



ORGANISATIONAL AND PSYCHOSOCIAL FACTORS AND THE DEVELOPMENT OF MUSCULOSKELETAL DISORDERS OF THE UPPER LIMBS

Programme d'appui scientifique à la protection des travailleurs 1999-2003
Research contract PS/10/18

FINAL REPORT

Synthese

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Key words: MSD-Longitudinal study-Psychosocial factors-Organisational factors-Biomechanical factors

I. INTRODUCTION

The musculoskeletal disorders (MSDs) from occupational origin constitute a world problem, as well from the point of view of health as socially and economically.

It covers a whole series of pathologies concerning the muscles, tendons and articulations of the back, the neck and the upper limbs (shoulders, elbows, wrists) and, to a lesser extent, the lower limbs.

Some statistics were noted down at the time of the last European investigation about the working conditions (Paoli et Merllié, 2001): in the European Union (UE), 30% of the workers complained about pain in the low back, 23% about the neck and shoulders, 13% about the arms and 12% about the lower limbs. The figures for Belgium were respectively 21%, 17%, 11% and 10%.

The estimates of cost and of days of absence attributed to MSDs vary greatly between countries but underline the considerable impact for the companies and the society in general:

The different countries agreed to evaluate the total cost between 0.6 and 2% of the GNP.

Many cross sectional and a few longitudinal epidemiological researches showed that the development of MSDs can be associated with a whole set of physical (efforts, repetitiveness, awkward postures, vibrations...), organisational, psychosocial and individual factors (Hagberg et al., 1995; Nordander et al., 1999; European agency for safety and health at work, fact 9, 2000).

A large review of literature (Malchaire et al., 2001a) showed that the possible associations and, all the more, causalities (between MSDs and the different factors) are far from being systematic.

This lack of systematic association can partly be due to the fact that the majority of the indexed studies were cross-sectional, i.e. observed at a given time the concomitancy between MSDs and the risk factors.

The rare longitudinal studies (4 studies existed when the present study began) don't take into consideration the whole set of the risk factors.

It appears therefore necessary to conduct a longitudinal study looking for the association between the development of MSDs and the existence at the same time of biomechanical, organisational and psychosocial constraint factors.

Following the studies undertaken separately by the partners on stress (ULB), on organization at work (KULeuven) and on MSDs (UCL), it appeared possible to combine these various approaches to arrive at a global comprehension of the problem and to define more effective prevention strategies.

II. GENERAL OBJECTIVES OF THE STUDY

The research objectives are:

- to quantify the interindividual differences in musculoskeletal constraints which contribute to the development of the MSDs
- to analyse and quantify the relationship between these interindividual differences in musculoskeletal constraints and the general constraints imposed by the work situation (stress, attitude...).
- to analyse and quantify the relationship between these constraints, the organisational aspects of the work environment and the personal characteristics of the subject,

taking into account the functional capacities, themselves function of the individual characteristics of the subject (age, sex...).

III. MATERIAL AND METHODS

A. Population

19 workplaces were selected. They came from 15 different companies and from several economic sectors:

- 10 companies from the secondary sector (industry),
- 3 companies from the service sector (services to companies, transport, procurement supplies),
- 2 companies from the quaternary sector (care, education and administration).

298 operators were interviewed the first year, 181 men and 117 women.

B. Methodology

All the operators were subjected to a questionnaire of 261 questions, filled in during an interview and concerning general characteristics (age, weight, height, seniority, ...), health status, personal habits and extra professional activities (smoking, sport,...), characteristics of current workplaces, musculoskeletal history in the area of the shoulders, the elbows, and more particularly of the neck and the wrists/hands, personality traits (type A, conscientiousness, extraversion, neuroticism), professional styles (integrated, functional, instrumental) and stress characteristics (the Karasek questionnaire).

This questionnaire was followed by an clinical examination (Cock et Masset, 1994) focused on MSD in the upper limbs.

Finally, a battery of tests was conducted comprising the measurement of the maximum voluntary contraction (MVC) using a Jamar hydraulic dynamometer, the measurement of the maximum angles in the wrists, a finger dexterity test (the O'Connor finger dexterity test) and an assembly test of cubes (concrete intelligence test of Bonnardel).

Each participant passed an individual interview (1.5 hours), during which the questionnaire and the tests described here above were used.

All these participants were seen again approximately 15 months later for the analysis of biomechanical constraints as well as for the second interviews (1 hour, with a shorter protocol).

The analysis of the working conditions included, the analysis of the biomechanical constraints by video recordings and the analysis of the socio-organisational factors by questionnaires.

- The biomechanical constraints:

Video recordings were made for each employee in order to assess the occupational constraints.

The procedure described at the third level, the Analysis level, of the MSD prevention strategy, developed by the Research Unit (Malchaire et al., 2001b) was used.

It was focused on the operator's wrists to evaluate the effort level, to quantify wrist positions in the two movement axes (flexion – extension and in deviation) and to calculate a variability index.

