Guide

A classification of methods for assessing and/or preventing the risks of musculoskeletal disorders

etui.

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A classification of methods for assessing and/ or preventing the risks of musculoskeletal disorders

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Preface

Musculoskeletal disorders (MSDs) still top European workers' concerns. The success of efforts to improve prevention is not readily apparent. The effects of preventive measures can only be judged at some remove. And they are not necessarily to be gauged in terms of monetary and economic benefits to businesses. The effects of MSDs are lifelong.

What is clearly most needed to bring EU health and safety law up to date is a comprehensive directive on MSDs. The current legislative framework is unfit for purpose as it looks only at specifics like manual handling and work with VDUs. A holistic approach is essential.

Tripartite working groups of workers, employers and government held a string of meetings in 2009 to work on a document drafted by the Commission to merge and update the Manual Handling and Work with VDUs Directives into a comprehensive directive on the prevention of MSDs. The discussions were challenging and resulted in a bitty and rather vague position by the Advisory Committee on Safety and Health at Work. The European employers are fairly ill-disposed to any improvement in the law. The governments are divided and the Commission's political commitment seems less than robust. But it must step up to the plate: only the Commission can start the legislative process going with a formal proposal.

This bleak picture is no reason not to continue tackling MSDs at source. That is what this report on methods for assessing MSD risks sets out to do, with a strategic approach aimed at eliminating MSD risks at their workface source, first through observation, then analysis.

Looking for MSD risk factors in every case is not the be-all and end-all. Too often, companies are less concerned to eliminate risks than to measure them through inappropriately-named "risk management" contracted out to specialist firms.

Risk management is a misnomer on several counts. Firstly, because management techniques are ill-suited to eliminating risk factors at source. Secondly, because risk management is not about the redesign or re-engineering that should logically follow when design flaws or lack of forward planning in the work system are identified. And finally, because it does not lead to a process of continuous improvement which factors in known or experienced flaws. This information tends not to rise up from operator to engineer or manager because the essential feedback loops are non-existent, and this is the drawback of non-participatory prevention techniques.

Many companies assess risks at a frozen moment in time, drafting in here-today, gone-tomorrow paid consultants (outsiders with no decision-making or implementation authority) to do a "one-shot" assessment. Sporting the insignia of their profession – measuring equipment and checklists – they mostly have no remit to look at risk elimination options or reduction strategies.

Prevention all too often stops short at a written screening report that may prove compliance with the law but does nothing to eliminate hazardous exposures. Such practices may reflect a belief in the infallibility of designers and managers who know the "one best way" they are trained in but do not recognize the design flaws uncovered by prevention professionals or worse still, by lesser-qualified workers deemed incapable of suggesting an "even better way!"

This book, with its descriptions of workplace experiments, aims to fight back against the sale of methods that screen for "manageable risks" and disregard both the study of real work and workers' own understanding.

Preventing MSDs is all about workers and the tasks they actually do in a single working space, time and environment: the workplace. It factors in the operations actually performed, not just those specified.

Prevention cannot be done without a range of actions geared to participatory, cross-disciplinary, across-the-board intervention.

For that, the authors have selected a number of methods and instruments for screening and analysis to provide a simple tool so that users can:

— understand the methods used by prevention professionals;
— be able to discuss with them which method best suits the specific working conditions in the situation studied;
— more effectively prepare actions to improve that work setting through knowledge of the strengths and weaknesses of the tools used.

Our aim was to find tools of a high standard that performed efficiently in investigating the overall characteristics of work likely to cause MSDs, and that rely on the active participation of the operators concerned. They are tools that lead to the elimination of risk factors. But they also have to allow for monitoring the progress made and what remains to be made.

A future publication will look at risk elimination strategies on the basis of workplace experiences, with a particular focus on small and medium-sized firms (SMEs) and especially the very small firms that are a part of the EU's economic and business lifeblood, but are hard to reach for prevention purposes.

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Introduction

The necessity of a comprehensive approach of the working situation

There is a great deal of evidence in the scientific literature that musculoskeletal disorders (MSDs) are linked not only to the biomechanical factors of postures, forces, repetition and duration, but also to work organisation and psychosocial aspects of the work situation: work content, relationships, responsibilities, mistakes, and so on.

There is also evidence that the only way to get a sustained reduction in the number of MSD cases is by looking for improvements not just in the biomechanical factors but in everything that directly and indirectly determines workers' quality of life.

Rather than tackle the onset of MSDs just by studying the biomechanical factors, therefore, we need to first assess the things that directly and indirectly determine that quality of life, and look at the biomechanical aspects afterwards if need be.

On the other hand, to try and improve psychosocial aspects as a way of reducing MSDs is not an option. While the psychosocial conditions of work can be screened for using a participatory method like that of the Déparis dialogue guide – presented as an example – they really need to be investigated using specific tools that are not reviewed here.

Methods for assessing and/or preventing the risks of MSDs

A very large number of MSD risk assessment and/or prevention methods have been devised and are available for use. Most have been developed by researchers whose job and focus were to establish general relationships between work stressors (dose) and the prevalence of MSDs (response), rather than solving a problem in a specific work situation.

A prime example of this difference is the RULA method, which will be described below. RULA aims to make an overall assessment of the MSD risk to the body based on observations of postures and forces acting on the neck, shoulders, elbows, wrists, lower back and legs. The epidemiological studies that must be done to determine dose-response relationships require the amount of work stressors to be calculated in a great number of very different work situations with a variable prevalence of MSDs. Work stressors can affect different body regions, so an aggregate index is essential. In shopfloor practice, however, work situations involving biomechanical work strains on all these body regions are rarely found, and, even where they are, the preventive measures will differ according to the body regions concerned.

Like RULA, these musculoskeletal risk assessment and/or prevention methods usually require the positions of one or more body segments to be determined while working. This raises a number of big questions:

— Is the work phase studied representative?
— How reliable are the estimates?
— How relevant are they to prevention?

Is the work phase studied representative?

Whatever the method used, the first key question to ask when looking at the results is: is the work phase observed representative?

The new forms of work organisation require employees to be flexible and adaptable at all times. Increasingly, the nature of industrial work, products and procedures are constantly changing, so that no single phase of work can be considered representative of what will ultimately cause physiological damage, especially MSDs.

A study using a RULA-type method done after a cursory analysis of working conditions based on a 20-odd minute video recording may well be worthless, therefore.

How reliable are the estimates?

If the work phase is representative, the next thing is determine whether the observations are valid. Many of these tools, especially the most sophisticated, require the study to be done using a video recording. But how can you make observations about the position of the neck, shoulders and wrists all at the same time from a single video shot only from the front or side? How do you observe the angles of the arms and the angles of flexion and deviation (downward and side-to-side movements) of the hands on the same video image?

Better than just doing a single assessment that produces a single score is to work out the probable range of scores for each factor by using best- and worst-case

Strain index					**4.5**	**18**
Estimated force needed to perform the work						
	% FMV	**Borg**	**Intensity of exertion**		**Choice**	**Choice**
Light	< 10 %	<= 2	Barely noticeable or relaxed effort		○	○
Somewhat hard	10-29 %	3	Noticeable or definite effort		◔	○
Hard	30-49 %	4-5	Obvious effort; unchanged expression		○	◕
Very hard	50-79 %	6-7	Substantial effort, changed expression		○	○
Near maximal	=>80 %	> 7	Uses shoulder or trunk for force		○	○
Duration of exertion (% of cycle time)					30	50
Number of efforts per minute					15	20
Hand/wrist posture						
	Extension	**Flexion**	**Ulnar deviation**	**Perception**	**Choice**	**Choice**
Very good	0-10°	0-5°	0-10°	Perfectly neutral	◔	○
Good	11-25°	6-15°	11-15°	Near neutral	○	◕
Fair	26-40°	16-30°	15-20°	Not neutral	○	○
Bad	41-55°	31-50°	21-25°	Marked deviation	○	○
Very bad	> 60°	> 50°	> 25°	Near extreme	○	○
Speed of work						
			Perception		**Choice**	**Choice**
	Very slow		Extremely relaxed pace		○	○
	Slow		Taking one's own time		◔	○
	Fair		Normal speed of motion		○	◕
	Fast		Rushed, but able to keep up		○	○
	Very fast		Rushed and barely able/unable to keep up		○	○
Duration of task per day					2	2

assumptions for each factor to be rated. In the Strain Index example below, for instance, the user's choice hovers between "somewhat hard" and "hard" for exertion, "perfectly neutral" and "near neutral" for the wrist and hand postures, etc. The Strain Index assessment is therefore between 4.5 (representing the product of all the best-case assumptions) and 18 (the product of the worst-case assumptions).

When looking at the study findings, therefore, the representativeness of the video recording used also needs to be considered.

Evaluating a range of scores rather than one single score enables you to assess how valid the quantification is. This is especially essential where postures have to be identified from video images, percentage durations of exertion or number of repetitions over a cycle time.

How relevant are they to prevention?

