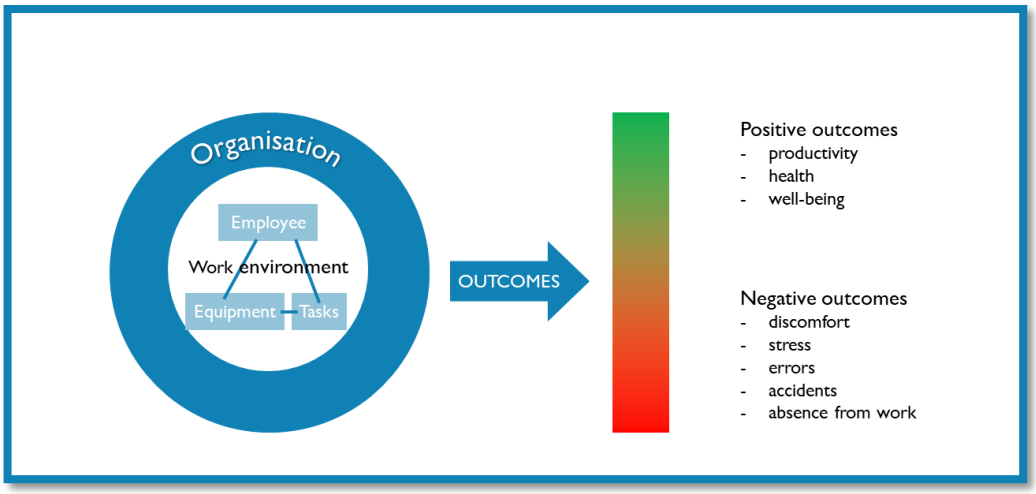
Ergonomics and accidents in cleaning work



CLEANING ERGONOMICS

ErgoClean, Cleaning ergonomics – to prevent occupational diseases and accidents

This report has been compiled by the following companies:
Estonia - Puhastusekspert OÜ (Veronika Kahre, Helge Alt)
Finland - Propuhtaus (Tarja Valkosalo)
Hungary – Brite-Sol (Judit Kiss)
The Netherlands – SVS B.V. (Lydia Huizinga, Frans Tijsse Klasen, André de Reus)

Report author: Tarja Valkosalo

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Preface

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

To obtain the required information, surveys were carried out among cleaners and supervisors, and existing training materials were mapped out. Information on the numbers of and reasons for accidents and occupational diseases was sought, but such information was available from a few countries only. To obtain more information on the workload in cleaning, smart wear measurements were carried out.

This report presents the survey results and smart wear measurements obtained.
A list of existing training materials is published on every partner website and on the project website ergoclean.eu.

The results will be used to plan the content of the guidance materials to be produced by the ErgoClean project. The aim is to develop materials for training in the ergonomics of cleaning so as to prevent the most common occupational diseases and accidents.

Because of the relatively small scale of this research, no scientific conclusions can be drawn for the time being.

Main findings

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

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

The working pace can cause stress and increase the workload. Around one in two cleaners and supervisors feel busy daily or weekly. On the positive side, most respondents felt that they could influence their work pace to some extent at least.

The surveys show that supervisors have more influence over their own work than cleaners do. One in three cleaners felt that they had no influence at all on the content of their work, while only 6% of the supervisors did.

The survey results also show that cooperation with the facility management and the users of the premises is needed to improve the working conditions of cleaners. Work ergonomics is also affected by cleanability, space planning, surface materials, and their condition.

The quick-report images produced by the smart wear measurements help us to visualise the muscle load. The red colour in the images draws attention to the muscle groups under strain, 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 methods, tools, and styles of work in situations where alternative methods for removing dirt are available.

The measurements also highlighted the importance of correct use of tools. 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.

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

According to the measurements, the load on the thigh muscles in cleaning work was very low. 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 the ways 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 too long a tool handle or with too wide mopping movements and not mop if a scrubber drier can be used.

When we look at the results, however, we should bear in mind that the choice of cleaning methods is influenced by many factors. 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 strain 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 humans and other parts of the operating system and applies the theoretical principles, knowledge, and methods of ergonomics to optimising human well-being and the efficiency of the operating system.

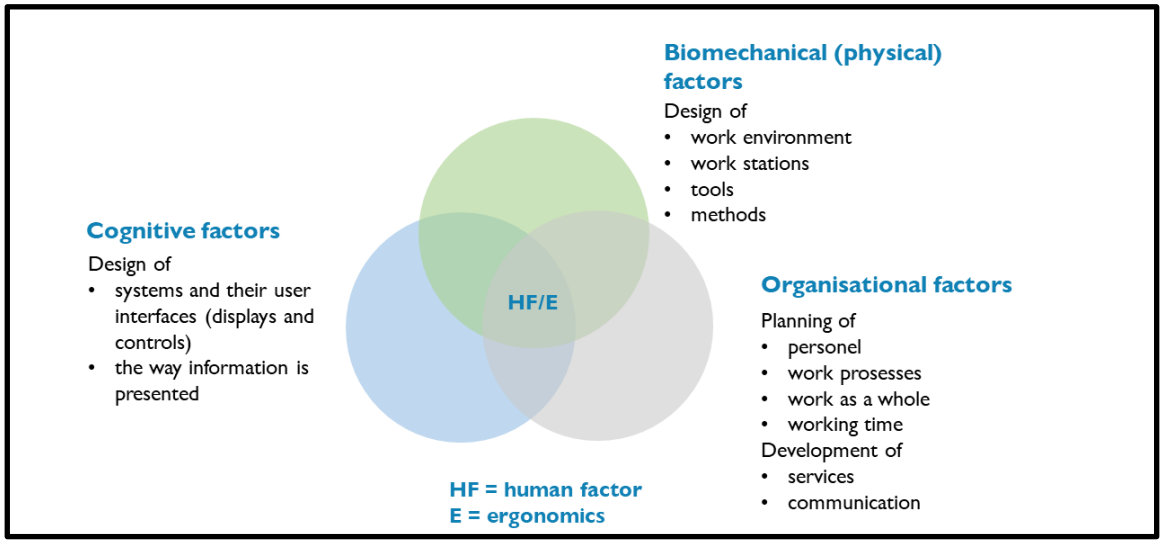
Ergonomics is often divided into biomechanical (physical), cognitive, and organisational ergonomics (Fig. 1).

Biomechanical (physical) ergonomics focuses on the development of the working environment, the work equipment, workstations, and working methods from the individual perspective. The development of interaction between humans and the physical environment must take into account factors such as working movements, working postures, and the handling of the workload.

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

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

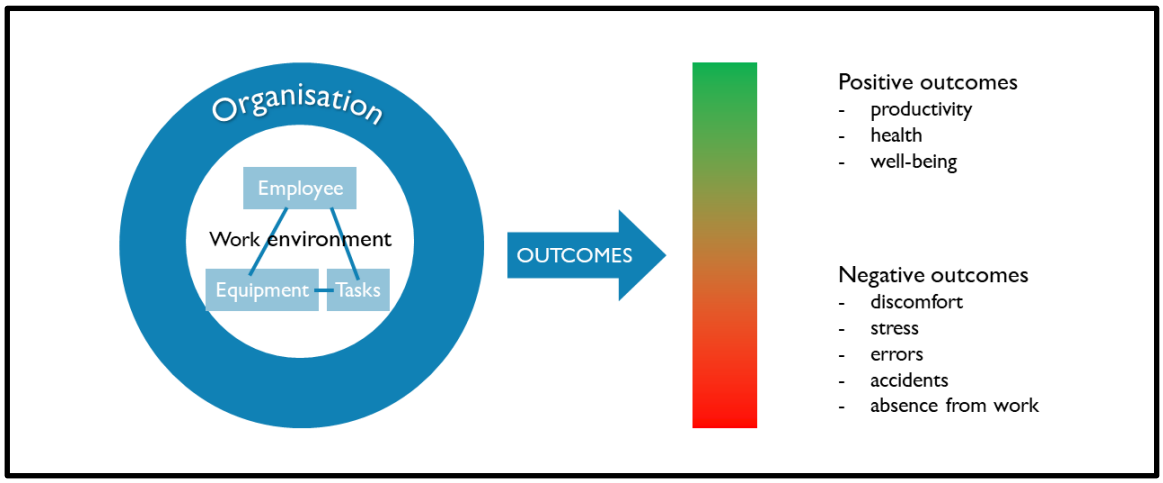
Figure 1. What is ergonomics?



