents, or absence from work. Positive outcomes include productivity, health, and wll-being. (Kekkonen, P. Several actors, one workplace — Development of collaboration of several actors inside and between the organisations. University of Oulu Graduate School; University of Oulu, Faculty of Technology Acta Univ. Oul. C 776, 2021)

Figure 2. Ergonomics in the work system



Cleaner and supervisor surveys

As part of the project, surveys were carried out for cleaners and supervisors. The surveys were called “The workload of cleaning work - ways to prevent work-related illnesses and accidents”.

Both surveys were conducted in the same way in Estonia, Finland, Hungary, and the Netherlands.

The project aims to address ergonomics and occupational safety holistically, taking into account physical, psychosocial and organisational stress factors. The results of the survey will be used in the design of training and guidance materials for professional cleaning.

The surveys were carried out in November 2022. Surveys were sent to ten organisations in each country and were answered by a total of 267 cleaners and 147 supervisors. The survey was conducted as an electronic survey, which did not collect personal, employer or any other information from the respondents outside the questionnaire.

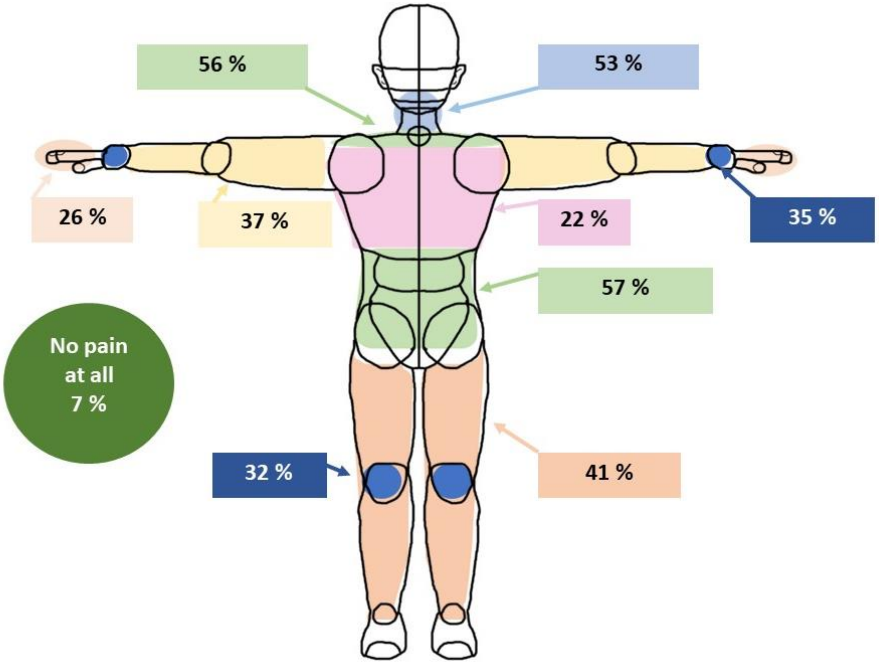
Overall, according to the responses, cleaning work is considered a good job. 93% of cleaners and 97% of supervisors considered their work to be meaningful and 54% of cleaners and 75% of supervisors were always or often enthusiastic about their work.

RESULTS

Musculoskeletal disorders in cleaning work

We know that musculoskeletal disorders are common among cleaners. The cleaners who responded to the survey reported experiencing pain, particularly in the lower back, shoulders, and neck (Fig. 3). More than half of the respondents experienced pain in these areas of the body. Pain experiences were higher among older respondents.

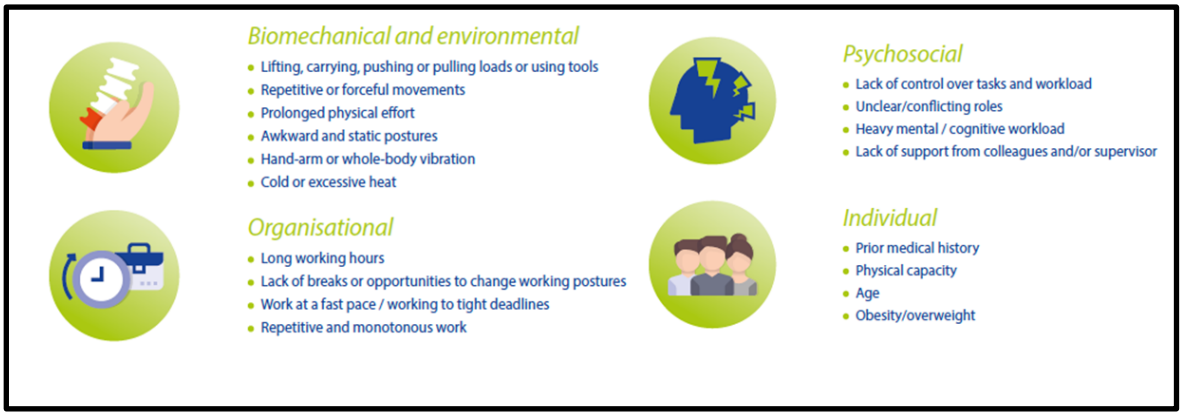
Figure 3. The percentage of cleaners who had experienced pain in different body parts.



The *EU's Healthy Workplaces Lighten the Load* campaign lists the potential risk factors for developing musculoskeletal symptoms (Fig. 4).

These include biomechanical and work environment factors, as well as organisational, psychosocial, and individual-related factors.

Figure 4. Factors potentially contributing to the development of work-related MSDs (musculoskeleton disorders)



Reference: https://healthy-workplaces.eu/sites/default/files/infographics/HWC20-Definition-Work-related-MSD-infographics_TE0220309ENN.jpg

Biomechanical and work environmental factors

Biomechanical and work environment factors include stress caused by carrying, lifting, poor and static working postures, which are also present in cleaning work. Also, work environment has an impact because cleaners can't influence on their workstations.

The surveys were carried out to find out the experiences of both cleaners and supervisors about the factors that hinder cleaning at work sites. Both cleaners and supervisors agreed on the factors that hinder cleaning (Fig. 5).

The main obstacles to cleaning were the amount of goods on tables and floors. Around 70% of respondents felt that the amount of goods prevented efficient cleaning. Many had also identified the large amount of furniture and its awkward positioning, as well as flooring materials unsuitable for the use and consumption of the space and their wear and tear as obstacles. Around one in three respondents had found the customer's behaviour or indifferent attitude to cleaning as problematic.

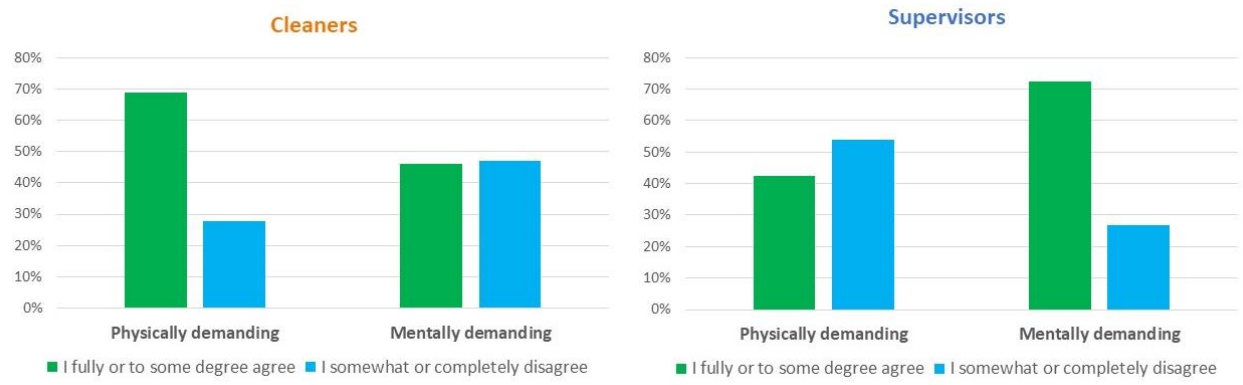
A cleaner can rightly be called a multi-space worker. The workplace changes several times a day, and the cleaner has no control over the ergonomics of the working environment. However, the working environment also has a significant impact on the ergonomics of cleaning work. These include the condition of the premises and surface materials, furnishings, the cleanliness and tidiness of the premises, air conditioning and waste management.