The more sophisticated tools require the user to focus on the position of the body segment concerned. But this diverts attention away from the task performed: the specialist looks at the position of the trunk or arm, but does not ask why the work is done in this position, nor what might be changed to do it otherwise.

Observing the trunk or arm position does not require any kind of dialogue with the worker; at best he may simply have been consulted when determining the work phase to study. So the study may well show that the arm is above heart level for 23% of the time, but offer no suggestion of what needs changing to bring this percentage down.

Some MSD assessment methods take a scoring approach. This is typically the case with the RULA, OCRA and OWAS methods.

Most scientists and specialists (ergonomists, occupational doctors, etc.), but also practitioners, think a score is needed to determine whether a situation is acceptable, classify risk situations or compare situations before and after intervention. This is a soft option which leaves the score to take the decision. A limit value is set; if the score is higher, there is a problem and solutions must be found; if it is lower, the situation is acceptable. This may be all very well provided the scoring is reliable and that the score scale reflects the risk scale. If it does not, the priorities and decisions may be wrong.

Before choosing the MSD risk assessment and/or prevention method, therefore, consider whether the findings will actually help improve the work situation.

Unfortunately, the outputs of these highly sophisticated and very costly methods are often trite: changes "might be required", "are needed in the near future", or "are needed immediately".

Note that the simpler methods, not based on these detailed quantifications but on more general observations, implicitly require dialogue with the workers, give a more overall assessment rather than one limited to the duration of the video recording and lead much more directly to improvements.

The criteria for classifying MSD risk assessment and/or prevention methods

Various reviews of MSD risk assessment methods have been published. They include:

— ISO 11228-3 (2007) *Ergonomics - Manual handling - Part 3: handling of low loads at high frequency*.
— Neumann, P. (2006) *Inventory of tools for ergonomic evaluation inventory of tools for ergonomic evaluation*, Stockholm: National Institute for Working Life.
— Occupational Health and Safety Council of Ontario (2008) *MSD Prevention Toolbox. Part 3C: more on in-depth risk assessment methods*, Toronto: OHSCO.
— Takala, E.-P. *et al.* (2010) 'Systematic evaluation of observational methods assessing biomechanical exposures at work', *Scandinavian Journal of Work, Environment and Health*, 36 (1), 3-24.

They describe the different methods in terms more geared towards the scientific validity of the criteria, reproducibility of assessments, etc.

The information given here for the different methods reviewed are:

1. References: The authors of the method and where to find more detailed information.
2. Stated purposes: What the authors claim the method does, the purpose for which it was it developed.
3. Body regions assessed
4. Description: What the method consists of. This booklet is not aimed at specialists and experts, but employers, workers and workers' reps, so all we give here is a general description of how to use the tool and interpret the outputs.
5. Potential users and training requirements: the training required by the person who will do the study.
6. Time needed: the time needed to do a study using the method, once the representative period to be studied has been determined and the video recording – if any – has been made.
7. Scope: how far can the findings of the study done with this method be used for:
   — Epidemiology: to aggregate the findings with those of other sectors or firms to get a better picture of trends;
   — Quantification: to develop a risk scale and set priorities;
   — Prevention: to make direct improvements to the work situation.
   What is the benefit-cost ratio of the method?
8. Classification
   It was decided to classify the methods into three categories based primarily on the skills required to use them:
   — Level 1 can be described as Screening: simple methods that do not require a detailed knowledge of the work situation, and do not involve a quantitative assessment of postures or forces; can be used by the workers themselves;
   — Level 2 can be described as Analysis: the methods take longer to use (about an hour) and take more factors into account;
   — Level 3 can be described as Expertise: the methods are much more complex, take longer to use and mostly require videotaping and specific skills in methodology and biomechanics.

The methods are not described in order of complexity relative to those that come before or after them, and there is obviously no clear dividing-line between the most complex methods for one level and the least complex for the next level. Complexity here is not just about how difficult the method is to apply, but also the skills required to interpret the outputs properly. For example, the NIOSH equation for the evaluation of lifting tasks is relatively easy to use, particularly using the available software. But it does require certain skills to use and interpret the outputs properly.

Prevention was a key criterion for classification. With a few exceptions, none of the methods explicitly address this aspect and most of the titles include the words "assessment" and "identification" but not often the word "prevention". Also, very few methods provide support for users in identifying solutions. As already mentioned above, however, the simpler Levels 1 and 2 methods require more dialogue with the workers concerned and take less attention away from the preventive aspects than the more sophisticated methods that require quantitative estimates.

The problems in context: the Déparis dialogue guide

References

— Malchaire, J. (2007) *Stratégie SOBANE et guide de dépistage Déparis*, Série Stratégie SOBANE. Gestion des risques professionnels, Brussels, SPF Emploi, Travail, Concertation sociale.

An editable version (WinWord) of the Déparis dialogue guide in French and Dutch can be found at www.sobane.be, and in other languages at www.deparisnet.be along with examples of its use.

Stated purposes

The purpose of the Déparis guide is to enable the work group (workers and technical management) to review all aspects of the conditions of their working life in the work situation (work areas, work organisation, ergonomic factors, environmental factors, psychosocial aspects), and to attempt to identify improvements and preventive measures. It aims to lead the firm quickly towards cost-effective prevention, in particular by involving those directly affected.

Body regions assessed

Not applicable. The guide provides a structure for discussing all aspects that determine the quality of working life in the work situation.

Description

The Déparis dialogue guide (from the French *Dépistage participatif des risques* – participatory risk screening) was designed to be used by workers and their technical supervisors to take stock as objectively as possible of their work situation and discuss practical detailed ways of doing the work in the best possible conditions for themselves and the firm.

It takes the form of 18 tables dealing with 18 aspects of the work situation:

1. Premises and working areas
2. Work organisation
3. Work accidents
4. Electricity, fire and explosions
5. Controls and signals
6. Work material, tools, machines
7. Work postures
8. Efforts and handling operations
9. Lighting
10. Noise
11. Chemical and biological risks
12. Thermal environments
13. Vibration
14. Autonomy and individual responsibilities
15. Work content
16. Time constraints
17. Work relations between workers and with superiors
18. Psychosocial environment

Each table offers a series of points to be discussed. The group discussion is run so as to avoid spending too much time on the relevance and severity of complaints or requirements, and to identify what can be done to improve the work situation in the short, medium and long terms.

During the meeting, the Déparis coordinator notes down the proposed solutions and attempts to directly identify who is most appropriate to give effect to the improvements (what) and in what time frame (when). He also draws conclusions on what aspects require further study to finalise the proposed solutions.

Finally, the group as a whole gives an overall assessment of the priority of the changes for each item using a traffic light system and smileys: ☹ Red light: must be improved, 😐 Amber light: to be improved if possible; 🙂 Green light: situation satisfactory.

After the meeting, the outputs are summarised in two tables

— An overview table showing the assessments for the 18 items and giving an overview of the status of the work situation. It enables a quick visual comparison of a current and former state, or the state of different work situations in the same firm, or the state of a work situation as seen by different work teams;
— A summary results matrix of the actions and additional studies proposed in the discussion, indicating "who" does "what" and "when". This matrix will lead to the short, medium and long term action plan for the work situation.

A work situation in a hospital is very different from one on a building site or in the service sector, so the guide needs to be adapted to the specific work situation concerned. A number of sector-specific guides are available on the websites mentioned to make it easier to produce a guide adapted to real local specific characteristics.

Potential users and required training

The guide is aimed at work groups: workers and local technical management. It requires no special training in ergonomics. Using it effectively requires the facilitator to have certain abilities to run meetings.

Time needed

A Déparis meeting requires about 4 workers and 4 members of technical management to get together for about 2 hours. But it can only be organised when top management, line management, workers and their reps have fully understood the implications of the participatory approach and are ready to engage with it and take the outputs on board on a fully informed basis.

Scope

The guide aims to organise a dialogue between workers and their immediate supervisors to identify simple preventive measures and improve the work situation as quickly as possible. The use of the guide in different countries with differing levels of development is illustrated in a number of publications.

The dialogue guide is easy to use provided the conditions of the participatory process are met: mutual confidence between the partners, understanding of the procedure and commitment to own the outputs. On that basis, it is a key tool for the lasting prevention of MSDs, and indeed any other risk to health, safety or welfare.

Classification

The Déparis guide does not strictly fit into the levels of classification outlined above because its aim is more to set musculoskeletal problems back in the general context of the work situation and to work for a generally better quality of working life.

Methods for assessing and/or preventing the risks of musculoskeletal disorders

Manual handling assessment charts (MAC)

References

— Health and Safety Executive (2008) *Manual handling assessment charts*, HSE leaflet INDG383, Sudbury: HSE Books.

The guide and user manual can be downloaded from www.handlingloads.eu.

Stated purposes

The Manual Handling Assessment Charts (MAC) were designed to help health and safety inspectors to assess the most common risk factors in lifting, lowering, transporting and handling heavy loads. The purpose of the assessment is to identify and then reduce the overall level of risk of the task.

The MAC tool cannot be used to assess some manual handling operations, such as those that involve pushing and pulling. In such cases, the MAC does not enable an overall assessment of the risk. Also, the MAC was not designed to assess risks from upper limb musculoskeletal disorders.

