

COMPREHENSIVE ASSESSMENT OF THE RISKS OF SEDENTARY WORK

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Abstract

Recent research shows that musculoskeletal disorders remain a major health and cost problem and their importance is growing. This is reflected in the fact that musculoskeletal disorders are one of the top three concerns for European companies. The Community strategy on health and safety at work highlights the importance of better adapting the workplace to individual needs and the effective application of key ergonomic principles in workplace design and work organisation (EP, 2012). Despite continuous efforts, musculoskeletal disorders – back, neck and upper limb – remain a major health and cost burden. The work-body position has a similar perception, with relatively small outliers, but the proportion of working time spent on manual handling or repetitive hand or arm movements is steadily increasing. Recent European research also demonstrates that musculoskeletal disorders – back, neck and upper limb – remain a major health and cost problem and their importance is increasing. This is also indicated by the fact that musculoskeletal disorders are among the top three causes of concern for occupational health and safety in European companies (Szabó, 2011). This is why we chose to focus our research on a comprehensive assessment of the potential risks associated with sedentary work and to investigate the risk analysis methods that can be applied, using a laboratory work example.

Keywords: health and safety at work, sedentary work, ergonomics

1. Introduction

A key principle is that workers should have the opportunity to change between sitting and standing postures. The aim of alternating between standing and sitting is to reduce the risk of certain postures. The risk of standing can be reduced by the choice of flooring (floorboards, rubber mats) or better choice of shoes, and the risk of sitting by the purchase of appropriate chairs. When working in a sedentary position, not only should chairs be provided, but also a motionless posture, hunched shoulders, and hunched waist should be avoided. This can be achieved by good chair use habits, proper adjustment of chairs and a suitable workplace.

Humans have natural postures (sitting, standing, lying on their side) and are capable of long-term uncomfortable postures (reaching forward, hanging). Natural postures must be achieved both at work and when using equipment. For both standing and sitting work, natural posture requires a symmetrical position of the limbs at the trunk, the head slightly tilted forward and the feet on the ground.

Avoid: Single-acting additives:

- forward tilt of the trunk and head
- a posture requiring a raised upper arm
- the twisted body position
- stress on tissues sensitive to the support of the body

There are many studies and publications that show that sitting puts more strain on the spine than standing, and when combined with poor posture, this can lead to musculoskeletal disorders.

(Figure 1). This includes travelling to work, working, eating, using the commuting home from work or sedentary leisure activities. In addition, there is too little time for physical activity. This lifestyle is a major contributor to the development of intestinal diseases and can also lead to musculoskeletal disorders (Szabó, 2012).