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

Ergonomics is affected by the organisation of work. A work system consists of an employee and the 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 absences from work. Positive outcomes include productivity, health, and well-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 of cleaners and supervisors were carried out. 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.

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

The surveys were carried out in November 2022. Questionnaires were sent to ten organisations in each country, and they were answered by a total of 267 cleaners and 147 supervisors. The survey was conducted as an electronic survey without collecting any extra personal, employer or other information from the respondents.

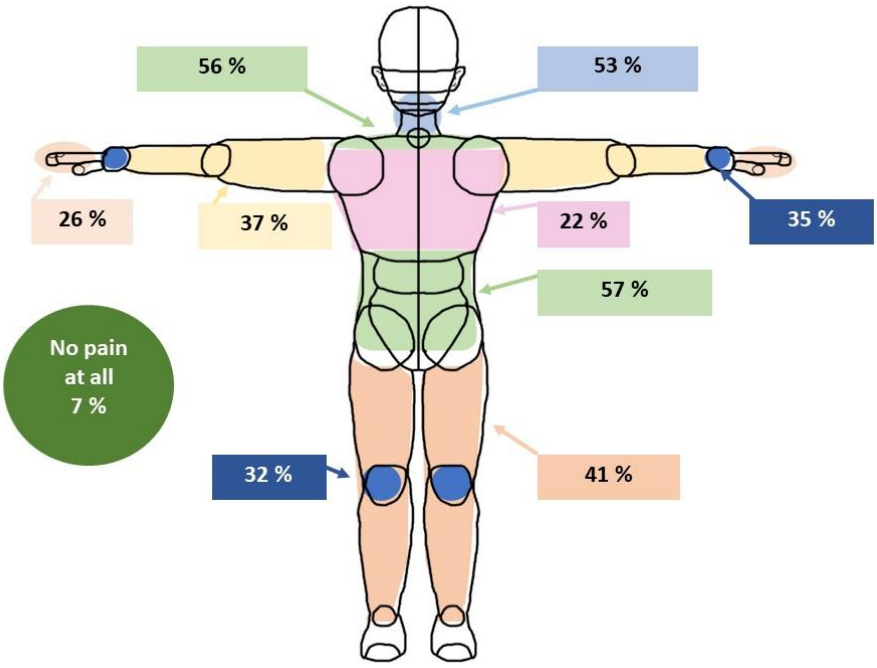
According to the responses, cleaning work is regarded as a good job overall. Ninety-three per cent of the cleaners and 97% of the supervisors considered their work to be meaningful, and 54% of the cleaners and 75% of the supervisors were always or often enthusiastic about their work.

RESULTS

Musculoskeletal disorders in cleaning work

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

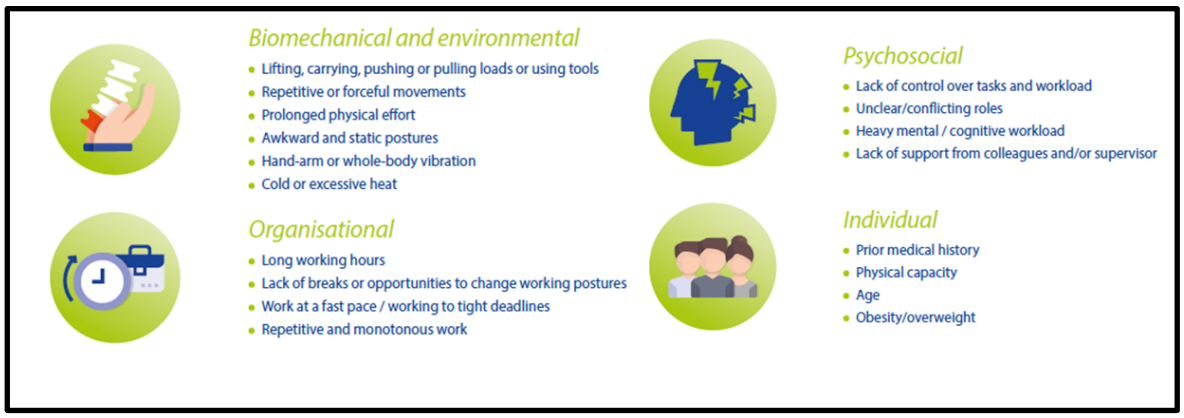
Figure 3. The percentage of cleaners who had experienced pain in different body parts.



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 factors.

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



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

Biomechanical and work environment factors

Biomechanical and work environment factors include the strain caused by carrying and lifting and poor and static working postures, which are also present in cleaning work. Also, the work environment has an impact because cleaners have no influence on their work environments.

The surveys were carried out to find out the experiences of both cleaners and supervisors related to the factors that hinder cleaning at workplaces. Both groups agreed on what these factors were (Fig. 5).

The main obstacles to cleaning were the amounts of stuff on tables and floors. Around 70% of the respondents felt that the amounts of stuff prevented efficient cleaning. Many also identified the large amounts and awkward positioning of furniture, poorly chosen flooring materials and the wear and tear of them as obstacles. Around one in three respondents had found customers' behaviour or indifferent attitudes to cleaning problematic.

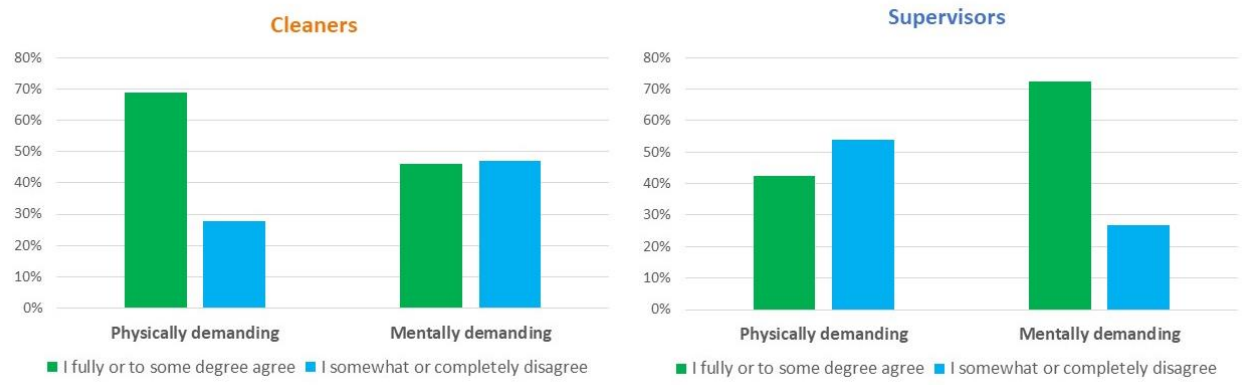
A cleaner can rightly be called a multi-space worker. They change workplaces several times a day and have no control over the ergonomics of the working environment. We know, after all, that the working environment also has significant effects on the ergonomics of cleaning work. These include the condition of the premises, the surface materials and furnishings, the cleanliness and tidiness of the premises, the air conditioning, and the waste management.

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

Figure 5. Percentages of the respondents reporting various factors that hinder cleaning and hamper ergonomics.