Body regions assessed

The back only

Description

MAC Score sheet

Company Name:
Task Description:

- ○ Task has a history of manual handling incidents (e.g. company accident book, RIDDOR reports).
- ○ Task is known to be hard work or high risk.
- ○ Employees doing the work show signs that they are finding it hard work (e.g. breathing heavily, red-faced, sweating).
- ○ Other indications, if so. what?

Date:

Signature:

Insert the colour band and numerical score for each of the risk factors in the boxes below, referring to your assessment, using the tool.

Risk factors	Colour band (G, A, R or P)			Numerical score		
	Lev	Port	Lev gr	Lev	Port	Lev gr
Load weight and lift/carry frequency						
Hand distance from the lower back						
Vertical lift region						
Trunk twisting/sideways bending Asymmetrical trunk/load (carrying)						
Postural constraints						
Grip on the load						
Floor surface						
Other environmental factors						
Carry distance						
Obstacles en route (carrying only)						
Communication and co-ordination (team handling only)						
Other risk factors, e.g. individual factors, psychosocial factors etc	**Total score:**					

The MAC is used to assess three types of tasks, including:
— lifting operations;
— transport operations;
— team handling operations.

For each type of assessment, a guide is used to assess 8 or 9 risk factors. A score sheet is used to summarise the results and calculate a total score.

Assessments are done by observing the task and the worst case scenario using the colour coding and score as shown below.

Hand distance from lower back

Close: Upper arms aligned vertically and upright trunk	**Moderate:** Upper arms angled away from body	**Moderate:** Trunk bent forward	**Far:** Upper arms angled away from body and trunk bent forward
0	3	3	6

Health and Safety Executive, UK
See: http://www.hse.gov.uk/pubns/indg383.pdf

The colour bands are:
— green: low risk;
— amber: medium risk;
— red: high risk: prompt action needed
— purple: very high risk

Potential users and training requirements

The tool was designed for use by health and safety inspectors. However, the guidance says that "employers, safety officers, safety representatives and others may also find the MAC useful to identify high risk manual handling operations and help them complete their risk assessments".

No training is needed to use it; being well-acquainted with the guide itself is enough.

Time needed

Once the study to determine representative work procedures is done, the method can be gone through quite quickly. But it does need a discussion with some workers to ensure that scores are as objective as possible.

Scope

The total score helps prioritise those tasks that need most urgent attention and helps check the effectiveness of improvements.

The guide seems to have a fairly good benefit-cost ratio. It is easy to use, and can easily help the partners to identify possible improvements to work procedures and working conditions if users supplement the score evaluation with discussions about the reason for a particular work circumstance and how it might be changed. However, it is only usable for standard, traditional lifting and transport operations.

Classification

Level 1, Screening

Key Indicator Method (KIM)

References

— Jürgens, W.W., D. Mohr, R. Pangert, E. Pernack, K. Schultz und U. Steinberg (2001) *Handlungsanleitung zur Beurteilung der Arbeitsbedingungen beim Heben und Tragen von Lasten*, Saarbrücken: Ministerium für Frauen, Arbeit, Gesundheit und Soziales.
— Jürgens, W.W., D. Mohr, R. Pangert, E. Pernack, K. Schultz und U. Steinberg (2002) *Handlungsanleitung zur Beurteilung der Arbeitsbedingungen beim Ziehen und Schieben von Lasten*, Saarbrücken: Länderausschuss für Arbeitsschutz und Sicherheitstechnik.

The guides can be downloaded from www.handlingloads.eu.

Stated purposes

Two KIM tools have been developed for risk assessment of manual handling of loads tasks consisting in:
— lifting, holding, carrying;
— pushing or pulling a load.

Body regions assessed

Back

Description

Lifting or displacement operations (< 5 s)		Holding (> 5 s)		Carrying (> 5 m)	
Number on working day	Time scores	Total duration on working day	Time scores	Overall length on working day	Time scores
< 10	1	< 5 min	1	< 300 m	1
10 < to 40	2	5 to 15 min	2	300 m < to 1 km	2
40 < to 200	4	15 min < to 1 hr	4	1 km < to 4 km	4
200 < to 500	6	1 hr < to 2 hrs	6	4 km < to 8 km	6
500 < to 1000	8	2 hrs < to 4 hrs	8	8 km < to 16 km	8
≥ 1000	10	≥ 4 hrs	10	≥ 16 km	10

For lifting, holding and carrying operations; the method first requires time scores between 1 and 10 to be determined:
— for lifting or displacement operations (<5s), depending on the number per day;
— for holding operations (> 5s), depending on the total time per day;
— for carrying operations (> 5m), depending on the distance travelled per day.

Scores are then calculated based on:
— the weight of the load: 1 to 25 for men and women separately;
— posture, and the position of the load: 1 to 8;
— working conditions (obstacles, space, etc.): 0 to 2.

The risk score is calculated by the following formula:

Load score
+ Posture score
+ Working conditions score
= Total **X** Time score = Risk score

The results are interpreted in accordance with the following table.

Risk score	Risk range	Description of work situation
< 10	1	Low load, physical overload unlikely
10 < to 25	2	Increased load, re-design helpful for less resilient persons*
25 < to 50	3	Highly increased load, re-design recommended
≥ 50	4	High load, re-design necessary

* Less resilient persons in this context are persons older than 40 or younger than 21 years, newcomers in the job or people suffering from illness.

The KIM tool on pushing and pulling tasks follows the same pattern, taking into account the number of operations and distance travelled per day, the means of moving the load, the positioning accuracy required, postures, and working conditions (space).

The scores are assessed for a day's work. If the conditions (weight, posture, etc.) change within the day, average values should be used. If the tasks involve substantially different load handling operations, each must be assessed and documented separately.

Potential users and training requirements

The method claims to be for health and safety practitioners (ergonomists, occupational doctors, etc.), employers, workers, workers' reps, inspectors, etc. No training is needed to use it; being well-acquainted with the guide itself is enough.

Time needed

Once the study to determine representative work procedures is done, the method can be gone through quite quickly. But it does need a discussion with some workers to ensure that scores are as objective as possible.

Scope

The KIM tool applies to somewhat different handling operations from those addressed by the MAC tool and so is complementary to it. The calculation of scores seems more long-winded, however, and so more likely to divert attention away from prevention. The guide also seems to have a fairly good benefit-cost ratio, provided users supplement the score assessment with discussion of the reasons for problems and improvements to work procedures and working conditions.

Classification

Level 1, Screening

FIFARIM

References

— Mairiaux, Ph. *et al.* (2008) *Manutentions manuelles : guide pour évaluer et prévenir les risques*, Brussels, SPF Emploi, Travail, Concertation sociale.
— *(2008) Manutentions manuelles: FIFARIM - Fiche d'identification des facteurs de risques liés à la manutention*, Brussels, SPF Emploi, Travail, Concertation sociale.

The method is published as a brochure in French and Dutch by Belgium's Department of Employment, Labour and Social Dialogue. It can be downloaded from www.emploi.belgique.be/publicationDefault.aspx?id=21356.

Stated purposes

The aim is to enable shopfloor users to identify the risk factors involved in the manual handling of loads. A three-step prevention strategy is then worked out based on the level of risk.

Body regions assessed

Back

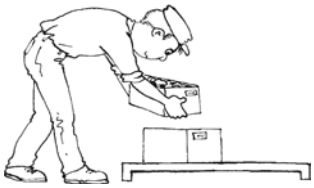
Description

The guide includes a series of figures illustrating 26 risk factors in the manual handling of a load:

1. Trunk bent forward
2. Arms above shoulder height
3. Shoulder twisting
4. Trunk sideways bending
5. Arms extended forward
6. Stressful handling position
7. Overweight load
8. Fragile, unstable or irregular objects
9. Bulky load
10. Poor weight estimation
11. Load difficult to grasp
12. Objects with sharp or rough edges
13. Very hot, very cold or very dirty object
14. Carry distances
15. Moving with slopes or steps
16. Obstacles or uneven floor
17. Overloading
18. Floor condition
19. Condition of handling machinery
20. Machinery handles
21. Space available for handling
22. Physical environment
23. Time pressures
24. Productivity bonuses
25. Rush jobs
26. Monotonous, repetitive handling

The user is asked to determine the frequency of this risk factor on a scale ranging from rarely to often.

The method handbook also comprises for each of the 26 figures:
— A "What you need to know" help section that explains to the user the importance of the figure.
— A "Recommendations" help section describing simple measures that can be taken to improve the situation.

Trunk bent forward (flexion more than 45°)	Rare ..... often
	When? Why?
	What to do?
What you need to know	Bending the trunk forward increases the pressure on the intervertebral discs and leads to a narrowing of the spaces. These two factors contribute to premature aging of the vertebral joint.
Recommendations	Keep your trunk straight and pick up or move the load above knee-height (approx. 60 cm).