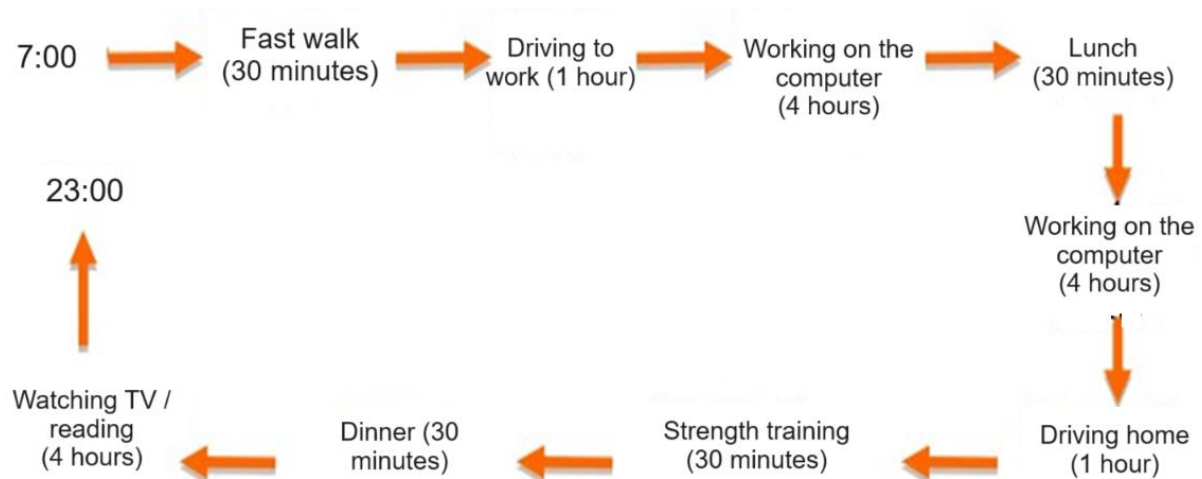


Figure 1. Example of the total sitting time of an adult person in a day

Sedentary workers may suffer from musculoskeletal problems due to inappropriate workstation design and/or posture:

- neck pain,
- neck stiffness,

- headaches.
- waist problems,
- tendonitis,
- numbness radiating to the forearm or fingers (Hignett and McAtamney, 2000; Herczeg and Izsó, 2007; Kozák, 2020).

2. Presentation of test methods

In our studies, the ergonomic risk assessment methods we used were:

- REBA – Rapid Entire Body Assessment,
- RULA – Rapid Upper Limb Assessment,
- measuring employee satisfaction with a questionnaire.

2.1. REBA – Rapid Entire Body Assessment

The Rapid Entire Body Assessment (REBA) method (*Figure 1*) is a problem detection tool that can be used to identify the presence of ergonomic risk, particularly for musculoskeletal disorders, in repetitive physical work in a given workplace (Hignett and McAtamney, 2000).

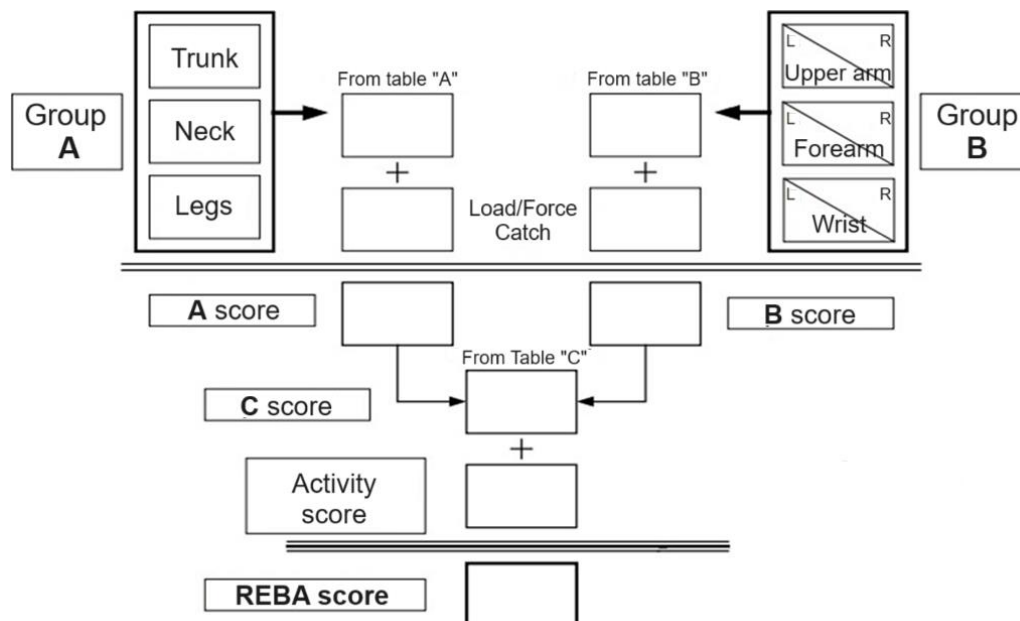


Figure 2. REBA evaluation sheet (Szabó, 2012)

2.2. RULA – Rapid Upper Limb Assessment

The Rapid Upper Limb Assessment (RULA) method is a paper-and-pencil-based problem-solving tool (*Figure 3*) to identify the presence of ergonomics, particularly the risk of musculoskeletal disorders, in a given workplace during repetitive physical work activities and is a method for investigating workplace ergonomics based on MSD reports (McAtamney and Corlett, 1993; Hignett and McAtamney, 2000; Herczeg and Izsó, 2007; Lee and Jung, 2015; Kozák, 2020).