According to respondents, their employers are making efforts to improve safety in the workplace, but this alone is not enough. Cleaning is often an outsourced service, so cooperation with the client organisation and possibly other outsourced service providers is needed to improve safety and ergonomics. According to the survey results, one in five respondents felt that cooperation with the building maintenance service was poor.

Figure 5. Percentages of all respondents reporting various factors that hinder cleaning and reduce ergonomics.

According to surveys, 70% of cleaners found their work physically stressful and 70% of supervisors psychologically stressful (Fig. 6).

Figure 6. Cleaners' and supervisors' experiences of the physical and mental strain of their work.

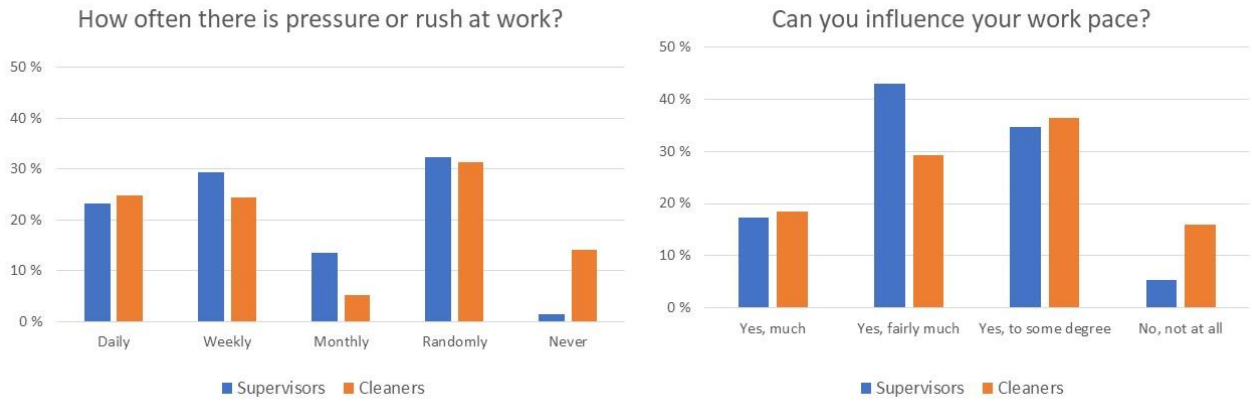


Organisational factors

Organisational stress factors include rush, long working hours, monotonous work, and lack of breaks.

The surveys looked at how busy the cleaners and supervisors felt at work and what they could do about it. Around one in two cleaners and supervisors felt busy on a daily or weekly basis. On the positive side, most respondents felt that they could influence the pace of work at least to some extent (Fig. 7).

Figure 7. Cleaners' and supervisors' experiences of being busy and having an influence on their work pace.



Psychosocial factors

Psychosocial strain can arise if the worker has little control over his or her own work and workload if the work is emotionally demanding or if there is a lack of support from colleagues and supervisors.

Respondents perceived their own work as diverse and varied (61% for cleaners / 89% for supervisors) and independent (81% / 82%), with support from both colleagues (77% / 84%) and supervisors (75% / 75%). According to respondents, information is shared in the workplace in a reasonably open way (59% / 71%). There is room for improvement in terms of

equal treatment of staff, as only 57% of cleaners and 68% of supervisors felt that they were treated equally. More than half of respondents were confident that they would keep their jobs (63% / 70%).

Surveys show that supervisors have more influence over their own work than cleaners. One in three cleaners felt that they had no influence at all on the content of their work, compared with only 6% of supervisors. 39% of cleaners and 20% of supervisors had no influence at all on where they worked.

Individual factors

The onset of symptoms is individual and influenced by factors such as age, physical performance, health, and weight.

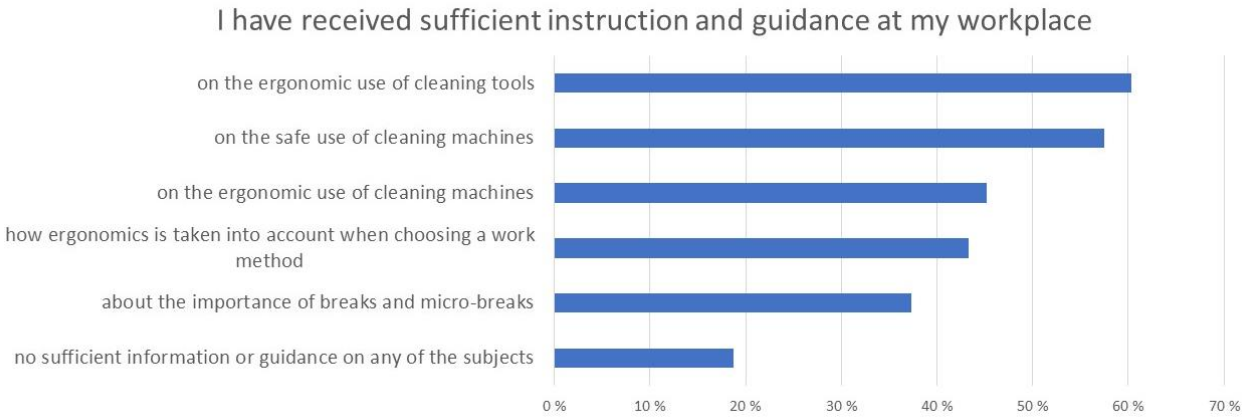
Need for guidance

The physical stress of cleaning work is influenced by the choice of tools and methods. The decisive factor is the cleaner's ability to choose the best possible tools and methods for different situations. Professional skills and on-the-job training play a major role.

Cleaners were most satisfied with the training they received in the use of cleaning equipment (Fig. 8). 60% of respondents felt that they had received sufficient guidance and instruction on the ergonomic use of cleaning tools.

The importance of breaks and micro-breaks is not sufficiently explained according to the survey. Another worrying result is that one in five cleaners had not received sufficient guidance on any of the topics asked.

Figure 8. Cleaners' experience of the adequacy of ergonomics-related training in the workplace.



Smart wear measurements

Cleaning is considered a medium-heavy job. What does that mean and where does the load fall? Smart wear measurements were done to receive answers to that question.

The measurements used smart wear and technology from the Finnish company Myontec. Motion sensors in the smart shirt and shorts were used to measure the load on the arms, shoulder area and thigh muscles, the number of micro-breaks during muscle work and the elevated position of the upper arms. It should be noted that not all muscle groups were measured with the smart wear, e.g. the smart wear for measuring back load was not used.

The tests were carried out in Finland during October and November 2022 in cooperation with the staff of Keuda Cleaning Services. Two cleaners were involved in the studies. Each of the employees performed two repetitions of the tested methods.

Including repetitions, 111 tests were performed. In some tests the work was deliberately done incorrectly to show how poor ergonomics is reflected in the results.

Because there are differences in cleaning methods and practices between countries, methods that were not commonly used in all project countries were also selected for testing.