Ref. Troubles musculosquelettiques. Série stratégie SOBANE – Gestion des risques professionnels Direction générale Humanisation du travail. Belgium

A change to the Sheet as illustrated above is used to consolidate this information into a single document so that questions about why these risk factors exist and how best to improve the situation can be discussed more clearly with the workers.

Potential users and training requirements
No training is needed to use it; being well-acquainted with the guide itself is enough.

Time needed
The method requires some time for discussion with workers (30 to 60 minutes: 1-2 minutes per figure) to put into practice.

Scope
The structure and form of the brochure are geared to prevention. The question of a representative work phase to study does not arise if the discussion with the workers is about the work situation in general and not at a point in time.

The FIFARIM guide addresses a wider variety of risk factors than the MAC and KIM tools, which are more concerned with repeated handling. No scoring is involved, and using it with the work group means that all the aspects where action is needed to improve the work situation can be identified. This tool therefore appears to have the ideal benefit-cost ratio for a firm faced with a range of changing work situations that include lower back strain.

Classification
Level 1, Screening

Assessment tool for repetitive tasks of the upper limbs (ART)

References

— Ferreira, J., M. Gray, L. Hunter, M. Birtles and D. Riley (2009) *Development of an assessment tool for repetitive tasks of the upper limbs (ART)*, HSE Research Report RR707, Sudbury: HSE Books.

The guide and user manual in English can be downloaded from www.hse.gov.uk/research/rrhtm/rr707.htm.

Stated purposes

The ART tool was patterned on the MAC model described above to enable health and safety inspectors to screen frequent handling of light loads or other repetitive tasks and the common physical risk factors that may contribute to upper limb disorders (ULDs).

The purpose of the assessment is to identify and then reduce the overall level of risk of the task.

Body regions assessed

The neck, lower back and upper limbs

Description

The task is observed during a representative work cycle and partial scores of strain are obtained for:

— the frequency and repetition of shoulder and arm movements (number of times the same set of movements is performed per minute);
— force;
— head, back, shoulder, wrist and hand postures;
— work circumstances: breaks, work pace, vibration, cold, use of gloves, etc.

Risk factors	Colour		Score	
	Left arm	Right arm	Left arm	Right arm
A1. Shoulder – arm movements				
A2. Repetition				
B. Force				
C1. Head/neck posture				
C2. Back posture				
C3. Shoulder/arm posture				
C4. Wrist posture				
C5. Hand/finger posture				
D1. Breaks				
D2. Work pace				
D3. Other factors				
		Task score		
E. Duration	Time		X	
		Exposure score		
Other risk factors: (e.g., psychosocial aspects, personal factors, etc.)				

A task score is calculated by adding together these partial scores. The total exposure score is calculated by multiplying this task score by a multiplier representing the daily time for which the task is performed. The assessment is performed separately for the left and right sides.

Each partial score has three levels:
— Green: low level of risk: infrequent movements, neutral postures, no indication of particular effort, etc.; numerical score = 0.
— Amber: medium level of risk, task to be examined closely: frequent movements, occasionally awkward postures, moderate force, etc.; numerical score = 1 to 4 according to the factor.
— Red: high level of risk, prompt action needed: very frequent movements, awkward postures for more than 50% of the time, strong/very strong force, etc.; numerical score = 2 to 12 depending on the factor.

Potential users and training requirements
Like the MAC tool, the ART tool was designed for health and safety inspectors, but can be used by all concerned (employers, workers, etc.) to identify high-risk tasks and help them with their risk assessments. No training is needed to use it; being well-acquainted with the guide itself is enough.

Time needed
Once the study to determine representative work procedures is done, the method can be gone through quite quickly. But it does need a discussion with some workers to ensure that scores are as objective as possible.

Scope
The total score helps prioritise those tasks that need most urgent attention and help check the effectiveness of any improvements.

The guide seems to have a fairly good benefit-cost ratio. It can lead to improvements provided the user supplements the score assessment with discussions about the reasons for particular harmful work circumstances and how work procedures and working conditions might be changed.

Classification
Level 1, Screening

Risk Filter and Risk Assessment Worksheets

References

— Health and Safety Executive (2002) *Upper limb disorders in the workplace*, Health and Safety Guidance HSG60, Sudbury: HSE Books.

The guide can be downloaded in English from www.hse.gov.uk/PUBNS/books/hsg60.htm.

Stated purposes

The risk filter and risk assessment worksheet are provided not to enable an accurate assessment of exposure, but to help identify MSD risks and possible ways to reduce them.

Taken together, the risk filter and risk assessment worksheet form a two-stage assessment process:

— Step 1: The Risk Filter Worksheet is used to identify situations where further assessment is needed. Some risk factors have been specifically omitted in order to achieve a usable first-level screening tool.
— Step 2: The Risk Assessment Worksheet is used to perform a more detailed risk assessment for the tasks identified by the risk filter.

Body regions covered

Neck and upper limbs

Description

The Risk Filter Worksheet asks 19 questions on: previous cases of MSDs or aches and pains (3 questions), repetition (3), awkward postures (6), force (6) and vibration (1). Typical questions are: "Are there any repetitive elements such as repeating the same motions every few seconds? Yes – No". If the answer to any question is "yes", a full risk assessment of the job should be done using the Risk Assessment Worksheet.

The Risk Assessment Worksheet includes 8 sections on:

— Repetition: 5 factors
— Working posture of the wrists, hands and fingers: 12 factors
— Working posture of the arms and shoulders: 7 factors
— Working posture of the head and neck: 4 factors
— Force: 9 factors
— Working environment: 5 factors
— Psychosocial factors: 10 factors
— Individual differences: 4 factors

For each factor, the user is asked to:

— Answer Yes or No as to its existence;
— Describe any problems and their probable causes;
— Describe any possible improvements ("control options") identified.

A non-exhaustive list of possible solutions is given in each section. The sheet ends with a six-column table in the same way as the Déparis dialogue guide:

1. The worksheet reference
2. Controls to be implemented
3. Priority
4. Who is responsible for implementing controls
5. Target implementation date
6. Date set for re-evaluation

4. Working postures **Head and neck**	Yes	No	**Describe any problem(s) and probable cause(s):** Note problem postures and identify parts of the upper limb involved. eg. neck held in fixed bending position to see screw holes.	**Describe any risk control option you have identified**	**Control options** (not exhaustive list)
4.1. Does the task involve **repetitively** bending or twisting the neck?					**Optimize working posture:** – Ensure visual requirements are not too demanding – Provide visual aids – Ensure lighting is suitable – Reposition items that workers are required to look at
4.2. Does the task involve **holding** the neck bent and/or twisted for more than 2 hours total per working day?					
4.3. Do the visual demands of the task require the worker to view fine details and adopt awkward positions?					
4.4. Do aspects of lighting such as dim light, shadow, flickering light, glare and/or reflections cause the worker to adopt awkward postures?					

Potential users and training requirements

Everyone, including workers and their supervisors. No training is needed to use it; being well-acquainted with the guide itself is enough.

Time needed

The question of a representative work phase to study does not arise if the discussion with the workers is about the work situation in general. The method can be gone through in about 60 minutes. It obviously needs a discussion with the work group to understand the problems, causes and what can be done about them.

Scope

The method is clearly geared to prevention rather than quantifying risks. It can be regarded as the equivalent of the FIFARIM method for upper limb MSDs. It also therefore appears to have the ideal -benefit- cost ratio for a firm faced with a range of changing work situations that include repetitive hand and arm movements.

Classification

Level 1, Screening

PLIBEL

References

— Kemmlert, K. (1995) 'A method assigned for the identification of ergonomics hazards: PLIBEL', *Applied Ergonomics*, 26 (3), 199-211.

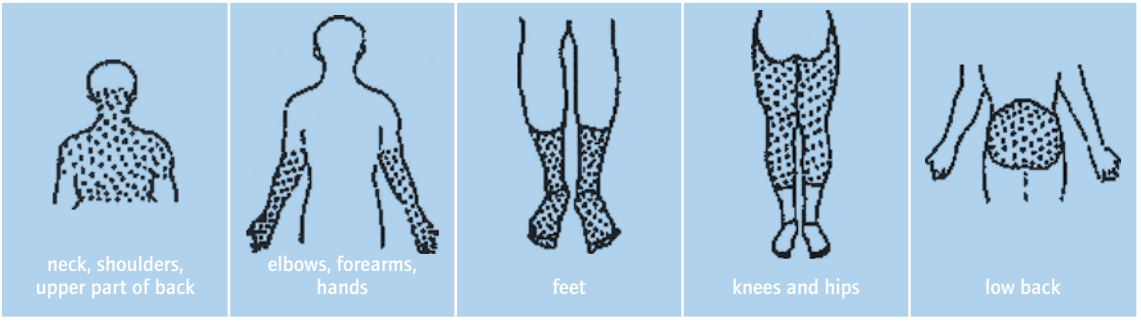
Stated purposes

The author sought to develop a simple tool for rapid screening of key risk factors and identifying situations that require further examination. This method was developed as part of an epidemiological study, but is designed for shopfloor users.

Body regions assessed

Neck, shoulders and upper back, elbows, forearms and hands, feet, knees and hips, lower back.