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

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

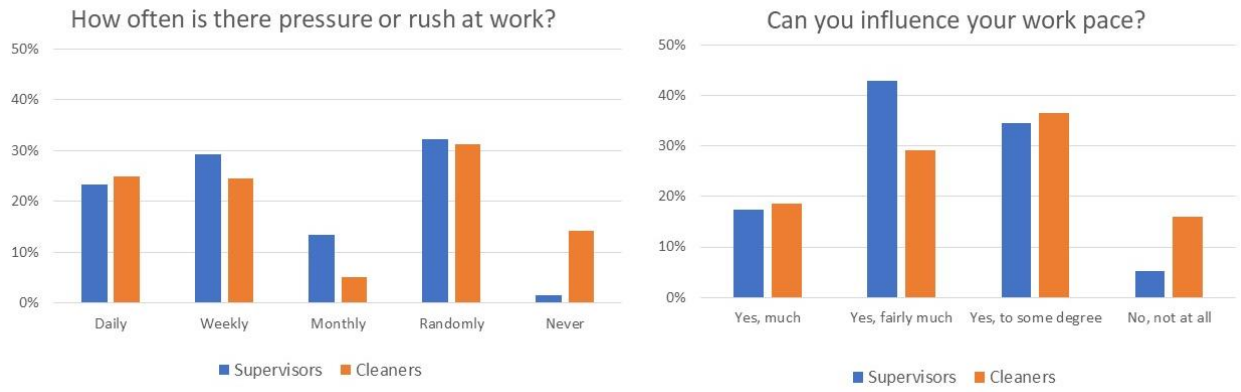


Organisational factors

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

The surveys explored how often the cleaners and supervisors felt time pressures at work and whether they could do anything about it. Around one in two cleaners and supervisors felt rushed daily or weekly. On the positive side, most respondents felt that they could influence their work pace at least to some extent (Fig. 7).

Figure 7. Cleaners' and supervisors' experiences of being rushed at work and possibilities of influencing their work pace.



Psychosocial factors

Psychosocial strain can arise if the workers have little control over their work and workload, if the work is emotionally demanding, and if support from colleagues and supervisors is lacking.

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

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

The surveys show that supervisors have more influence over their own work than cleaners do. One in three cleaners felt that they had no influence at all on the content of their work, whereas only 6% of the supervisors did. Thirty-nine per cent of the cleaners and 20% of the 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.

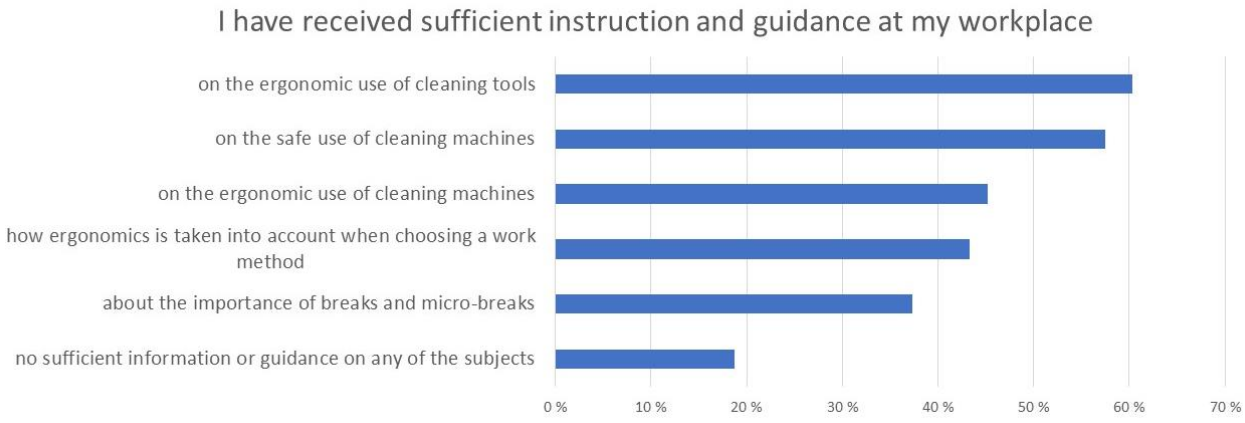
Need for guidance

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.

The cleaners were most satisfied with the training they received on the use of cleaning equipment (Fig. 8). Sixty per cent of the 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 was 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 at 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 were done with smart wear and technology from the Finnish company Myontec. Motion sensors in a smart shirt and shorts were used to measure the load on the arms, shoulder area, and thigh muscles, the number of micro-breaks during the muscle work, and elevated positions of the upper arms. It should be noted that not all muscle groups were measured with smart wear; the load on the back, for example, was not measured.

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

Including the 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 the cleaning methods and practices current in different countries, some methods that were not commonly used in all project countries were also selected for testing.

Table 1. The 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

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

Use of cleaning machines

- scrubber driers
- vacuum cleaners

Sink cleaning with

- a brush
- a sponge
- a microfibre cloth

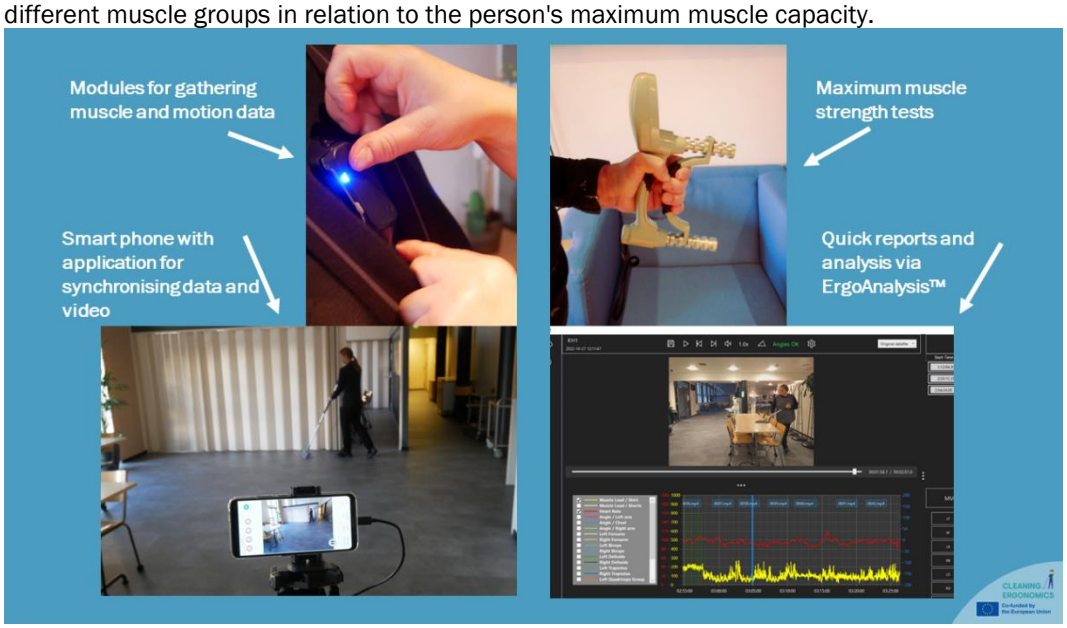
Cleaning a toilet seat

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, and the workload was related to them (Fig. 9).

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

Figure 9. Smart wear motion sensors measure the 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?

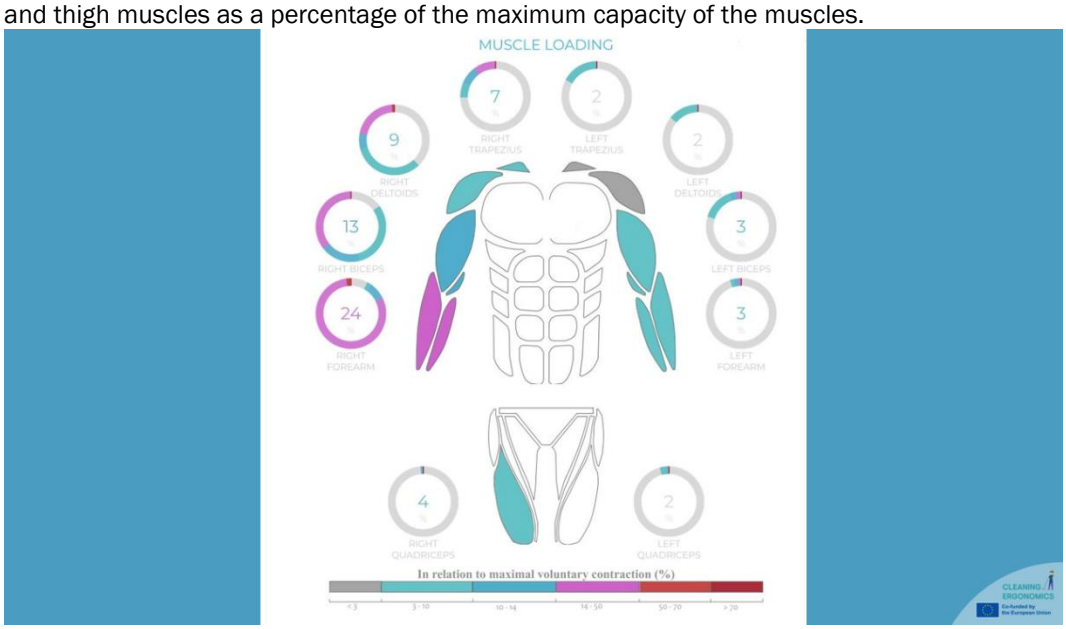
The results of the smart wear measurements are available in the form of quick reports (Figs. 10, 11, 12). The reports show, by colour and percentage, the load on different muscle groups and the number of micro-breaks and shoulder elevations.