Table 1. Methods tested and compared

Damp, moist, and wet mopping

- with a mop and a squeezee mop
- S-mopping
- push-mopping
- mopping forwards
- mopping backwards
- with too long a shaft
- with too wide a movement

Damp, moist, and wet wiping

- with microfibre cloth and an interior mop
- wiping forth and back
- wiping sideways
- wiping with and without taking support
- with too wide a movement

Using cleaning machines

- scrubber driers
- vacuum cleaners

Sink cleaning with

- a brush
- a sponge
- a microfibre cloth

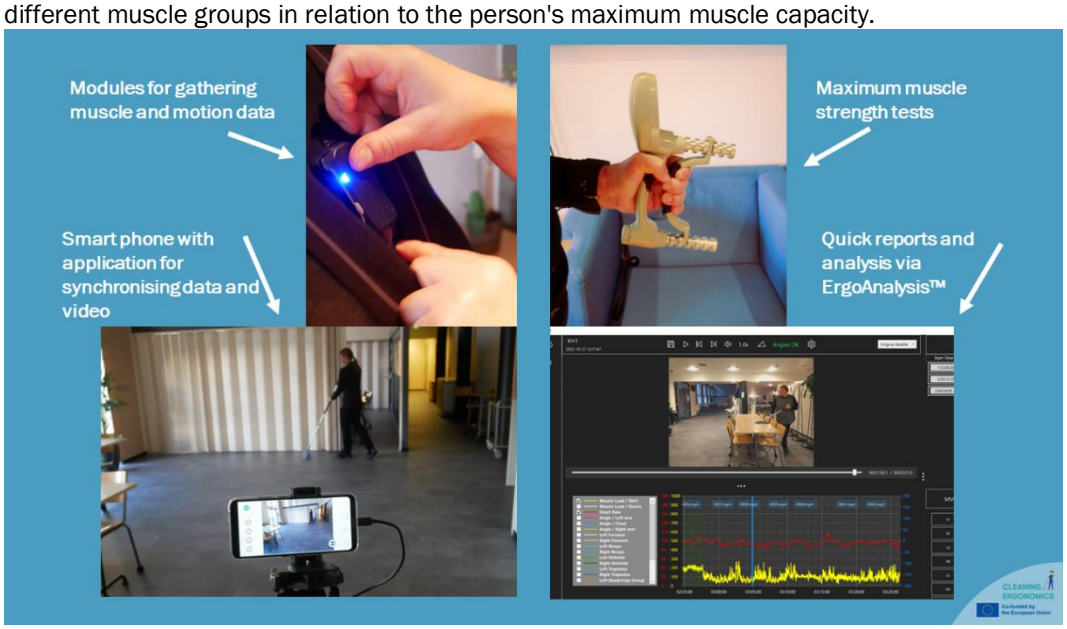
Cleaning a toilet seat

Wringing a cleaning cloth.

The measurements started with putting on the smart wear and setting up the measurement sensors. The maximum muscle capacities were then measured, to which the workload was related (Fig. 9).

The measurements were videotaped on a smartphone. Measurement data and video were synchronised, allowing the video and results to be viewed using the analysis program.

Figure 9. Smart wear motion sensors measure muscle load. The measurement results are stored in the phone app along with the video. The analysis software produces a quick report of the load on different muscle groups in relation to the person's maximum muscle capacity.



WHAT INFORMATION DO SMART WEAR MEASUREMENTS PROVIDE?

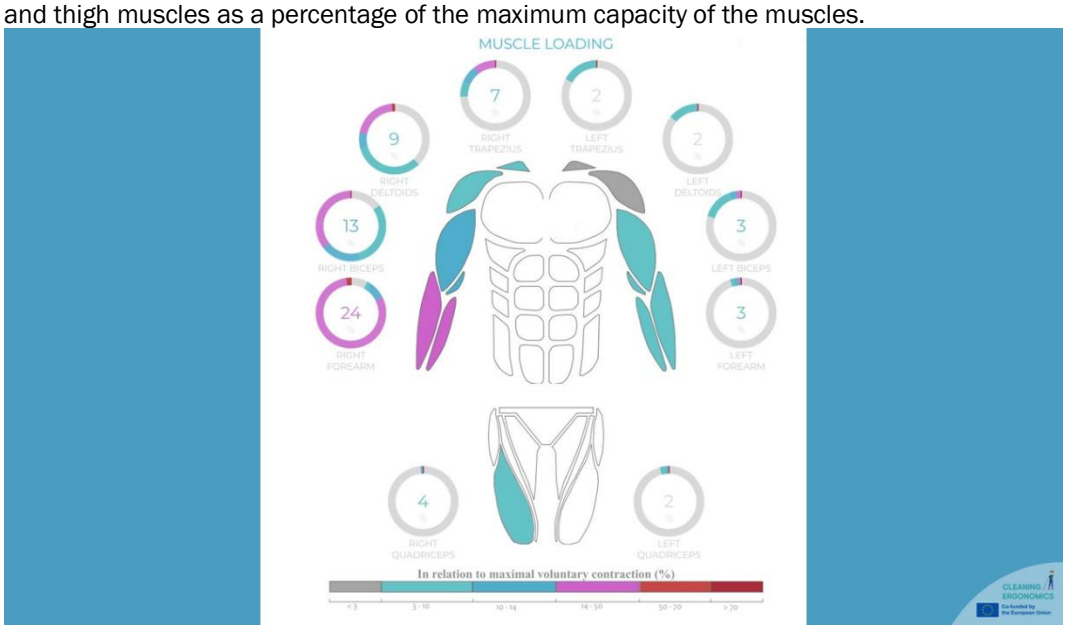
The results of the smart wear measurements are available in the form of quick reports Fig. 10, 11, 12). The reports show, by colour and percentage, the load on different muscle groups and the number of micro-breaks and shoulder elevations.

Muscle loading

The results of smart wear measurements of muscle load are expressed as a percentage of the maximum capacity of the muscle.

The results were analysed based on studies from Lund University, which found that the risk of musculoskeletal disorders increases if the percentage of muscle strain is more than 10% for more than half of the daily working time or more than 30% for more than 10% of the working time. (Anvidsson, I. & al. 2017. Åtjärdsnivåer mot belastningsskada. Arbets- och miljömedicin Syd. Rapport nr 18/2017).

Figure 10. A quick report shows the muscle load on the forearms, upper arms, deltoids, shoulders, and thigh muscles as a percentage of the maximum capacity of the muscles.



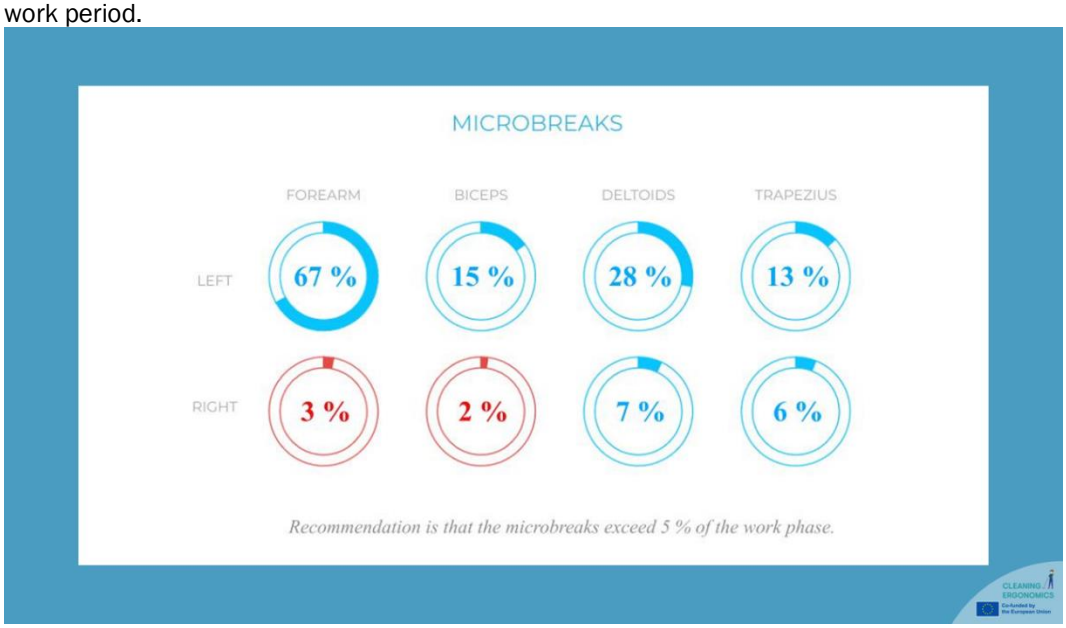
In the methods tested, the 10% threshold was almost always exceeded for at least one muscle group. For all muscles, a load of less than 10% was achieved only in damp and moist push-mopping methods and when one of the cleaners cleaned the floor with a scrubber drier.