RULA Employee Assessment Worksheet

Complete this worksheet following the step-by-step procedure below. Keep a copy in the employee's personnel folder for future reference.

A. Arm & Wrist Analysis

Step 1: Locate Upper Arm Position
 Diagrams showing upper arm positions: 0° to 20°, 20° to 45°, 45° to 90°, 90°+.
 Step 1a: Adjust...
 If shoulder is raised: +1;
 If upper arm is abducted: +1;
 If arm is supported or person is leaning: -1.
 Final Upper Arm Score =

Step 2: Locate Lower Arm Position
 Diagrams showing lower arm positions: 0° to 100°, 0-60°, 100°+.
 Step 2a: Adjust...
 If arm is working across midline of the body: +1;
 If arm out to side of body: +1.
 Final Lower Arm Score =

Step 3: Locate Wrist Position
 Diagrams showing wrist positions: 0°, 0° to 15°, 15° to 30°, 30° to 45°, 45° to 60°, 60° to 75°, 75° to 90°, 90° to 105°, 105° to 120°, 120° to 135°, 135° to 150°, 150°+.
 Step 3a: Adjust...
 If wrist is bent from the midline: +1.
 Final Wrist Score =

Step 4: Wrist Twist
 If wrist is twisted mainly in mid-range = 1;
 If twist at or near end of twisting range = 2.
 Wrist Twist Score =

Step 5: Look-up Posture Score in Table A
 Use values from steps 1, 2, 3 & 4 to locate Posture Score in table A.
 Posture Score A =

Step 6: Add Muscle Use Score
 If posture mainly static (i.e. held for longer than 1 minute) or:
 If action repeatedly occurs 4 times per minute or more: +1.
 Muscle Use Score =

Step 7: Add Force/load Score
 If load less than 2 kg (intermittent): +0;
 If 2 kg to 10 kg (intermittent): +1;
 If 2 kg to 10 kg (static or repeated): +2;
 If more than 10 kg load or repeated or shocks: +3.
 Force/load Score =

Step 8: Find Row in Table C
 The completed score from the Arm/Wrist analysis is used to find the row on Table C.
 Final Wrist & Arm Score =

SCORES

Table A

Upper Arm	Lower Arm	Wrist	1	2	3	4
1	1	1	1	2	3	4
1	1	2	2	3	4	5
1	1	3	3	4	5	6
1	2	1	2	3	4	5
1	2	2	3	4	5	6
1	2	3	4	5	6	7
1	3	1	2	3	4	5
1	3	2	3	4	5	6
1	3	3	4	5	6	7
1	4	1	2	3	4	5
1	4	2	3	4	5	6
1	4	3	4	5	6	7
2	1	1	2	3	4	5
2	1	2	3	4	5	6
2	1	3	4	5	6	7
2	2	1	2	3	4	5
2	2	2	3	4	5	6
2	2	3	4	5	6	7
2	3	1	2	3	4	5
2	3	2	3	4	5	6
2	3	3	4	5	6	7
2	4	1	2	3	4	5
2	4	2	3	4	5	6
2	4	3	4	5	6	7
3	1	1	2	3	4	5
3	1	2	3	4	5	6
3	1	3	4	5	6	7
3	2	1	2	3	4	5
3	2	2	3	4	5	6
3	2	3	4	5	6	7
3	3	1	2	3	4	5
3	3	2	3	4	5	6
3	3	3	4	5	6	7
3	4	1	2	3	4	5
3	4	2	3	4	5	6
3	4	3	4	5	6	7