Muscle load

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 in relation to study results from Lund University, which show that the risk of musculoskeletal disorders increases if the percentage of muscle strain exceeds 10% for more than a half the daily working hours or if it exceeds 30% for more than 10% of the working hours (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.



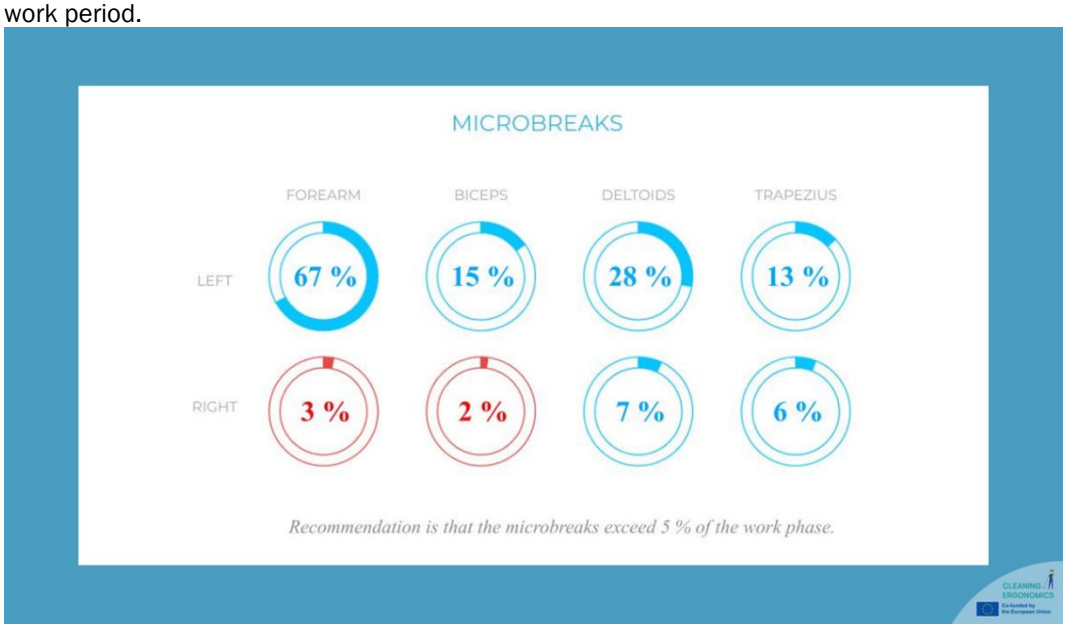
In the methods tested, the 10% threshold was almost always exceeded for at least one muscle group. For all muscles, a load of less than 10% was achieved only in damp and moist push-mopping methods and, with one cleaner, cleaning the floor with a scrubber drier.

The load on the thigh muscles was very low. No load 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 account for 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.

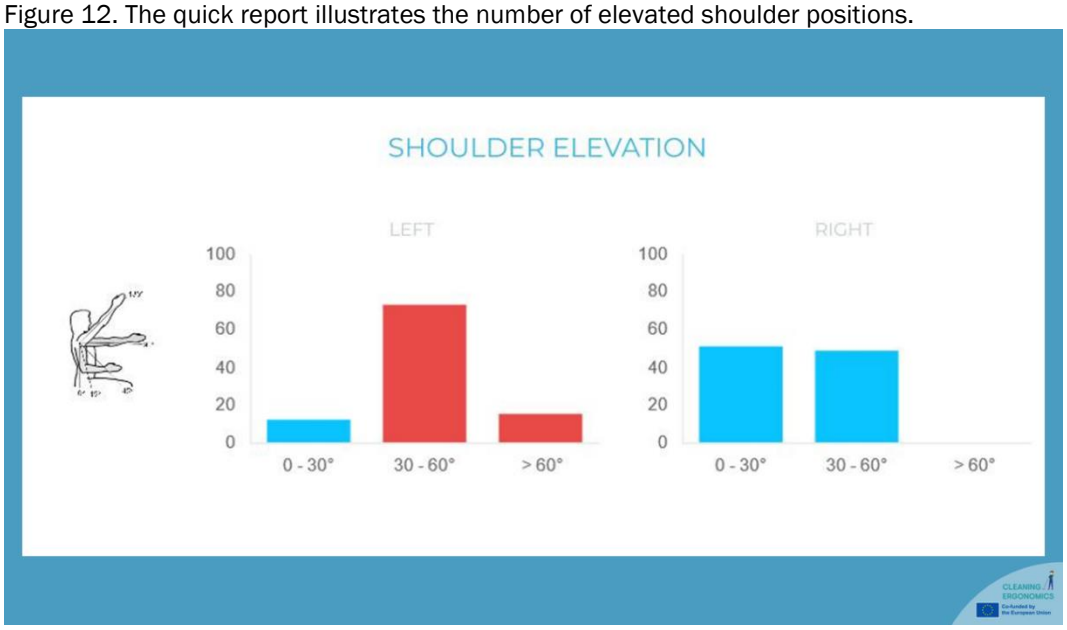


Shoulder elevation

Shoulder elevation should not exceed 30 degrees. The risk of musculoskeletal disorders increases if you work more than half 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 the working hours.

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



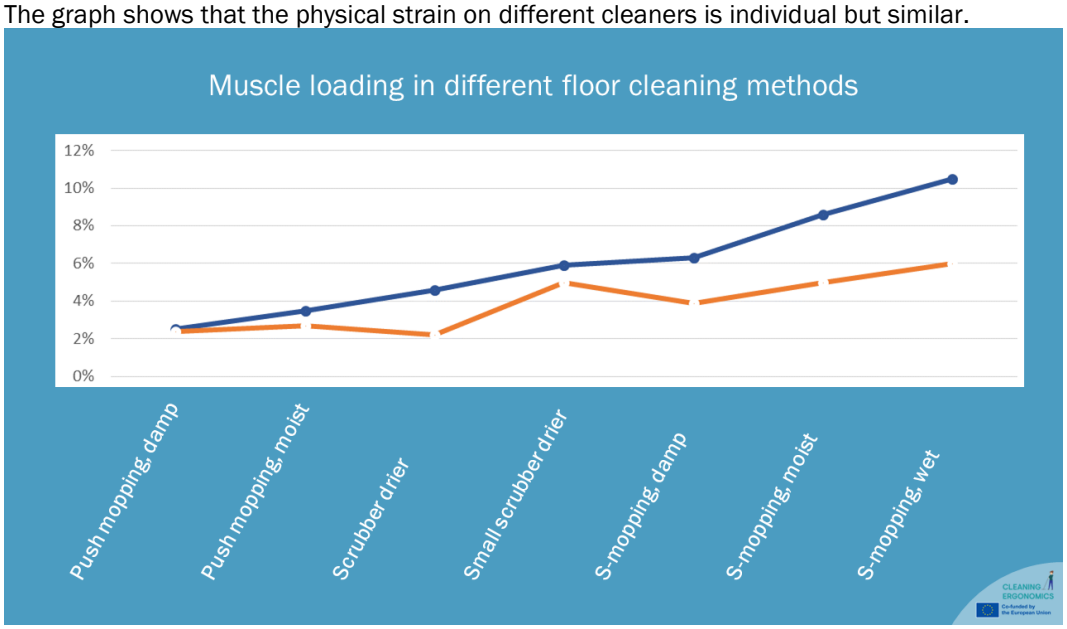
RESULTS

Muscle loads are 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 one. Factors such as age, physical condition, weight, and state of health all matter.