The load on the thigh muscles was very low. No loading above 10 % occurred in any of the methods tested.

Number of micro-breaks

The number of micro-breaks gives an idea of how much work the muscle is doing statically and dynamically. To avoid unnecessary strain on the muscle, muscle micro-breaks should be more than 5% of the working time.

Figure 11. For the muscle workload, it is better to have muscle micro-breaks more than 5% of the work period.

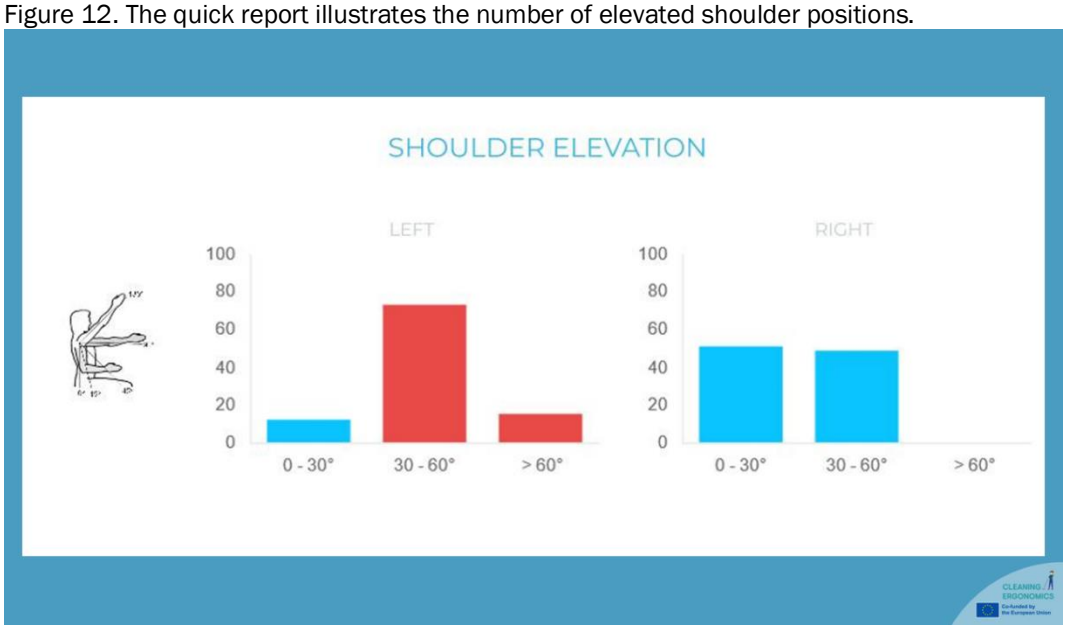


Shoulder elevation

Shoulder elevation should not be more than 30 degrees. The risk of musculoskeletal disorders increases if you work more than half of the time with your shoulders raised more than 30 degrees and your arms unsupported.

Shoulder elevation of more than 60 degrees should not occur for more than 10% of working time.

Figure 12. The quick report illustrates the number of elevated shoulder positions.



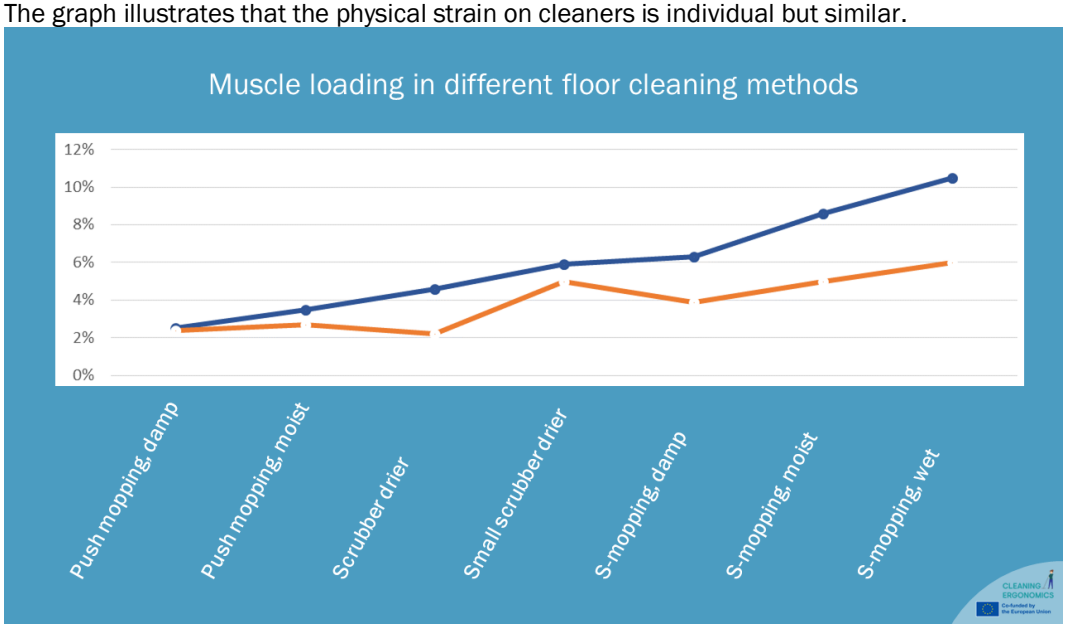
RESULTS

Loading is individual

According to the measurements, the cleaning workload is individual. The same work method can make one person more susceptible to musculoskeletal disorders than another. Factors such as age, physical condition, weight, and state of health does matter.

Despite individual differences, the results were similar for both cleaners. This became apparent when comparing the sum variables of the load of the different methods. The sum variable takes into account the load on the different muscle groups of the arms in relation to the maximum capacities. In the method-specific results, the value of the sum variable is shown as a percentage in the muscle load graph.

Figure 13. Sum variables were calculated to compare the muscle load of different cleaning methods. The graph illustrates that the physical strain on cleaners is individual but similar.



Choose the lightest cleaning method

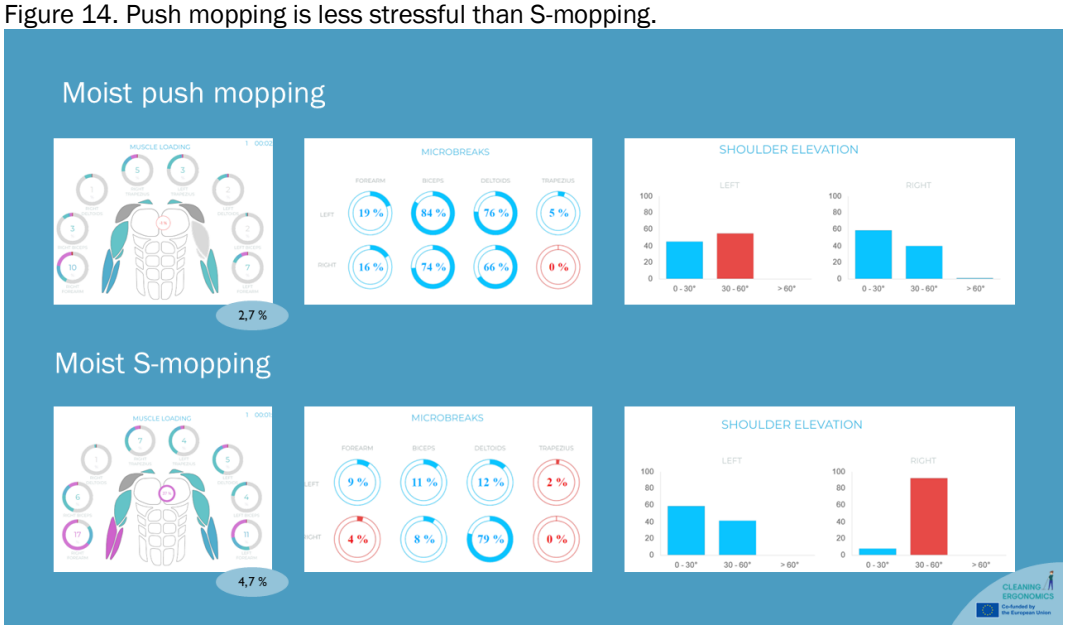
In Finland and Estonia, cleaning methods are divided into dry, damp, moist and wet methods. In the Netherlands and Hungary, methods are divided into dry, moist, and wet methods, with the moisture content of the moist method depending, among other things, on the surface material and dirt to be removed.