Description



1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.
4.	4.	4.	4.	4.
5.	5.	5.	5.	5.
6.	6.	6.	6.	6.
7.	7.	7.	7.	7.
8.	8.	8.	8.	8.
a.	a.	a.	a.	a. .....
b.	b.	b.	b.	b. .....
c.	c.	c.	c.	c. .....
9.	9.	9.	9.	9.
a.	a.			a. .....
b.	b.			b. .....
c.	c.			c. .....
d.	d.			d. .....
10.	10.			10.
a.	a.			a. .....
b.	b.			b. .....
c.	c.			c. .....
d.	d.	d.	d.	d. .....
11.	11.	11.	11.	11.
a. ..... e.	a. ..... e.	a.		a. ..... e. .....
b. ..... f.	b. ..... f.	b.		b. ..... f. .....
c. ..... g.	c. ..... g.	c.		c. ..... g. .....
d.	d.	d.		d. .....
12.	12.	12.		12.
13.	13.	13.		13.
14.	14.	14.		14.
a.	a.	a.		a. .....
b.	b.	b.		b. .....
15.	15.	15.		15.
a.	a.	a.		a. .....
b.	b.	b.		b. .....
16.	16.	16.		16.
17.	17.	17.		17.
a. ..... c.	a. ..... c.	a.		a. ..... c. .....
b. ..... d.	b. ..... d.	b. ..... d.	b. ..... d.	b. ..... d. .....

Method of application

— Find the injured body region
— Follow white fields to the right
— Do the work tasks contain any of the factors described?
— If so, tick where appropriate

Also take these factors into consideration:

a) the possibility to take breaks and pauses
b) the possibility to choose order and type of work tasks or place of work
c) if the job is performed under time demands or psychological stress
d) if the work can have unusual or unexpected situations
e) presence of cold, heat, draught, noise or troublesome visual conditions
f) presence of jerks, shakes or vibrations

The assessment is performed in two stages:
— Preliminary observation of the job with workers interviewed to determine representative work phases and high-risk tasks;
— Using a 35-question checklist, the existence of risk factors related to postures, repetition, work space, load lifting, tools, etc. are identified for one or more body regions.

The method takes into consideration:
— The possibility of taking breaks; the possibility of choosing the type and order of work tasks and pace of work; time demands and psychosocial stress; unusual or unexpected situations;
— Environmental factors: cold, heat, draughts, noise, poor lighting, jerks, shakes or vibrations.

No total score is calculated; preference is given to the list of problems on which action should be taken to improve the work situation. It is recommended that the checklist be accompanied by photographs illustrating the problems.

Potential users and training requirements
Everyone, including workers and their supervisors. No training is needed to use it; being well-acquainted with the guide itself is enough.

Time needed
The question of a representative work phase to study does not arise if the discussion with the workers is about the work situation in general. The method can be gone through in about 30 minutes.

Scope
The study is qualitative and directly geared to prevention, targeting risk factors through questions that guide the search for solutions. It is a general, simple tool with a good benefit-cost ratio. The range of risk factors is wide, allowing real opportunities for preventive measures and improvements to be developed.

Classification
Level 1, Screening

Keyserling Checklist

References

— Keyserling, W. M., D. S. Stetson, B. A. Silverstein and M. L. Brouwer (1993) 'A checklist for evaluating ergonomic risk factors associated with upper extremity cumulative trauma disorders', *Ergonomics*, 36 (7), 807-831.

Stated purposes

To identify jobs requiring further study based on direct observations of the most common risk factors. This checklist was developed as part of a prospective study as guidance for a later stage. The method aims to be usable from direct observation.

Body regions assessed

Upper limbs

Description

Force	0	X	XX
1. **Efforts to lift, carry, push / pull objects more than 4.5 kg in weight** Also answer "yes" to this question if the worker applies a twisting or pulling effort to equipment using sustained static force (e.g. hand carts, or tools, fixed appliances or objects hanging from a sling)			
2. **Gripping objects or tools whose surface is smooth or slippery or which are difficult to grip**			
3. **Pressing or pushing with the fingertips or thumb** The fingertip is that part of the finger including the fingerprint and the tip of the nail. Answer "yes" if the finger or thumb is used to forcefully put on a lid, a clip, a capsule or a finger or thumb is used to push a button with a force of more than 1 kg. Do not answer "yes" for tasks requiring light force such as sticking a label on			
4. **Discomfort caused by wearing gloves** Gloves can interfere with gripping and grasping if they are too thick, too tight or limit the sense of touch. Question the worker to see whether gloves are a problem.			
5. **Gripping or holding tools or objects weighing 2.7 kg/hand or more** Gripping or holding tools or objects weighing over 2.7 kg/hand means that an object weighing 2.7 kg or more is taken in a single hand, or an object weighing 5.4 kg or more is taken in both hands. If the object is suspended, the answer is "no"			

An 18-question checklist demonstrates the existence of risk factors related to repetition, force, postures, local mechanical stresses, hand tools or objects, vibration, cold air, etc.

The answers are in terms of presence (yes - no) and/or exposure duration: 0 = factors not present, X = moderate exposure (sometimes) and XX = significant exposure (more than a third of the time). The X and XXs are totalled.

This is a guidance checklist for a later stage. The jobs where most factors were identified are considered priority for further study.

Potential users and training requirements

The checklist aims to be simple, quick, basic and usable by shopfloor operators with no special experience in ergonomics. It requires no special training in MSDs.

Time needed

Once the study to determine a representative work procedure is done, the method can be gone through quite quickly (30 min.). But it does need a discussion with some workers to ensure that scores are as objective as possible.

Scope

This is a semi-quantitative method whose final score is of little interest but whose division into risk factors and the questions help direct the attempt to identify solutions.

The benefit cost ratio is good. It is easy to use, and can easily lead the partners to improvements in procedures and working conditions. It can be compared to the PLIBEL method described above.

Classification

Level 1, Screening

NIOSH equation

References

— Waters, T. R., V. Putz-Anderson, A. Garg and L. J. Fine (1993) 'Revised NIOSH equation for the design and evaluation of manual lifting tasks', *Ergonomics*, 36 (3), 749-776.
— Waters, T. R., V. Putz-Anderson and A. Garg (1994) *Applications manual for the revised NIOSH lifting equation*, Cincinnati: U.S. Department of Health and Human Service. National Institute for Occupational Safety and Health (NIOSH).
— EN 1005-2 (2003) *Safety of machinery - Human physical performance - Part 2: manual handling of machinery and component parts of machinery*.

The applications manual and example problems can be found on different scientific sites, such as: www.cdc.gov/niosh/docs/94-110. Various calculation programs are available, including at www.deparisnet.be/TMS/TMS.html.

Stated purposes

The aim is to assist safety and health practitioners to evaluate, prevent or reduce the occurrence of low back pain and disability for workers engaged in repetitive load lifting or lowering tasks in the sagittal plane of movement.

The method is used to determine the recommended weight limit of a load based on the lifting characteristics and to propose preventive measures. This method is a revised version of the equation proposed by NIOSH in 1981 in a practical guide to the manual lifting of loads.

Body regions assessed

Back

Description

The method applies only to load lifting and lowering operations. It computes the "Recommended Weight Limit" (RWL) based on lifting or lowering task conditions: distance of the load from the front of the body, height of the load, vertical travel distance, body twist, quality of coupling (grip), duration and frequency of the task.

Standard EN 1005-2 somewhat expands the scope by providing additional corrections depending on whether handling is performed one- or two-handed and by one or two people.

The "Lifting Index" (LI) is computed as the ratio between the weight of the load lifted and the recommended weight limit. Depending on the value of this index, the risk:
— is negligible (< 1);
— exists and the situation requires improving (1-3); or
— is unacceptable (> 3).

A Composite Lifting Index (CLI) can be calculated for frequent manual handling tasks with varying distances, heights, frequencies, etc., such as palletising/depalletising for example.

The table illustrates a study in which the user has attempted to compute the lifting index in the best (grip at the right distance and height, no twisting, etc.) and worst conditions. This example shows that the lifting index can vary by up to three times with completely different interpretations in terms of risk.

Gender	Male (1)	Female (2)	1	
Age	45			
Condition	Best	Multiplier factor	Worst	Multiplier factor
Horizontal distance to hands while holding object (cm)	30	0.83	40	0.63
Vertical distance to hands while holding object (cm)	60	0.96	50	0.93
Vertical travel distance (cm)	15	1.00	15	1.00
Quality of coupling (grip)	1	1.00	2	0.95
Twisting angle (degrees)	0	1.00	45	0.86
Duration of lifting (hours)	2		4	
Number of lifts per minute	3	0.79	3	0.55
1 or 2-hand handling	2	1.00	2	1.00
1- or 2-person handling	1	1.00	1	1.00
Additional handling tasks (0, 1 = yes)	0	1.00	1	0.8
Weight of load handled (kg)	15.0		10.0	
Recommended weight limit	**15.7**		**4.8**	
Lifting index	**0.95**		**3.15**	

Potential users and training requirements

The tool is fairly straightforward to use, but still requires a sound grasp of the basic concepts and assumptions if usable results and reliable interpretations are to be achieved. It is therefore recommended that these calculation computer programs, which arguably trivialise the assessment, be used only by people with such knowledge.