Despite individual differences, the results were similar for both cleaners. This became apparent when the sum variables of the load of the different methods were compared. 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 loads of different cleaning methods. The graph shows that the physical strain on different cleaners is individual but similar.



Choose the lightest cleaning method

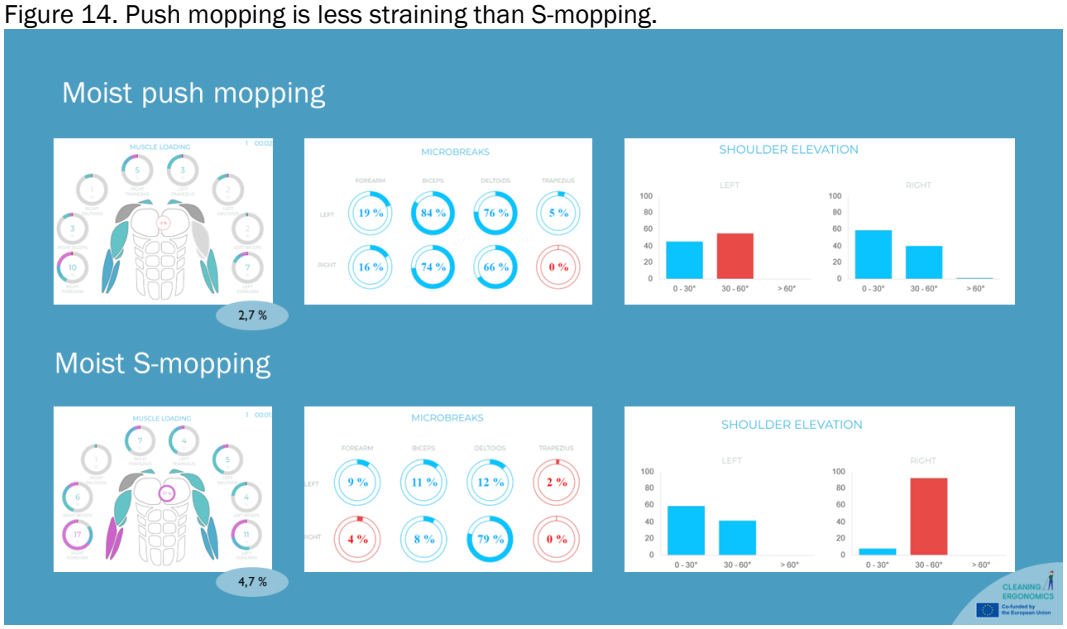
In Finland and Estonia, cleaning methods are divided into dry, damp, moist, and wet methods. In the Netherlands and Hungary, methods are divided into dry, moist, and wet methods, with the moisture content of the moist method depending, among other things, on the surface material and the dirt to be removed.

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

The measurements showed that in floor mopping, the moisture content of the tool influences the load (see Fig. 13). The same result was not obtained for flat furniture surfaces. We were left wondering whether the friction between the surface and the cleaning cloth was higher for damp wiping than for moister methods.

The technique 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 straining than S-mopping.



Choose a machine over a hand tool

The use of cleaning machines makes the work easier. In these studies, the use of a scrubber drier was found to be one of the least burdensome methods. With one of the cleaners, the load on no muscle group exceeded 10%, which is regarded as the threshold of exposure to musculoskeletal disorders. The other worker had a load below 10% for all other muscle groups but the right forearm, where the load was 11%. The diagram of the elevated shoulder positions suggests some changes that could be made to the machine's push handles to make the grip less straining.

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

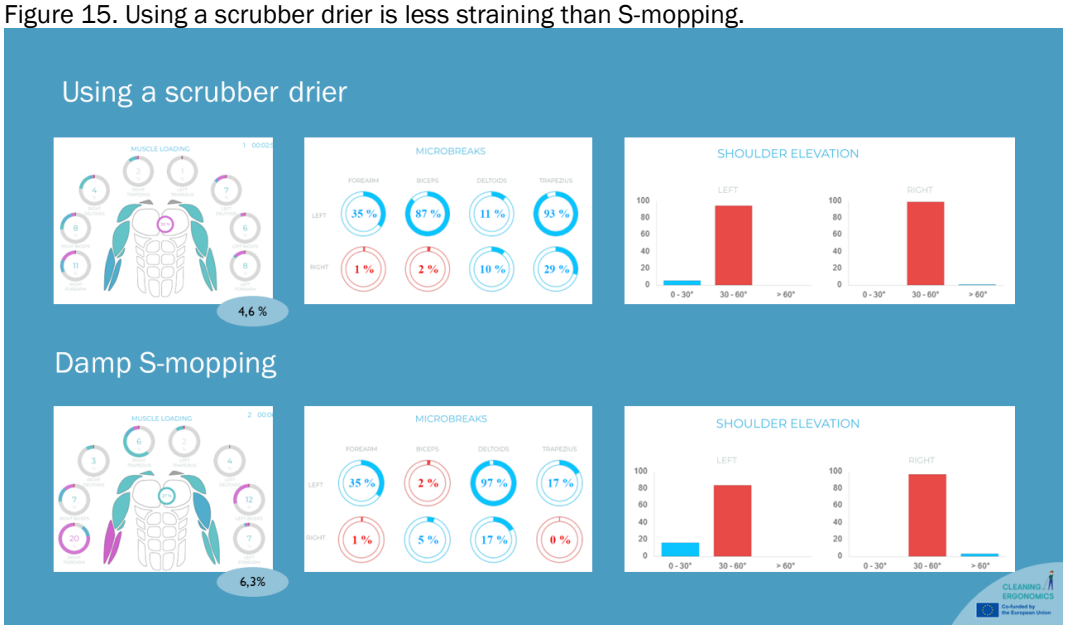
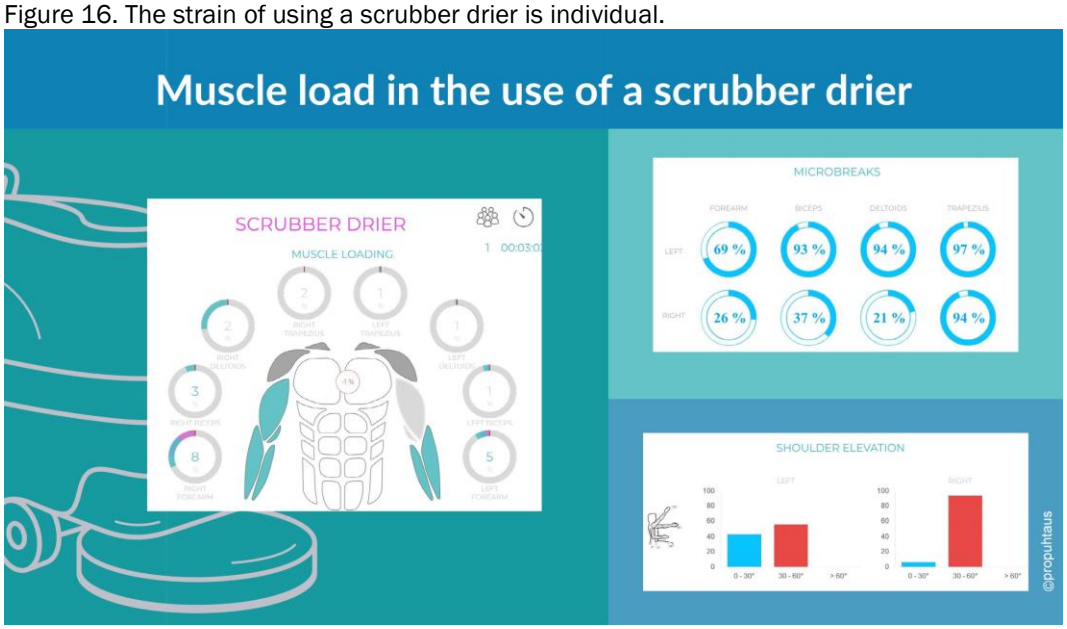


Figure 16. The strain of using a scrubber drier is individual.