Table B

Neck	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7
1	2	3	4	5	6	7	8
1	3	4	5	6	7	8	9
1	4	5	6	7	8	9	10
1	5	6	7	8	9	10	11
1	6	7	8	9	10	11	12
2	2	3	4	5	6	7	8
2	3	4	5	6	7	8	9
2	4	5	6	7	8	9	10
2	5	6	7	8	9	10	11
2	6	7	8	9	10	11	12
3	3	4	5	6	7	8	9
3	4	5	6	7	8	9	10
3	5	6	7	8	9	10	11
3	6	7	8	9	10	11	12
4	4	5	6	7	8	9	10
4	5	6	7	8	9	10	11
4	6	7	8	9	10	11	12
5	5	6	7	8	9	10	11
5	6	7	8	9	10	11	12
6	6	7	8	9	10	11	12
6	7	8	9	10	11	12	13
6	8	9	10	11	12	13	14

Table C

1	2	3	4	5	6	7
1	1	2	3	4	5	6
2	2	3	4	5	6	7
3	3	4	5	6	7	8
4	4	5	6	7	8	9
5	5	6	7	8	9	10
6	6	7	8	9	10	11
7	7	8	9	10	11	12
8	8	9	10	11	12	13
9	9	10	11	12	13	14
10	10	11	12	13	14	15
11	11	12	13	14	15	16
12	12	13	14	15	16	17
13	13	14	15	16	17	18
14	14	15	16	17	18	19
15	15	16	17	18	19	20

B. Neck, Trunk & Leg Analysis

Step 9: Locate Neck Position
 Diagrams showing neck positions: 0° to 10°, 10° to 20°, 20° to 30°, 30° to 40°, 40° to 50°, 50° to 60°, 60° to 70°, 70° to 80°, 80° to 90°, 90° to 100°, 100° to 110°, 110° to 120°, 120° to 130°, 130° to 140°, 140° to 150°, 150° to 160°, 160° to 170°, 170° to 180°.
 Step 9a: Adjust...
 If neck is twisted: +1; if neck is side-bending: +1.
 Final Neck Score =

Step 10: Locate Trunk Position
 Diagrams showing trunk positions: 0° to 10°, 10° to 20°, 20° to 30°, 30° to 40°, 40° to 50°, 50° to 60°, 60° to 70°, 70° to 80°, 80° to 90°, 90° to 100°, 100° to 110°, 110° to 120°, 120° to 130°, 130° to 140°, 140° to 150°, 150° to 160°, 160° to 170°, 170° to 180°.
 Step 10a: Adjust...
 If trunk is twisted: +1; if trunk is side-bending: +1.
 Final Trunk Score =

Step 11: Legs
 If legs & feet supported and balanced: +1;
 If feet: +2.
 Final Leg Score =

Step 12: Look-up Posture Score in Table B
 Use values from steps 9, 10 & 11 to locate Posture Score in Table B.
 Posture Score B =

Step 13: Add Muscle Use Score
 If posture mainly static or:
 If action 4 times or more: +1.
 Muscle Use Score =

Step 14: Add Force/load Score
 If load less than 2 kg (intermittent): +0;
 If 2 kg to 10 kg (intermittent): +1;
 If 2 kg to 10 kg (static or repeated): +2;
 If more than 10 kg load or repeated or shocks: +3.
 Force/load Score =

Step 15: Find Column in Table C
 The completed score from the Neck/Trunk & Leg analysis is used to find the column on Chart C.
 Final Neck, Trunk & Leg Score =

Final Score =

Subject: _____ Date: / /
 Company: _____ Department: _____ Scorer: _____

Figure 3. RULA Employee Evaluation Sheet (McAtamney and Corlett, 1993)

3. Workflow analysis

During the test laboratory work, the worker is seated at a table located under a fixed fume hood area. There is a footrest under the table and adjustable footrests on the chairs. The height of the chair is adjustable but the backrest is fixed. The work is carried out under sterile conditions, so they must wear a harness, goggles, sterile shoes and gloves. The work process is fast, usually requiring the use of both hands. To speed up and facilitate the work, the workers are supported by auxiliary staff. This means that the member or members of the support staff take everything to their seated colleagues, they do not have to interrupt the seated position. The workers then spend 6-7 hours sitting, with a lunch break.