Time needed

Once the study to determine a representative work procedure is done, the method takes about 30 minutes to go through. It needs a discussion with workers to arrive at the most objective scores possible. Calculating the Composite Lifting Index requires considerably longer.

Scope

This is a well-documented, scientifically robust method tested in numerous laboratory studies. It was designed for risk prediction. The multiplier factors for the different components enable the factors that most limit the recommended load weight - and are therefore responsible for the increased risk of lower back injuries – to be identified. General measures to reduce each of these factors are proposed.

The tool has been thoroughly analyzed, reviewed and validated and can be considered as one of the most valid means of assessing and prioritising simple load handling jobs.

It has a very good -benefit cost ratio: a discussion with the workers and managers on the basis of the multiplier factors enables solutions for improving work procedures or circumstances to be sought. This makes it the basic tool for anyone with health and safety responsibilities dealing with the risk of back injuries.

On the other hand, where prevention is concerned, we feel that calculating the Composite Lifting Index could be the short way to complex and pointless quantifying exercises.

Classification

Level 2, Analysis

Psychophysical tables

References

— Snook, S. H. and V. M. Ciriello (1991) 'The design of manual handling tasks: revised tables of maximum acceptable weights and forces', *Ergonomics*, 34 (9), 1197-1213.

The tables are available at http://libertymmhtables.libertymutual.com/CM_LMTablesWeb/pdf/LibertyMutualTables.pdf.

Stated purposes

To determine the maximum acceptable force that a worker is prepared to exert to perform different repetitive movements (method developed by an American insurance company).

Body regions covered

Mainly back and wrists

Description

The psychophysical response is the maximum exertion that a worker is willing to make under different conditions and over a certain period of time, working as hard as possible but without experiencing more fatigue, weakness or breathlessness than normal.

Tables give acceptable values for 10, 25, 50, 75 or 90% of men and women performing four types of activities:

— Lifting/lowering: maximum acceptable lifting and lowering weights according to the width of the object, load height at start, lift/lower distance and task frequency.
— Pull/push: maximum force needed to start and keep the load moving according to the vertical distance between floor level and grasp height, and the carrying distance.
— Carrying of loads: maximum acceptable weight according to hand height from floor level, carrying distance and task frequency.
— Wrist flexion and extension (women only): maximum torques according to working time and maximum forces of grip and pinch with the wrist in flexion (downward or inward movement of the wrist) or extension (upward movement of the wrist - palm facing outward).

The characteristics of the work to which the method applies are defined for each activity.

Potential users and training requirements

As with the NIOSH equation, it is a fairly simple tool to use, but requires a sound knowledge of the basic concepts and assumptions in order to achieve usable results and reliable interpretations. Specific training is essential to interpret the maximum torques (wrist flexion and extension).

Time needed

Once the study to determine a representative work procedure is done, the method takes about 30 minutes to go through, like the NIOSH equation which it is very similar to and supplements.

Scope

As for the NIOSH equation presented in the previous section, the quantifying process should preferably be accompanied by a discussion with the workers to identify preventive measures and improvements. The tables have also been extensively analyzed and criticised.

The -benefit cost ratio is equally good and it is also one of the basic tools for anyone with health and safety responsibilities involved in lower back risks.

Classification

Level 2, Analysis

Strain index

References

— Moore J. S and A. Garg (1995) 'The strain index: a proposed method to analyze jobs for risk of distal upper extremity disorders', *American Industrial Hygiene Association Journal*, 56 (5), 443-458.

Various computer programs are available on the Internet, in particular at: www.deparisnet.be/MSDs/Programmes/Malchaire_Strain_Index_30-10-09.exe.

Stated purposes

A semi-quantitative analysis method for identifying high-risk jobs by calculating an overall numerical score - the "Strain Index". The method was developed by researchers to assess exposure. It is intended for professional and ergonomic teams to predict the raised risk of developing an MSD.

Body regions assessed

The wrists and hands

Description

Strain index					**4.5**	**18**
Estimated force needed to perform the work						
	% FMV	**Borg**	**Perceived effort**		**Choice**	**Choice**
Light	< 10 %	<= 2	Barely noticeable or relaxed effort		○	○
Somewhat hard	10-29 %	3	Noticeable effort		●	○
Hard	30-49 %	4-5	Obvious effort, but expression unchanged		○	●
Very hard	50-79 %	6-7	Substantial effort, expression changed		○	○
Near maximal	=>80 %	> 7	Uses shoulder or trunk for force		○	○
Duration of exertion (% of cycle time)					30	50
Number of efforts per minute					15	20
Hand/wrist posture						
	Extension	**Flexion**	**Ulnar deviation**	**Perception**	**Choice**	**Choice**
Very good	0-10°	0-5°	0-10°	Perfectly neutral	●	○
Good	11-25°	6-15°	11-15°	Near neutral	○	●
Fair	26-40°	15-30°	16-20°	Not neutral	○	○
Bad	41-55°	31-50°	21-25°	Marked deviation	○	○
Vary bad	> 60°	> 50°	> 25°	Near extreme	○	○
Speed of work						
			Perception		**Choice**	**Choice**
	Very slow		Extremely relaxed pace		○	○
	Slow		Taking one's own time		●	○
	Fair		Normal speed of motion		○	●
	Fast		Rushed, but able to keep up		○	○
	Vary fast		Rushed and barely able/unable to keep up		○	○
Duration of task per day					2	2

The method consists in:

— Collecting data for six risk factors: intensity of exertion, duration of exertion, exertions per minute, wrist/hand posture, speed of work, and duration of task per day. A video recording of the work is recommended.
— Scoring each factor (from 1–5) by reference to one or more qualitative and quantitative criteria. The study is made easier by the fact that each partial score is validated by a range of observations and/or measurements.
— The final score - the "Strain Index" – is calculated by multiplying the six coefficients obtained.

A score > 7 indicates probably a hazardous job and a score < 3 a safe job.

One of the unique advantages of this method is that the assessment of postures, efforts and pace is based not on one single criterion but on 2 to 5 quantitative and qualitative criteria of the observer and workers. This gives it greater reliability.

Potential users and training requirements

This is a method for use by health and safety officers because training in ergonomics is needed for the scoring

Time needed

Once the study to determine a representative work procedure is done, the method can be gone through quite quickly in 45 mins/1 hour. It requires a discussion with the workers to get their perceptions of efforts, postures and paces, and to achieve reliable scores.

Scope

The Strain Index concerns only MSDs of the wrists and hands. In this limited - but the biggest (carpal tunnel syndrome, etc.) - field It has often been used to quantify risks and compare different work situations.

It has a fairly good benefit cost ratio: it is easy to use and produces a fairly reliable risk score where such quantitative assessments are wished for. The method is purely for assessing risk factors, not preventing risks, although the consultation that is needed with workers can be used to discuss preventive measures and improvements.

Classification

Level 2, Analysis

OWAS:
Ovaka Working Posture Analysing System

Reference

— Louhevaara V. and T. Suurnäkki (1992) *OWAS: a method for the evaluation of postural load during work*, Helsinki: Institute of Occupational Health. Centre for Occupational Safety.

A user guide and computer program can be downloaded from http://turva1.me.tut.fi/owas/.

Stated purposes

A semi-quantitative analysis method for:

— identifying and assessing stressful work postures;

— determining how urgently corrective measures are required to the job by a classification into four categories of action (from "no action" to "immediate corrective action").

Body regions assessed

Back, upper and lower limbs

Description

It is a three-stage method:

1. Video recording of the job.
2. Observation of the videotape at regular intervals (e.g., every 30 seconds), identifying the postures:
   — back: straight; bending forwards; twisting or bending to the side; bending and twisting to the side or bending forwards;
   — arms: both below shoulder level; one at or above shoulder level; both at or above shoulder level;
   — legs: sitting; upright with both straight; upright with one taking the body weight; upright or squatting with both knees bent; upright or squatting with one knee bent; kneeling on one or both knees; walking or moving;
   — weight of load handled or muscle effort required: weight or force required < 10 kg; between 10 to 20 kg; > 20 kg.
3. Classification into four action categories:
   — action Level 1: acceptable conditions; no changes needed;
   — action Level 2: some harmful effect; changes to be made in the future;
   — action Level 3: distinctly harmful effect; changes to be made as soon as possible;
   — action Level 4: extremely harmful effect; immediate solutions should be found.

What makes this method different is that it involves studying working conditions over time, identifying the frequency of postures and efforts over the sample. By focusing on variations, it is more approximate in its assessment of postures. This approach has been used by other researchers focusing on specific body regions.

Potential users and training requirements

The method is easy to understand but difficult to put into practice: it requires very special training to make the video recording of the representative work cycle and make the observations of the images at regular intervals.

Time needed

In addition to the study of a representative work procedure, the method takes several hours to apply in making and analysing the video recordings. One specific difficulty is that the video needs to cover the entire body, and so is not sufficiently precise for a detailed assessment of back or arm postures.