When a small scrubber drier was used, the muscle load was higher than with a regular scrubber drier but lower than with S-mopping (see Figure 13).

In textile floor vacuuming, the muscle 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 only.

Use the lightest tool possible

The workload is affected by the cleaning equipment used. We compared a microfibre cloth and a flat interior mop in cleaning flat surfaces, a mop and a squeegee mop in mopping floors, and a dish brush, sponge, and microfibre cloth in 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 greater at the beginning than with a familiar tool.

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

Figure 17. Using a squeegee mop is less straining than using a mop, provided that the tool is familiar.

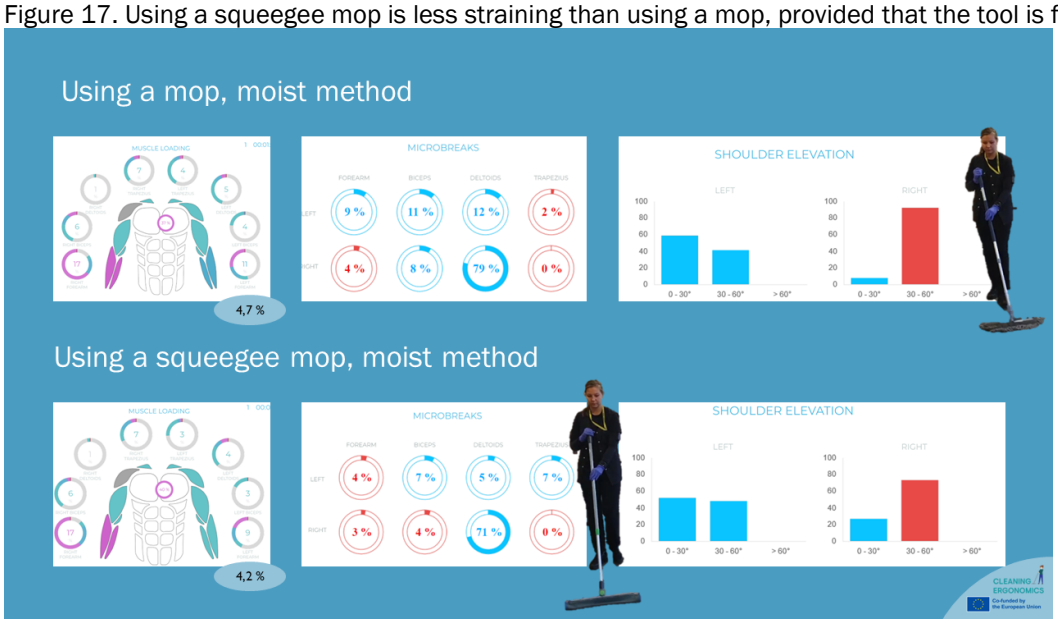
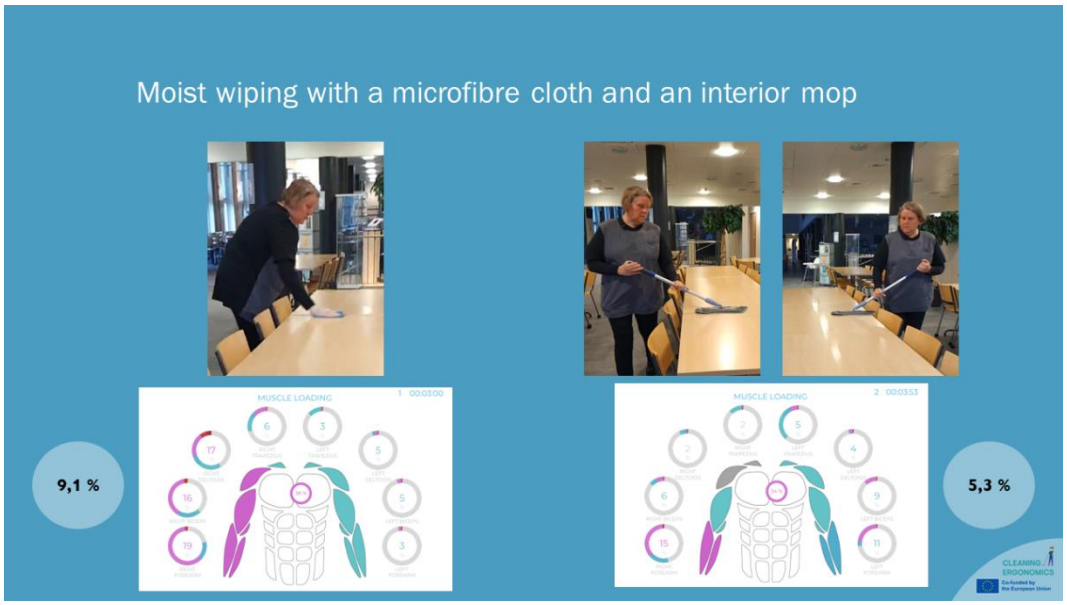
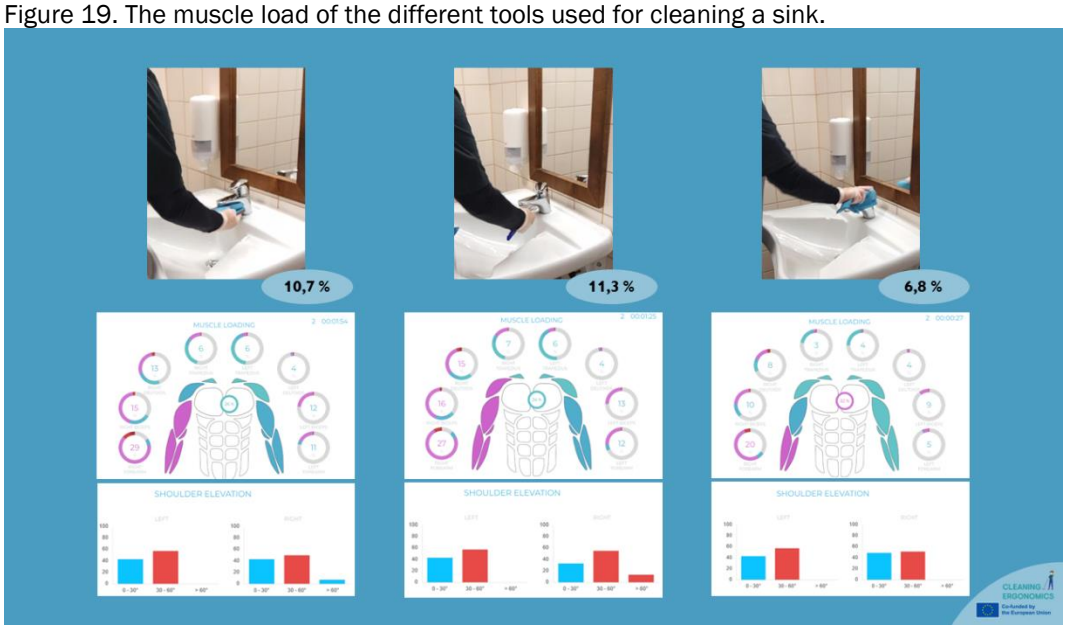


Figure 18. In all wiping methods, the use of a flat interior mop was less straining than cleaning the surface with a microfibre cloth.