Risk assessment methods were applied by observing workers in the course of their work.

The questionnaire survey shows (Figures 4 and 5) that workers complain of back and lower back pain, upper back pain during or as a result of the work process. Thus, two additional ergonomic risk assessment methods were applied to the work process.

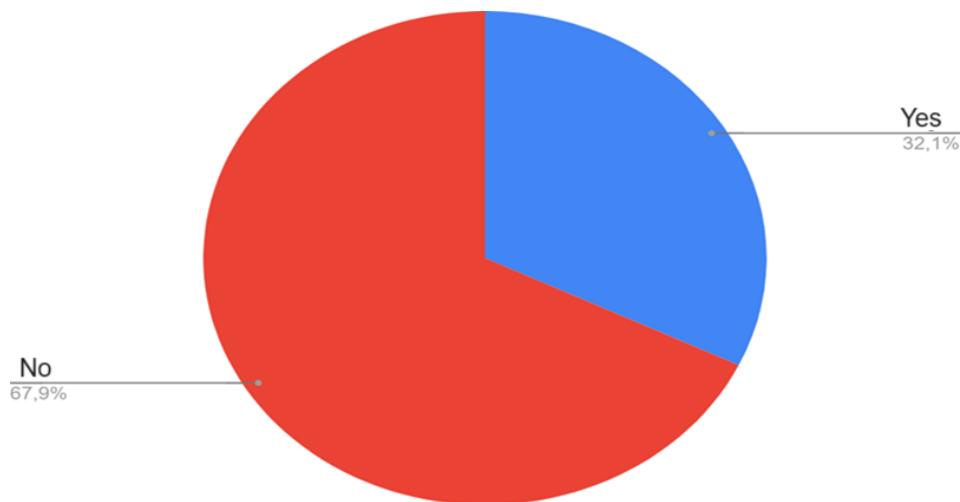


Figure 4. Do you consider the design of the workplace to be appropriate?
(McAtamney & Corlett, 1993)

RULA – Rapid Upper Limb Assessment Method

We first tested the workflow using this method, as it is the most suitable for sedentary work. Employee evaluation forms were completed wrists, which were given the highest possible score. However, not a single complaint was received during the surveys.

The position of the upper arm was worth 2 points and the position of the forearm was also worth 2 points. To these were added 4 points for wrist position and 2 points for wrist movement. I marked these scores in red on the table and from the intersection I got the score (4) with the muscle engagement (1 point), giving a final score of 5.

The neck, torso and legs were examined with a high baseline. In the questionnaire survey, this was the area that received the most complaints, although the results were not devastating. The waist and the neck are not horizontal during the work process, there is a tilt of between 00 and 200 and therefore a score of 2-2 was given. The position of the legs is stable in all cases, i.e. it is given that they should be stable as there is a footrest on both the chair and the table, which scored 1 point. Looking at the scores in the second table, we obtained a score of 2, to which we added the score for muscle strain (1 point). The final score was 3.

REBA – Rapid Entire Body Assessment

The other risk assessment method I used was REBA. This assessment is similar in structure to the previous method, where we can use 2 separate scores to determine the final score and then use the same to determine the action level. In this method, we also determine the score for the trunk, neck and legs and the score for the upper arm, forearm and wrist together.