In the smart wear measurements, the workload of the damp, moist and wet methods was tested. When using a damp method, the surface dries immediately after wiping and after a moist method the surface dries in about half a minute. The wet method leaves the surface so wet that it needs to be dried.

Measurements showed that in floor mopping, the moisture content of the tool influences the load (see Fig. 5). The same result was not obtained for flat furniture surfaces. We wondered whether the friction between the surface and the cleaning cloth was higher for damp wiping than for moister methods.

The working method also has an influence. Push-mopping was found to be less loading than S-mopping. A similar result was obtained when table surfaces were cleaned by push-wiping with an interior flat mop and by S-wiping.

Figure 14. Push mopping is less stressful than S-mopping.



Choose a machine over a hand tool

The use of cleaning machines makes work easier. In these studies, the use of a scrubber drier was one of the least burdensome methods. With one of the cleaners, the load on any muscle group did not exceed 10%, which is considered the threshold for exposure to musculoskeletal disorders. The other worker had a load below 10% otherwise, except for the right forearm, where the load was 11%. The diagram of the elevated shoulder positions suggests what changes could be made to the machine's push handles to make the grip less stressful.

Figure 15. Using a scrubber drier is less stressful than S-mopping.

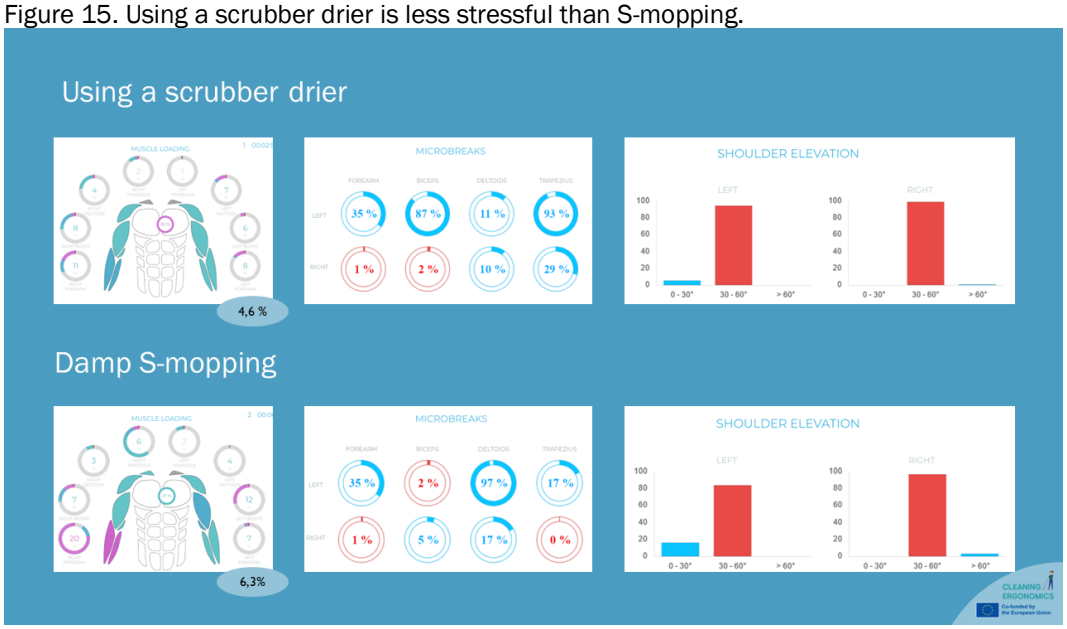
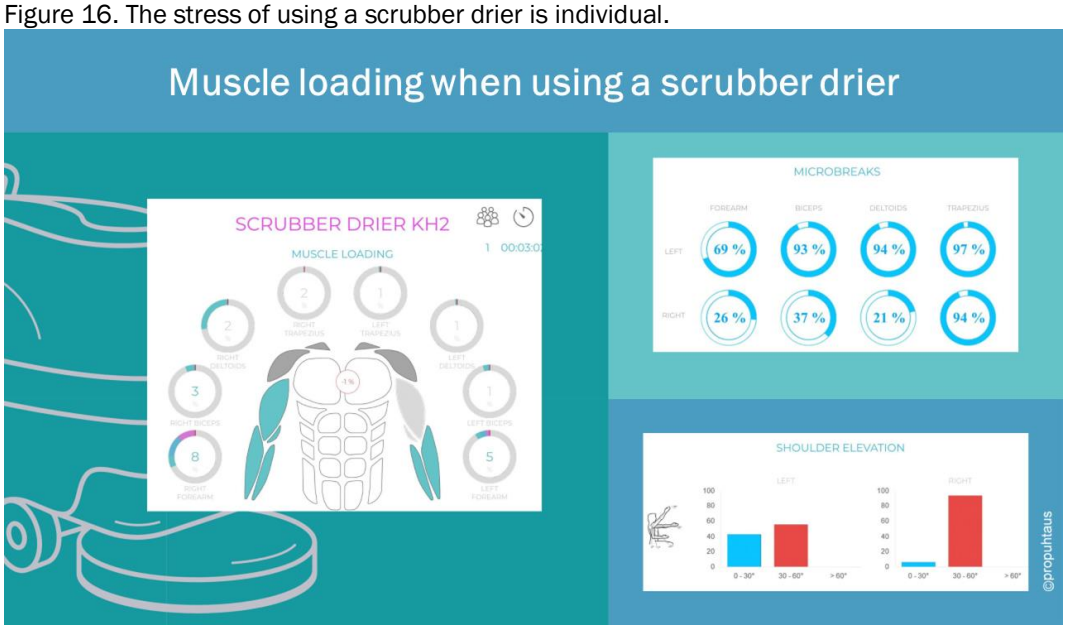


Figure 16. The stress of using a scrubber drier is individual.



When using a small scrubber drier, the load capacity was higher than the scrubber drier, but lower than the S-mopping (see Figure 13).

In the case of textile floor vacuuming, the load is significantly influenced by the working technique: whether one knows how to reduce the load by using the leg muscles to achieve the working movement or whether one uses the arm muscles.

Use the lightest tool possible

Cleaning equipment affects the workload. We compared a microfibre cloth and a flat interior mop for cleaning flat surfaces, a mop and a squeezee mop for mopping floors, and a dish brush, sponge and microfibre cloth for cleaning sinks.

We noticed that it is important to master the correct use of the tool. If the tool is not used correctly, the load may be at the beginning greater than with a familiar tool.

According to our measurements, from the point of view of workload, it is better to choose a flat interior mop for cleaning flat surfaces and a squeezee mop for mopping floors.

Figure 17. Using a squeezee mop is less stressful than using a mop if the tool is known.