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

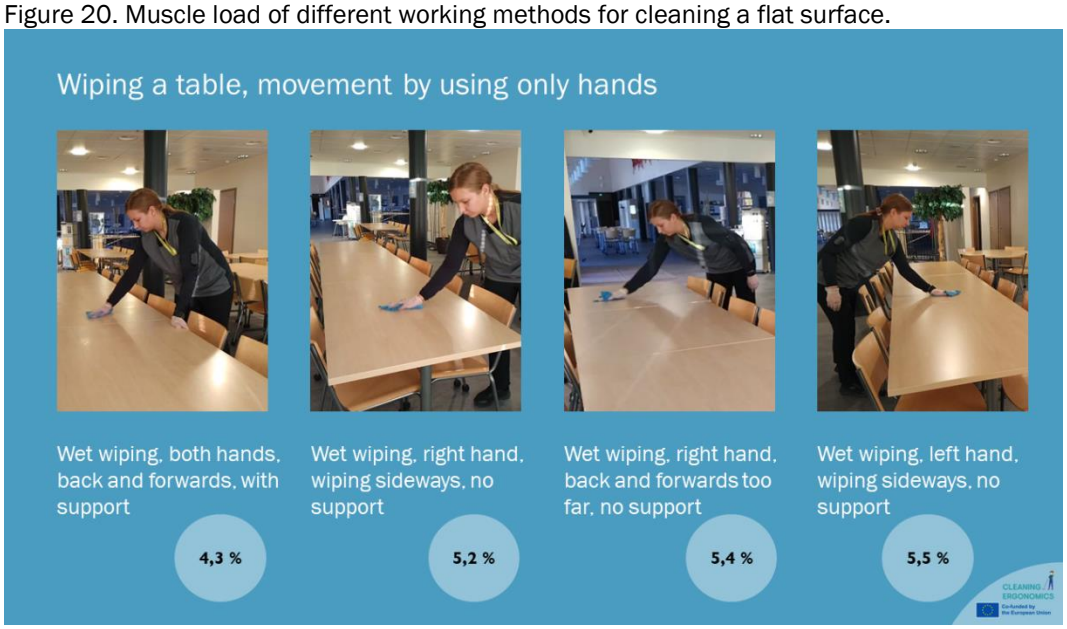
Figure 19. The muscle load of the different tools used for cleaning a sink.



Practise the most ergonomic way of working

There are several ways to reduce hand strain. Traditionally, ambidexterity is recommended when the goal is to reduce the load, but it requires good control of the work. Our tests showed that ambidexterity is not useful if you cannot work smoothly with both hands. To enable cleaners to wipe a flat surface, for example, correctly and fluently with both the right and the left hand, training is needed.

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

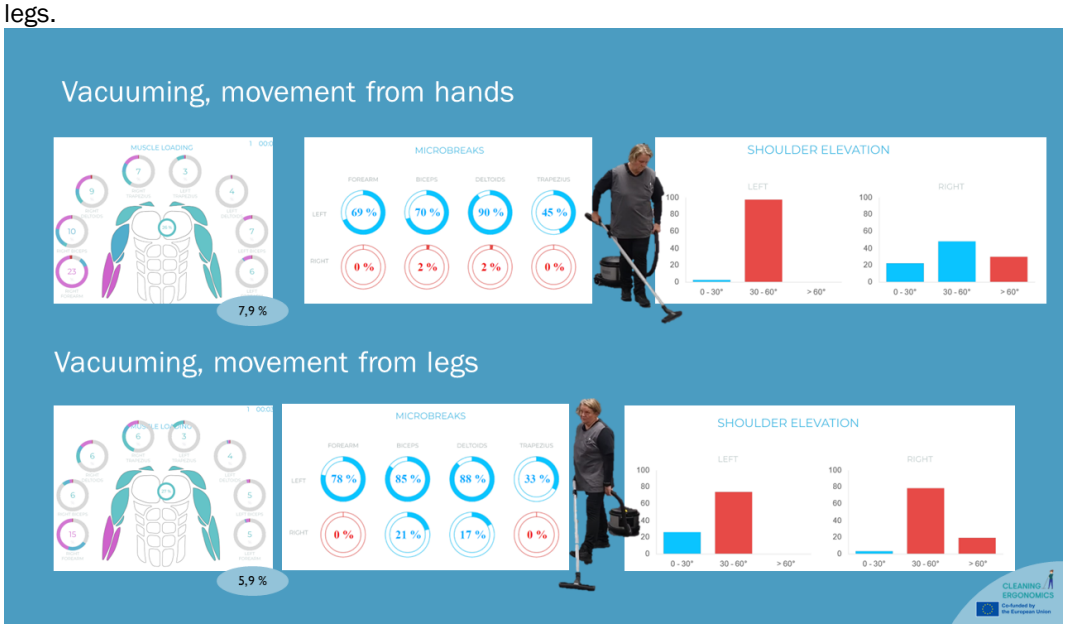


Use your leg muscles

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

The load on the arms can be reduced if you can make use of your legs during the work. In our tests, the muscle load was lower if legs were used to produce movement in wiping and vacuuming. Working with hands gets lighter when the body's centre of gravity is brought closer to the area being cleaned by leg movement. This working method is recommended and worth learning.

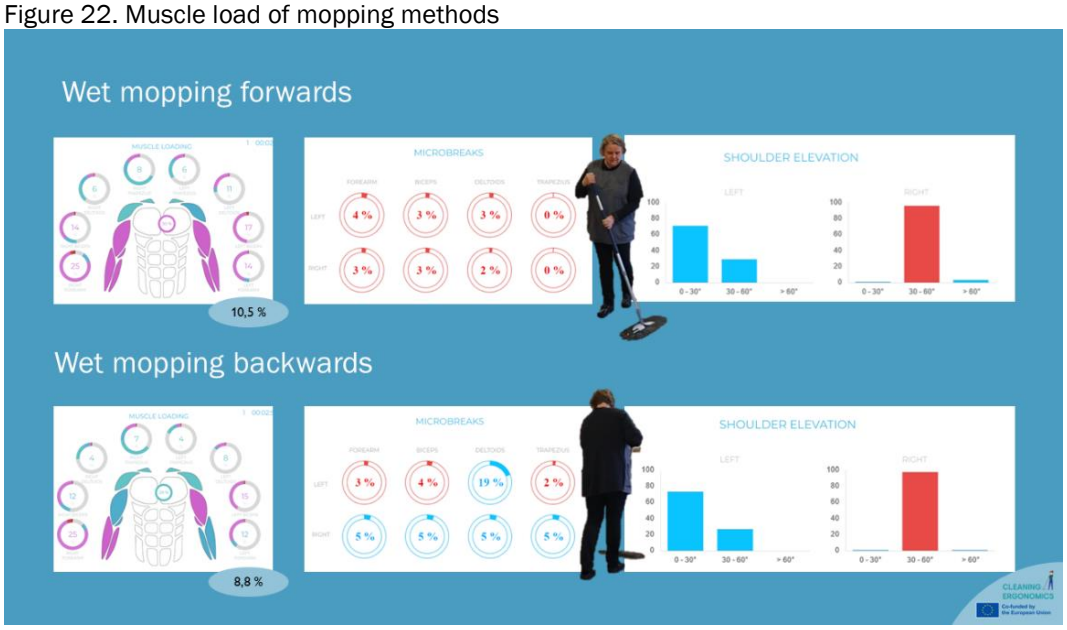
Figure 21. The muscle load of vacuuming is reduced if the working movement is produced with the legs.



Mopping forwards or backwards?

The manner of mopping varies from country to country. In Estonia and Finland, the recommendation is to mop the floor moving forwards. The reasoning is that this way you see the dirt and you also see where you are going, not having to twist your torso and neck looking backwards. In the Netherlands and Hungary, mopping is often done by moving backwards to avoid walking on the cleaned surface.