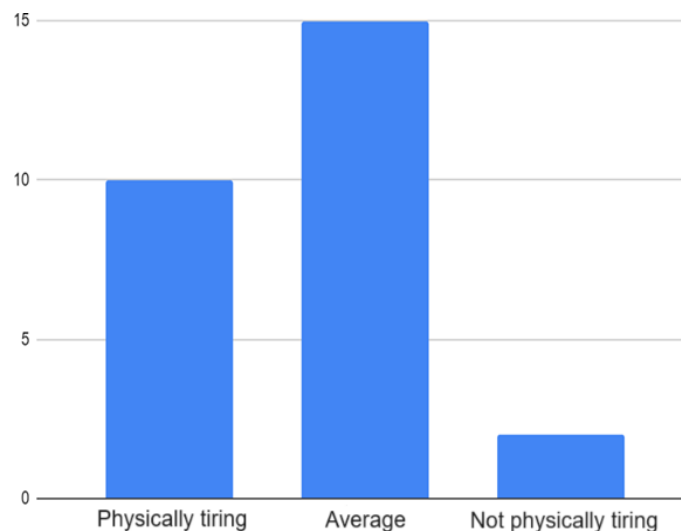


Figure 5. *Is work physically tiring or not?*

For the torso and neck, the value of the inclination must be determined, which in this position is also between 00 and 200 (2-2 points). The position of the legs is 1 point, because it is a sitting job. I have looked up these values in the table and since there is no load force that can be added to the value obtained in points, the final score for the leg, neck and torso will be the number read from the table.

The upper arm, forearm and wrist are assessed in a similar way on the RULA scorecard. The upper arm and forearm are scored 2-2 and the wrist is scored the maximum 3. These scores are also taken from the corresponding table, and since the grip here is only satisfactory plus one point is added to the result

Since it is a small range of repetitive motion, I added 1 to the value read from the table to get the REBA score, which was 5. This score falls into the medium risk level according to the scoring table and implies that some action needs to be taken on the workflow.

The questionnaire survey also revealed that many people blamed uncomfortable posture for the pain they experience at work, or cited chairs as a cause. The type of chairs currently used are height adjustable but not backrest adjustable, which is a disadvantage for workers, as they have different body shapes and heights. The chair is equipped with a footrest. When choosing chairs for the laboratory under study, attention should also be paid to the fact that it is not always the same material. In a sterile laboratory, surface disinfectants and H₂O₂ fumigation are used daily to remove germs.

The main function of work chairs is to relieve the back and spinal column. To work effectively, they must provide a comfortable posture and support the body's centre of gravity. The right chair does not force you into one posture, but allows you to assume as many postures as possible. Inappropriately designed chairs force the sitter into an uncomfortable posture, which can also affect feelings of fatigue.

When choosing chairs, the following important factors should be taken into account:

- The height of the chair should be adjustable;
- If possible, the distance between the backrest suspension point and the seat pan should be adjustable;
- Convex backrest in the lumbar region of the spinal column;
- The backrest should be of a size that allows you to work in a relaxed posture and does not restrict the movement of the shoulder joint;
- The chair must have at least 5 support points;

- The chair should have a spring action to cushion the shock to the spine during the descent;
- The shape and inclination of the seating surface prevents the seat from sliding forward.

4. Summary

From the methods listed above, it can be seen that although there are many different risk analysis methods, no method has yet been developed for sedentary work that is fully capable of assessing risks. In the assessments we used, there were also examples where there were questions about the weight of the material handled, which is not typical for sedentary work or does not reach the 10-20 kg value in the table. Sedentary work can be characterised as very diverse, ranging from office work, to a job as a bus driver, to laboratory occupations. Thus, the development of such a method should not only take into account generalities but also be job specific.

The main conclusions are:

- The questionnaire survey showed that workers suffer from upper back pain due to sedentary work. They believe this is due to inadequate posture and chairs;
- The risk assessment methods revealed that the position during sitting was inappropriate (in both cases it was concluded that a change was needed), but not to the extent that immediate intervention was required;
- The chairs tested were found to have only a non-adjustable backrest – otherwise they met all the main criteria;
- Post-work activities were not examined, but for such static sedentary work, exercise or even a pre-work warm-up (especially for the upper body) is recommended.

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