Scope

This method has been widely used in epidemiological studies reported in the scientific literature. The overall score is what determines the action category – i.e., the need for and urgency of making changes.

Used as described above, focusing on postures at regular time intervals, the method is useful for taking account of variations in working conditions over time, but can only give numerical totals of the frequencies of different postures and efforts, whereas for prevention purposes, attention needs to be paid to harmful postures and efforts.

The -benefit cost ratio for prevention is poor if the method does not at the same time try to identify the work phases that need improving.

Classification

Level 3, Expertise

Rapid Upper Limb Assessment (RULA)

References

— McAtamney L. and E. N. Corlett (1993) 'RULA: a survey method for the investigation of work-related upper limb disorders', *Applied Ergonomics*, 24 (2), 91-99.

The method is described on the site www.rula.co.uk.

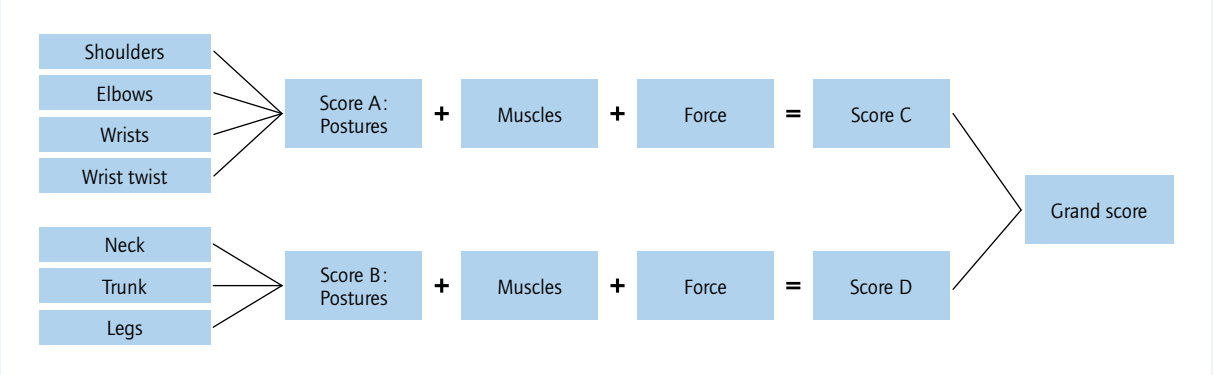
Stated purposes

The aim is to enable a quick and easy assessment of working conditions in which MSDs have been reported. The method was developed to screen workers at risk, identify the muscular effort associated with different risk factors which may contribute to muscle fatigue, and possibly to be incorporated into a general ergonomic assessment method.

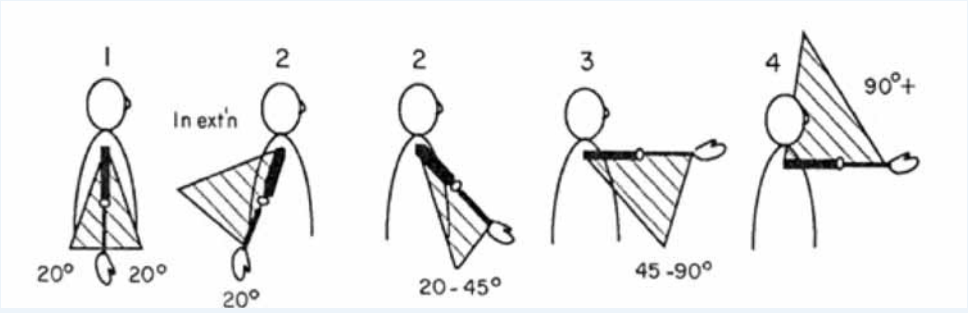
Body regions covered

Shoulders, elbows, wrists, neck, trunk, legs

Description



The figure summarises the method. The body is divided into two groups with three body parts per group (A: shoulders, elbows, wrists and B: neck, trunk, legs). A posture score is assigned to each body part from tables accompanied by diagrams. These scores are added up for each group.



A static muscle work score and a force score taking into account the repetition of motions are determined for each group and combined with the posture scores. A final table gives a single grand score from both groups.

Four action levels are defined from the final score:
— Action level 1: Low risk; posture acceptable.
— Action level 2: further investigation is needed and changes may be required.
— Action level 3: further investigation is needed and changes are required soon.
— Action level 4: further investigation is needed and changes are required immediately.

Potential users and training requirements

To be used properly, this requires thorough training in the method and the proper means of calculating the different intermediate scores; it should only be used by ergonomists.

Time needed

Once the study to determine a representative work procedure has been done, putting the method into practice takes some considerable time due to the need to evaluate the 11 partial scores for all body regions from videotape recordings.

Scope

The method was developed by researchers and has been used by others for epidemiological research purposes. The final score determines the overall level of risk of MSDs, but does not inquire into causes or lead to solutions for improvements.

In terms of prevention and improving working conditions, the guide has a fairly poor -benefit cost ratio. The hours or days of analysis required to determine the representative work period, make one or more video recordings, and calculate the scores lead to what is arguably a fairly insignificant outcome (further long, medium or short term investigation required). The method does not explicitly require workers to be involved.

Classification

Level 3, Expertise

OCRA index

References

— Colombini, D. and A. Grieco (eds) (1998) 'An observational method for classifying exposure to repetitive movements of the upper limbs', *Ergonomics*, 41 (9), 1261-1289.
— Occhipinti E., D. Colombini and A. Grieco (eds.) (1998) 'OCRA: a concise index for the assessment of exposure to repetitive movements of the upper limbs', *Ergonomics*, 41 (9), 1290-1311.
— The OCRA index is described in European Standard EN 1005-5 (2007) *Safety of machinery - Human physical performance - Part 5: Risk assessment for repetitive handling at high frequency*.

A detailed description is available on the website: www.epmresearch.org/html/okra-en.

Stated purposes

The objective is to classify work situations according to their exposure to MSDs and to calculate the amount of exposure to tasks involving repetitive movements of the upper limbs.

Body regions assessed

Upper limbs, but mostly the hands

Description

The risk level is assessed by the OCRA index which is the ratio between the number of technical actions actually carried out during the work shift (ATA) and the number of recommended technical actions (RTA) (for each upper limb).

Assessment is a three-stage process:

1. Determining the frequency of technical actions per minute and calculating the total number of technical actions actually carried out during the work shift, for each upper limb.
2. Calculating the total number of recommended technical actions carried out during the work shift according to the frequency of awkward forces, postures or movements, repetitions of the same movements, the presence of additional factors (cold, gloves, vibration, sudden movements, etc.), recovery periods and the daily duration of repetitive tasks. This stage requires many calculations to be performed (13), including the percentage of time that the shoulder is in flexion or abduction to 80° or more, the wrist is in radial or ulnar deviation to ≥ 20°, gripping is forceful with a narrow span (≥ 2 cm) and so on.
3. Calculating the OCRA risk index = ATA / RTA.

OCRA index	Zone	Risk level	Actions
≤ 2.2	Green	No risk	No action required
2.3 – 3.5	Orange	Very low risk	Improvements to risk factors recommended: posture, force, technical actions, etc.
> 3.5	Red	Risk	Re-design of tasks and workplaces required

Potential users and training requirements

Substantial training (several days) in MSDs and the method are needed, making it only for use by experts.

Time needed

The OCRA method requires a lot of time for analysis, especially where complex tasks and multitasking are involved. Once the study to determine a representative work procedure is done, it can take from several hours to several days to identify the technical actions, the percentages of time that positions are kept, etc., and to carry out the full study.

Scope

The OCRA index is one of the most sophisticated quantifying methods which claims to achieve precision by accumulating assessments of details. The final score defines the overall risk of MSD, but does not inquire into causes or lead to solutions for improvements. This makes it a quantification tool.

In terms of prevention and improving working conditions, the guide has a fairly poor -benefit cost ratio. Even more than the RULA method, after determining the representative period, making the video recording(s) and calculating all the scores, the conclusion (no risk, very low risk, risk) seems slight.

Classification

Level 3, Expertise

The OCRA checklist

References

— Occhipinti, E. and D. Colombini (2005) 'The occupational repetitive action (OCRA) methods: OCRA index and OCRA checklist', in N. Stanton, A. Hedge, K. Brookhuis, E. Salas and H. Hendrick (eds.) *Handbook of human factors and ergonomics methods*, Boca Raton: CRC Press, 15:1-14.

The checklist is available at www.epmresearch.org/html/ocra/A-Work_papers/the_Ocra_checklist_june2006.pdf.

Stated purposes

Realizing that the OCRA index is quite complex and time-consuming to use, the authors developed a simpler checklist for "initial screening" of jobs involving repetitive tasks, while the OCRA index would be useful for the redesign and analysis of such jobs.

The authors say that the checklist is not a substitute for assessing exposure by the OCRA index, since this is more accurate. However, they do say that the checklist is essential during the first phase of risk assessment for initial "risk mapping".