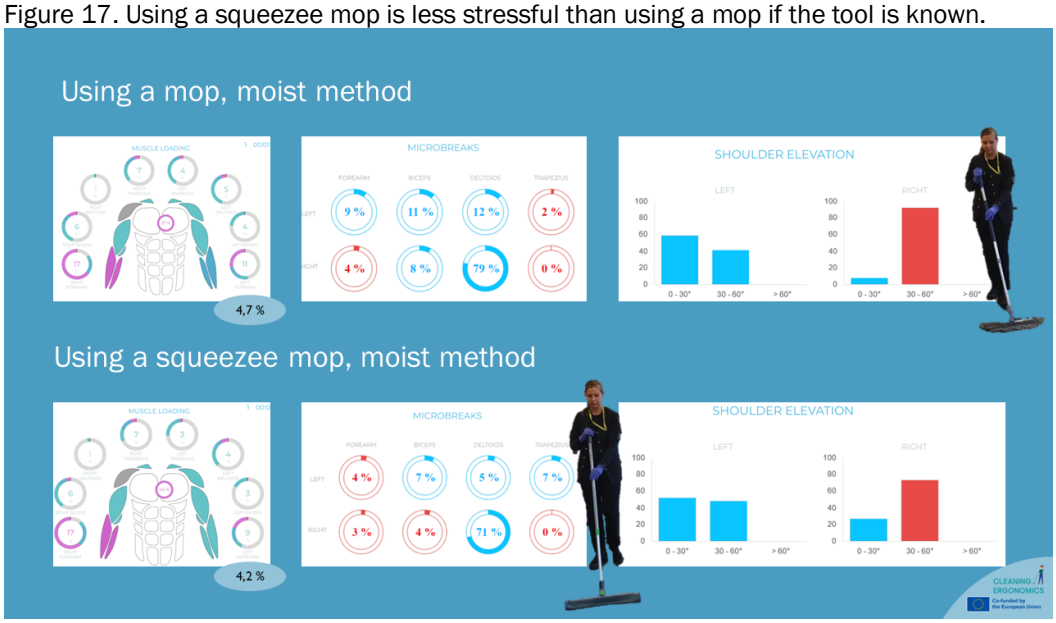
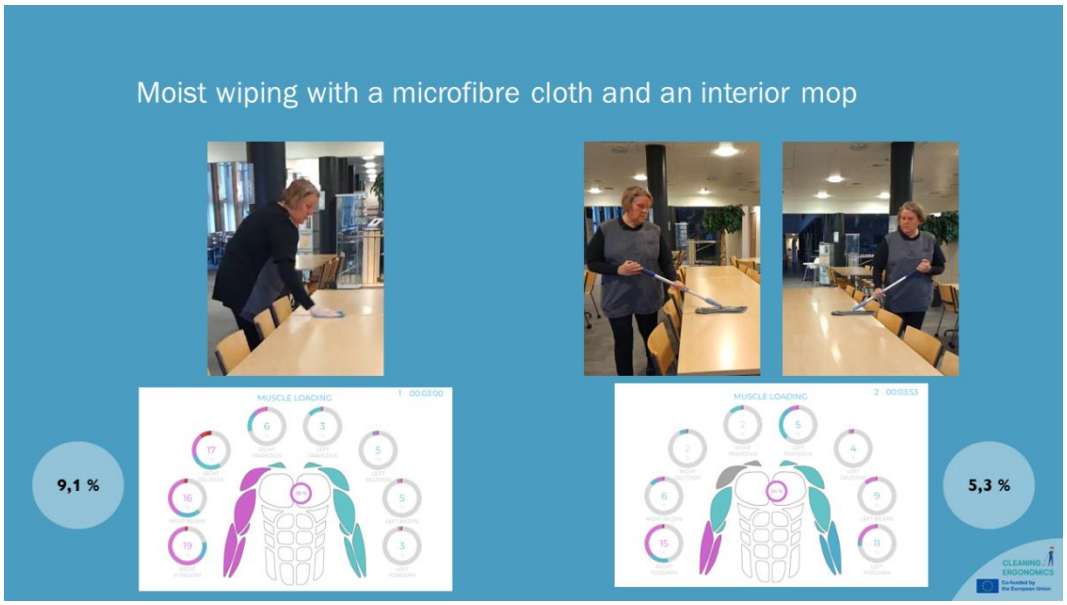
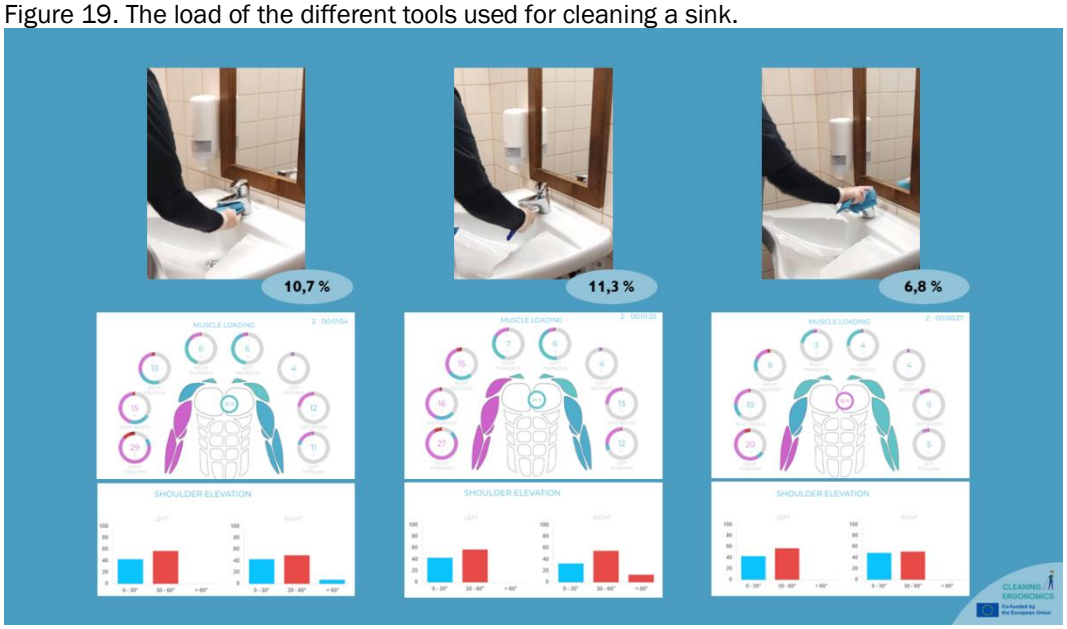


Figure 18. In all wiping methods, the use of a flat interior mop was less stressful than cleaning the surface with a microfibre cloth.



When cleaning a sink, the use of a microfibre cloth or a sponge was less burdensome than using a dishwashing brush.

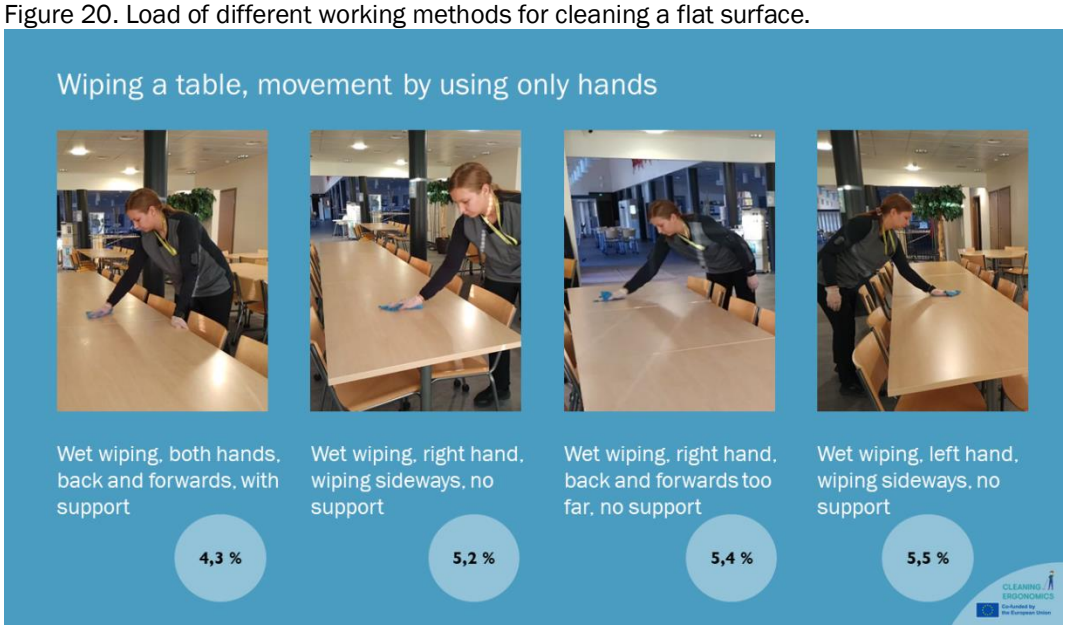
Figure 19. The load of the different tools used for cleaning a sink.