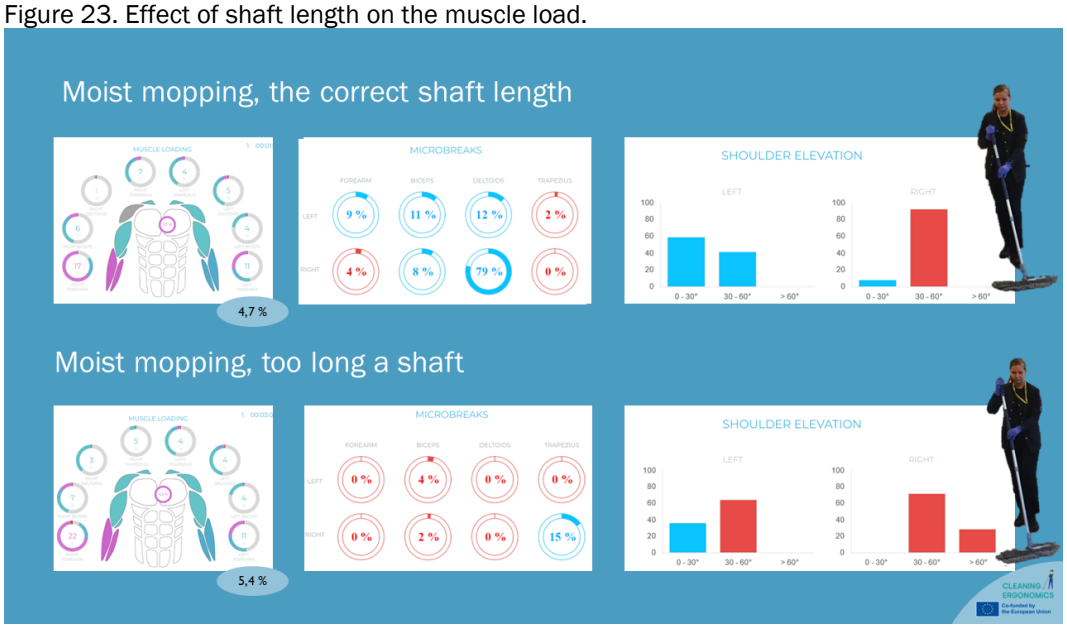
Figure 22. Muscle load of mopping methods



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 shaft length on the muscle load.

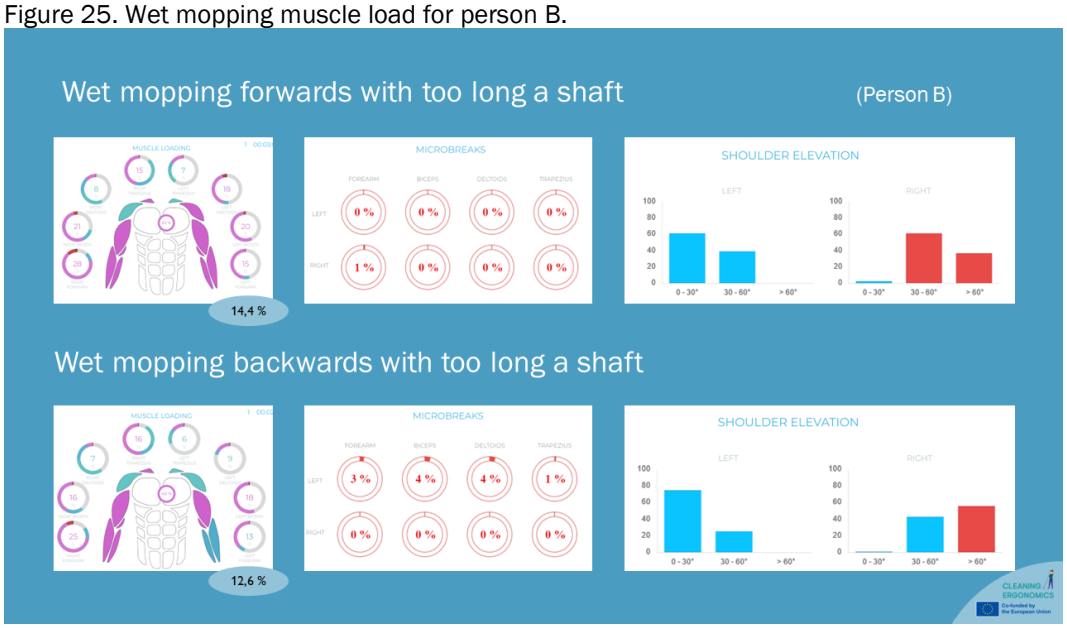


Adjusting the shaft to the right length is particularly important when heavy cleaning methods are used.

Figs. 24 and 25 show the results of wet mopping forwards and backwards for the two workers when the shaft was set too long. The figures show shoulder elevations of over 60 degrees. Positions above 60 degrees should not occur for more than 10% of the working time.

Figure 24: Wet mopping muscle load for person A.

Figure 25. Wet mopping muscle load for person B.



Avoid too wide a movement

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

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

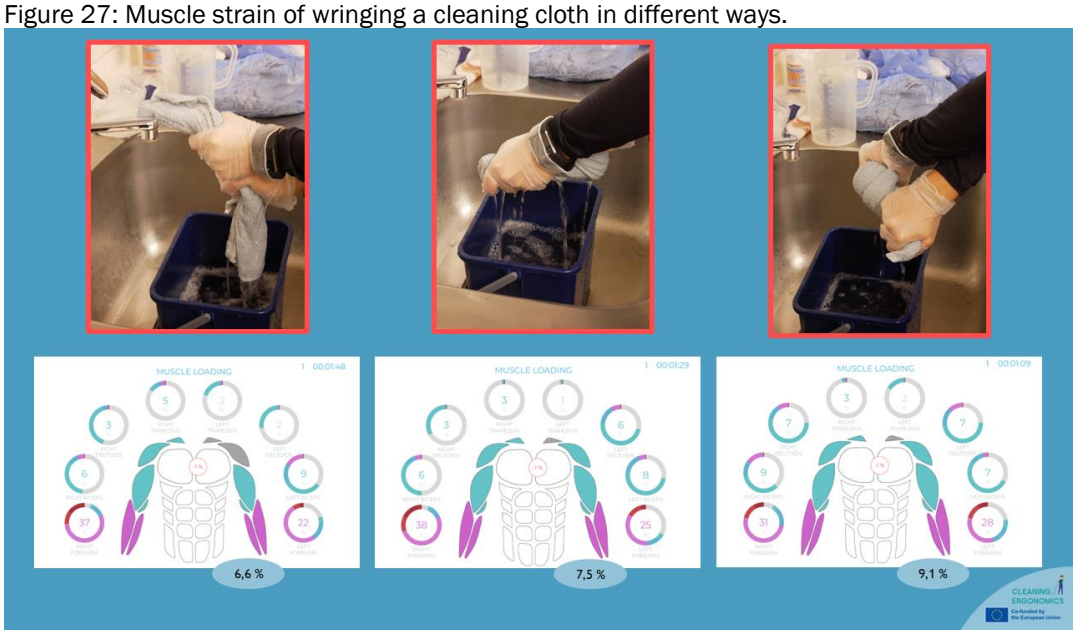
The lateral working movement also causes strain in wiping flat surfaces; instead, a back and forth working movement in the mid-torso area is recommended.

Do not wring cleaning cloths, pre-moisten them

Preconditioning the 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 can be avoided.

We tested different ways of wringing a cleaning cloth. The muscle load on the right forearm 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 of wringing a cleaning cloth in different ways.



Accidents

As part of the ErgoClean project we contacted the Eurostat 'Health and Safety at Work' statistics office for statistics on cleaners' occupational diseases and accidents. They told us they did not have statistics specifically on cleaners (occupation number/class 911), only on wider occupational groups, and encouraged us to contact the statistical authority in each country.

So we made inquiries to the statistical offices of 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 to analyse them and relate them to the numbers of accidents.

The answers we got made it clear that many countries do not collect statistics of this type and that the ways of collecting statistics vary from country to country. We did get statistics from some countries but not a real overview.

On the basis of the available data we can assume that the most common accidents in the field of cleaning are falls, sprains, incisions from objects, and knockdowns against objects.

At the top of the occupational diseases list there is pain in the lower back, wrists, arms, and shoulders. Also, the share of mental tension and stress grows from year to year.