Body regions assessed

Upper limbs, but mostly the hands

Description

The checklist allows an OCRA score to be calculated by first adding up partial scores from the frequency of technical actions, forces, recovery periods, shoulder-elbow-wrist-hand, positions, repetitiveness and the presence of additional factors (cold, gloves, etc.). The final score is obtained by multiplying these by a work duration factor.

OCRA score = (Frequency + Force + Recovery + Position + Repetitiveness + Other) x Work duration

The table below gives an example of evaluating a force partial score.

Near maximum force (8 or more on the Borg scale)	
6	2 s every 10 minutes
12	1 % time
24	5 % time
32	> 10 % time
High force (5-6-7 on the Borg scale)	
4	2 s every 10 minutes
8	1 % time
16	5 % time
24	> 10 % time
Moderate force (3-4 on the Borg scale)	
2	1/3 cycle time
4	1/2 cycle time
6	> 1/2 cycle time
8	almost the whole cycle time

This therefore means assessing the intensities of forces during technical actions using the Borg scale, and the duration of working time at each level of intensity. The scores are interpreted using the following table.

OCRA score	OCRA index	Colour	Risk
< 7.5	2.2		Acceptable
7.6 – 11	2.3 – 3.5		Limited risk
11.1 – 14	3.6 – 4.5		Low risk
14.1 – 22.5	4.6 – 9		Medium risk
> 22.5	> 9		High risk

Potential users and training requirements

Although the checklist is easier to use than the full method, substantial training in MSDs and the method are needed, making it only for use by specialists.

Time needed

Once the study to determine a representative work procedure is done, quite some time is needed to identify the technical actions, the percentages of time that positions are kept, etc. and to carry out the full study.

Scope

The OCRA checklist is much more complex than most of the tools discussed above, so that it cannot be considered as an "initial screening" tool. Once again, precision is claimed by accumulating assessments of details, and the final score defines the overall risk of MSD, but does not inquire into causes or lead to solutions for improvements.

In terms of prevention and improving working conditions, the score and conclusion also have a fairly poor -benefit cost ratio.

Classification

Level 2, Analysis

SOBANE Observation Guide – MSDs

References

— Malchaire, J. et al. (2007) *Troubles musculosquelettiques*, Série Stratégie SOBANE. Gestion des risques professionnels, Bruxelles, SPF Emploi, Travail, Concertation sociale.

Editable versions of the guide (WinWord) in French and Dutch can be downloaded from the SOBANE Strategy official website www.sobane.be. Other language versions can be found at www.deparisnet.be. Examples of use can be found at www.deparisnet.be.

Stated purposes

The document's aim is to describe tools that direct the attention of workers, their technical supervisors and prevention advisors to all the technical, organisational and human aspects that determine exposure conditions. It aims to lead more quickly to less costly yet effective prevention.

Body regions covered

All body regions: upper and lower limbs, back, neck

Description

The SOBANE Strategy calls on the company to put the problem of musculoskeletal disorders in the general context of the work situation using the Déparis participatory risk screening guide described earlier.

Subsequently, the Observation Guide is used following the same procedure to "observe" in detail all the aspects more directly related to MSDs, looking for every simple practical improvement. The Observation guide comprises 18 categories:

1. Seated work postures
2. Office work with a display screen
3. Standing work postures
4. Other postures
5. Clutter
6. Arrangement of tools, materials, orders, products, etc.
7. Tools
8. Vibrating tools
9. Neck, shoulders, elbows and wrists/hands postures
10. Wrist/hand efforts
11. Repetition
12. Mechanical aids
13. Mechanically handled loads
14. Manually lifted loads
15. Arm push-pulls
16. Working environments
17. Work organisation
18. Time organisation

Each category describes a set of points to look at in the group discussion with a view to identifying improvements. Not all categories may be relevant as such to the observed work situation, so the first job will be to choose those that are relevant.

2.2.11 Repetitiveness (sheet 4)

Check that:
– The work is organised so as to be able to alternate between each arm or hand.
– There is frequent rotation between jobs that require different positions and efforts.
– Repeated short breaks are arranged (5 min per hour).
  – the upper limbs and neck are exercised during breaks.
– Pneumatic or electric power tools are provided for the most repetitive tasks.
  – pedals are used rather than manual control systems.
– The best ways of performing the repetitive task to minimise the force and position constraints have been studied.
– They are known to all employees.
– Work paces are slowed down, if possible
  – Work organisation allows the operator to work at his/her own pace.

What practical and direct improvements can be made to the situation?
What should be studied in more detail?

As at the end of the Déparis dialogue meeting, the improvements and further studies suggested in the discussion are summarised in a table, identifying "who" does "what" and "when". This table leads to the short, medium and long-term action plan.

Potential users and training requirements

The guide is for the work group: workers and local organizers. It needs no special training in ergonomics. Using it requires the meeting leader to have some knowledge of how to run a meeting.

Time needed

As with the Déparis guide, the meeting requires about four workers and four technical supervisors to get together for about two hours. The question of a representative work phase to study does not arise since the discussion with the workers relates to the work situation generally and not at a point in time.

Once again, the Observation meeting can only be organised once all partners are ready to commit to it and accept the results.

Scope

The Observation Guide does not result in a score. Its sole purpose is to identify preventive measures and improve the work situation. An underlying aim is to train workers and their supervisors to deal with their problems. For that, the guide comes with information and training sheets written in terms that require no explanation.

The guide is easy to use if the conditions of the participatory process are met. So it is intended to be used after the Déparis dialogue guide, this time focusing in detail on those aspects of the work situation directly related to MSD risks. Over its 18 chapters, the guide calls attention to some 300 points that might increase the MSD risk. Considering the average results achieved, the -benefit cost ratio is very high.

Classification

Level 2, Analysis

Summary of musculoskeletal disorder risk assessment and/or prevention methods

The table below summarises the methods reviewed above. Most of the methods selected, therefore, are mainly concerned with quantifying risks. The simplest (MAC, KIM, ART, etc.) can fairly easily have questions added to them that lead to solutions: "Why is the work done this way?" and "How can the work situation be changed?"

The more complex the method, the more it tends to divert the user's attention from the work situation and to focus on the subject, position, force exerted, etc.

Level	Potential users	Main focus	
		Quantifying risks	Identifying solutions
1. Screening	The work group	MAC[2] KIM[2] ART[1] Keyserling Checklist[3]	FIFARIM[2] Risk filter and assessment worksheets[2] PLIBEL[1]
2. Analysis	Any prevention adviser	NIOSH[2] Psychophysical tables[2] Strain Index[3] OCRA Checklist[3]	SOBANE – Observation[1]
3. Expertise	Ergonomist	OWAS[1] RULA[1] OCRA index[3]	

1. Whole body / 2. Back problems / 3. Upper limbs

Conclusion

In a brochure entitled *Musculoskeletal disorders An ill-understood pandemic* published in 2007, the European Trade Union Institute showed that there was more than enough scientific understanding of the causes and the human, societal and economic impacts to get to grip with MSDs. For that, effective tools are needed.

In that earlier publication, the author said that legislative and company initiatives to manage MSDs were not being put to good use. The vast number of tools, methods, questionnaires, checklists, measuring equipment and methods found in the literature shows that is indeed the case.

This publication aims to provoke thought about the use of these methods: who they are for, what they do, but especially how they can help prevent MSDs. It also aims to prevent more time and energy being frittered away in large-scale surveys or campaigns to measure biomechanical risk factors. The problems are known; firms no longer need telling about the risks of poor work postures – what they need are tools to identify and avoid risk postures.

The traditional approach to prevention - identifying, quantifying, prioritising, solving – still often used for physical agents (noise, thermal environment, etc.) where workers are at best just consulted will no longer do for MSDs. The fact that there are multiple risk factors, that they are related to the actual conditions of how the job is done (and not the general set-up as for noise or heat), that there are no limit values, and that the aim is not just to prevent workers from suffering but to promote their well-being, makes it essential for the workers concerned to be actively involved in the preventive approach.

The methods described in this brochure mostly look only at biomechanical risk factors – postures, force, repetitiveness - whereas all epidemiological studies stress the key role of other factors like psychosocial aspects. The problem of MSDs therefore needs to be set in a broader framework which means first undertaking the most comprehensive review possible of the general context of the work situation. This is what "participatory risk screening" sets out to do: to give an overview, assign importance and improve knowledge not only of the risks but also anything that adds to workers' well-being, to present the workers with a coherent prevention policy, and to involve them directly in bettering the conditions of their working life.

Prevention should be an ongoing process, part of which is to constantly reassess how well the solutions applied are working through direct feedback from employers and workers. Age and gender differences and other personal characteristics require an assessment of the physiological response to work stresses through a specific health surveillance programme. That is doable in small and medium-sized firms including very small firms as we documented in the book *Risk assessment of biomechanical damage risks in small and medium-sized enterprises*, published in 2009.

Finally, specific efforts are needed to improve the manufacture of machinery early on in the design stage, including by collecting feedback from end-users and operators who are exposed day in, day out to a combination of risk factors, including those that can cause musculoskeletal disorders.