Practice the most ergonomic way of working

There are several ways to reduce hand strain. Traditionally, ambidexterity is recommended, but this requires good control of the work to reduce the load. Our tests showed that ambidexterity is not useful unless you can do the work smoothly with both hands. Training is therefore needed to be able to wipe a flat surface, for example, correctly and fluently with both right and left hands.

Figure 20. Load of different working methods for cleaning a flat surface.

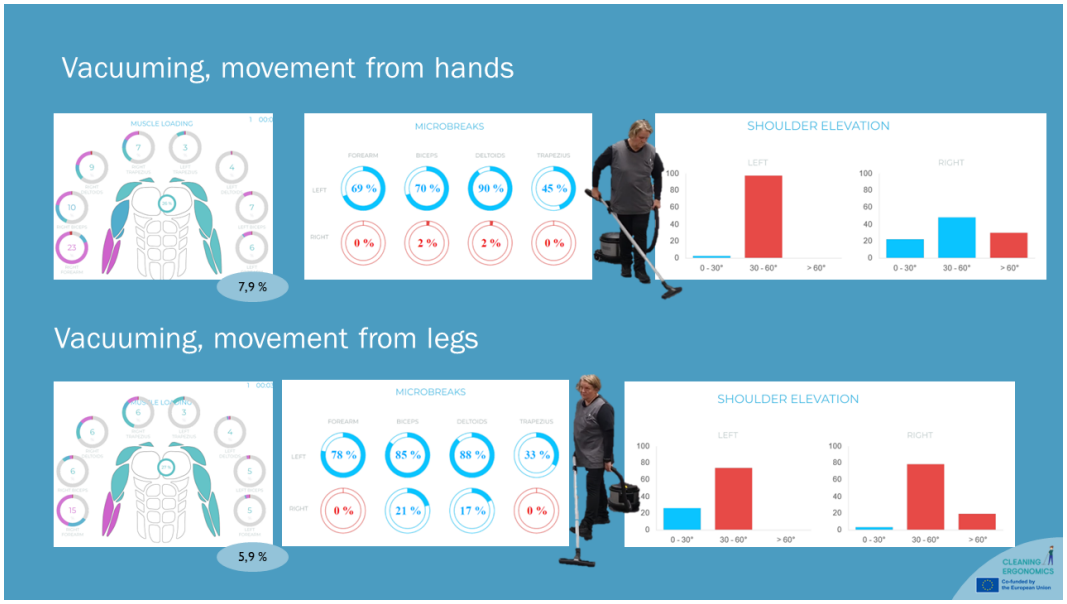


Use the leg muscles

Both cleaners were right-handed. The quick reports show that the right forearm was the most loaded arm in most of the methods.

The load on the arms can be reduced if you can make use of the movement of the legs during the work. In our tests, the muscle loading was lower when wiping and vacuuming if legs were used to produce movement. Work with the hands is lightened when the centre of gravity of the body is brought closer to the area to be cleaned by the movement of the feet. A recommended working method that is worth learning

Figure 21. The load is reduced if the working movement during vacuuming is produced by the movement of the feet.



Mopping backwards or forwards?

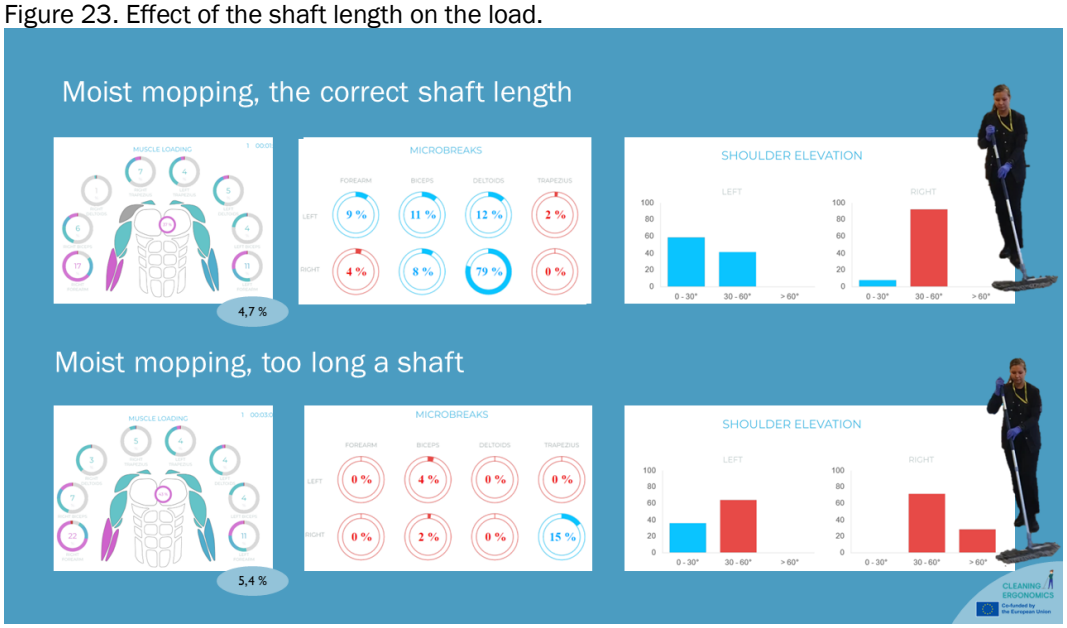
The way of mopping varies from country to country. In Estonia and Finland, it is recommended to mop the floor moving forward. The reasoning is to see the dirt and for safety reasons - you can see where you are going and you don't have to twist your torso and neck when looking backwards. In the Netherlands and Hungary, mopping is often done by moving backwards to avoid walking on the cleaned surface.

Figure 22. Load of mopping methods

Avoid: Too long a shaft

We also deliberately tested ways of working that we thought were wrong or bad. The measurements clearly showed the importance of the correct length of the tool shaft. If the upper palm repeatedly rises above the shoulder level when mopping, the load is reflected in the forearm and possibly also in the upper arm.

Figure 23. Effect of the shaft length on the load.



Adjusting the shaft to the right length is all the more important when using heavy cleaning methods.

Below are the results of wet mopping forwards and backwards for both workers when the shaft was set too long. The figure shows that there are also shoulder elevations over 60 degrees. Positions above 60 degrees should not occur for more than 10% of the working time.

Figure 24: Wet mopping load for person A.

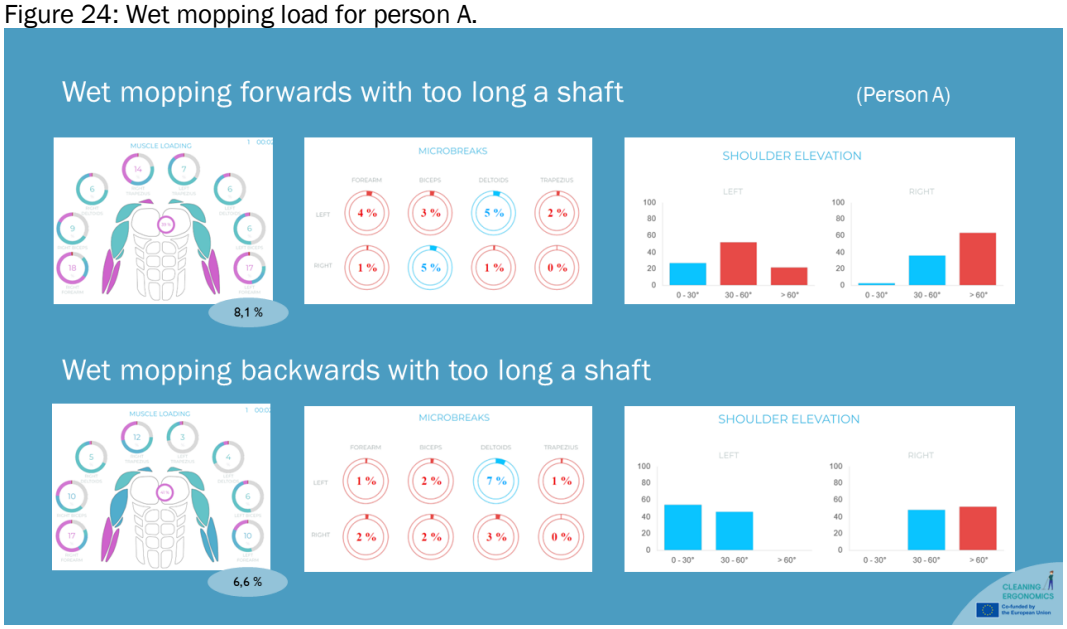
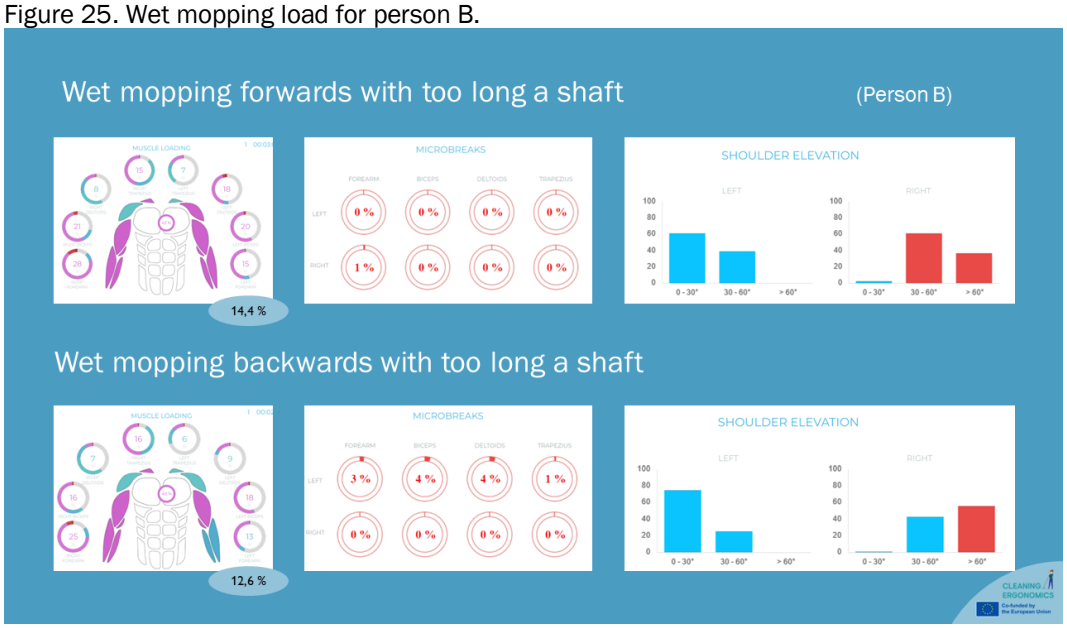


Figure 25. Wet mopping load for person B.



Avoid: Too wide a movement

The right forearm is stressed by too wide a mopping movement.

Figure 26: Too wide a working movement increases muscle strain and reduces micro-breaks in muscle work.

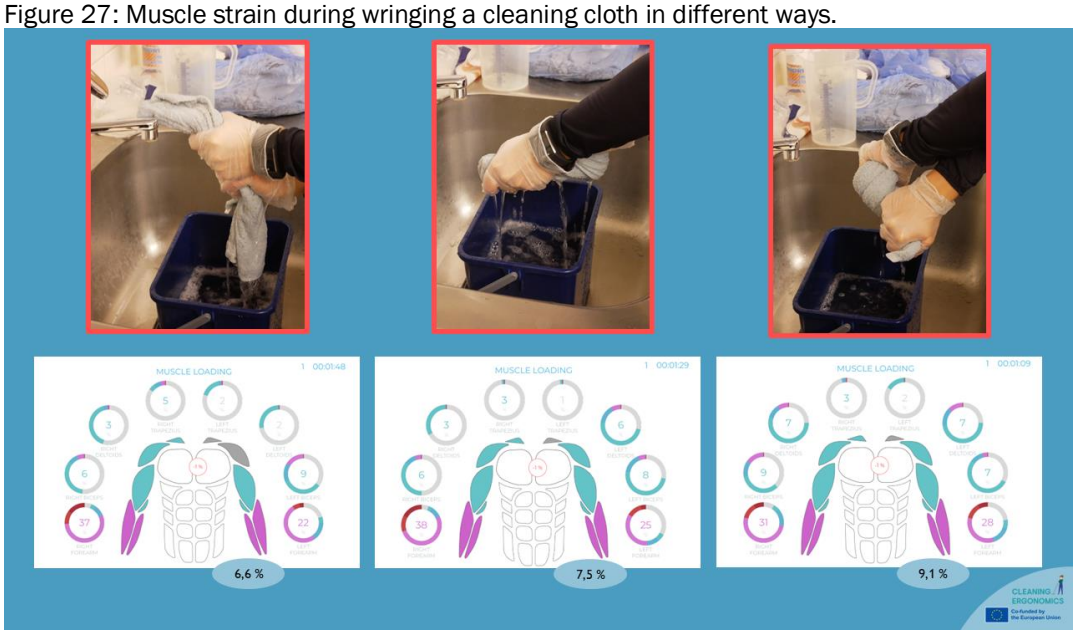
The lateral working movement is also a strain when wiping flat surfaces, where a back and forth working movement in the mid-torso area is recommended.

Do not wring cleaning cloths, pre-moisten

Pre-preparation of cleaning textiles is recommended. By pre-moistening cleaning cloths and mops at the beginning of the working day and not having cleaning solutions in buckets in a cleaning trolley, manual wringing of the cloths is avoided.

However, we tested different ways of wringing a cleaning cloth. The load on the forearms of the right hand exceeded 30%. The risk of musculoskeletal disorders increases if the 30% load lasts for more than 10% of the daily working time.

Figure 27: Muscle strain during wringing a cleaning cloth in different ways.



Accidents

As part of the ErgoClean project we contacted the Eurostat ‘Health and Safety at Work’ statistics. They informed that they do not have statistics on cleaner occupation level (occupation number/class 911 (ISCO)) but they encouraged us to contact the statistical authority in each country.

So, we made inquiries to the statistical offices of the 20 European countries to get an overview of the most common occupational diseases and accidents in the field of cleaning. In addition to the statistics, our aim was to collect information about prevailing cleaning methods, cleaner training systems, training materials, and working environments and analyse and compare them to the numbers of accidents.

When we got answers, it became clear that many countries do not collect this type of statistic, and that the statistics were collected different ways from country to country. We did get statistics from some countries, but we didn't get a real overview.

Based on the available data collected, we can assume that the most common accidents in the field of cleaning are falls, sprains, incisions with objects and knockdowns against objects.

The top of the occupational diseases is pain in the lower back, wrists, arms, and shoulders. Also, every year the share of mental tension and stress also worsens.