- The socio-organisational factors were studied by means of questionnaires and interviews.

These questionnaires concern the companies and the workplaces involved in the study. A first questionnaire, for the personnel manager, collects information on the socio-demographic data (number of workers in the company, contract type, range of age of the workers), the industrial accidents, the constitution of the wages (fixed and/or variable), the personnel turn over of the function in question, ...

An other questionnaire addressed to the production manager focuses on the production base, the three most important production criteria, the work schedules...

An interview with the production manager focuses on the presence of buffers in the production flow, the rotation opportunities, the tasks of the function, the short-cycled and the simple tasks, ...

Finally a checklist was completed by the researchers themselves, basing on their knowledge of the company, to characterize the workplaces on the degree of autonomy, the alternation between complex and simple tasks, little or no short-cycled tasks, the feedback...

Additionally this analysis of the work conditions were completed by the application of the strategy for the prevention of musculoskeletal problems in the upper limbs developed by the UCL "Unité Hygiène et de Physiologie du Travail" (Troubles musculosquelettiques du dos et des membres supérieurs (TMS) - Stratégie d'évaluation et de prévention, Ministère fédéral de l'emploi et du Travail. 69 pp. 2001), in order to get an overall view of the work situation and take advantage of the opinion of the employees directly concerned by the workplace. The key factor of this strategy is to identify as early as possible preventive solutions.

IV. RESULTS

- The prevalence of complaints during the last 12 months reported during the first interview is important and equal to 64% for the low back, 60% for the neck and 34% for the dominant wrist.
- An index of gravity of the complaints was defined to determine the incidence rate. Only the people developing severe complaints were regarded as suffering of MSD. The average incidence was 17.5% for the neck (between 0 and 30% according to the workplace) and 12.4% for the dominant wrist (between 0 and 28% according to the workplace).
- Logistic regression-models calculated (table 1) showed that the probability of development of severe complaints on the level of the dominant wrist is statistically higher among smoking people, for the workers who consider the efforts in the wrists as being average to high at work, for the subjects having a functional style, for the people for which work implies physical efforts (according to Karasek), where the psychological demands are low, where the agreement with the colleagues is good, where the workers feel their employment insecure.
The probability of development of severe neck complaints is statistically higher for the subjects appreciating their direct superiors, having a neurotic personality type rather extravert and not being conscientious.

Table 1: Multivariate logistical regression (model $A+B1+B3a+B4a$) between the development of wrist MSD and all the variables (Odds Ratio, 95% confidence Interval and significance level)

| Variables | OR | CI | p |
|----------------------------------|------|--------------|-------|
| For the dominant wrist | | | |
| Smoking | 4.99 | 1.45 - 17.21 | 0.011 |
| Efforts in the wrists | 6.71 | 1.35 - 33.21 | 0.020 |
| Functional style | 2.31 | 1.19 - 4.49 | 0.013 |
| Physical efforts Karasek | 2.36 | 1.09 - 5.09 | 0.029 |
| Psychological demands Karasek | 0.07 | 0.01 - 0.49 | 0.007 |
| Support colleagues Karasek | 3.71 | 1.16 - 11.85 | 0.027 |
| Insecurity of employment Karasek | 3.47 | 1.51 - 8.00 | 0.003 |
| For the neck | | | |
| Appreciation of the superiors | 2.62 | 1.30 - 5.30 | 0.007 |
| Neuroticism | 2.85 | 1.22 - 6.68 | 0.016 |
| Extraversion | 4.04 | 1.11 - 14.67 | 0.034 |
| Conscientious character | 0.29 | 0.08 - 0.97 | 0.045 |

- A Multi-Value Qualitative Comparative Analysis (MVQCA) was used to examine the relations between the organizational aspects and the development of MSD. MVQCA mutually compares the configurations of the workplaces in a systematic way by group (problematic and less-problematic), separately for the wrist complaints and for the neck complaints. These groups are
 - A problematic group (number of aggravated and/or new complaints is higher than the number of people without complaints)
 - A less problematic group (number of aggravated and/or new complaints is lower than the number of people without complaints).

The main results are:

For the wrist complaints:

- The characteristics of the work places belong to the PROBLEMATIC GROUP (n=8) are:
 - The absence of a rotation system in combination with a medium/high liberty to insert individual breaks.
 - A high percentage quite/very stressed individuals in combination with a medium/high degree of interdependence.
- The characteristics of the work places belong to the LESS PROBLEMATIC GROUP (n=9) are:
 - A low percentage quite/very stressed individuals in combination with a medium/high rotation.

For the neck complaints:

- The characteristics of the work places belong to the PROBLEMATIC GROUP (n=8) are:
 - A high percentage quite/very stressed individuals in combination with a low liberty to insert individual breaks.
- The characteristics of the work places belong to the LESS PROBLEMATIC GROUP (n=9) are:
 - A frequent rotation (medium/high).
 - A medium/high liberty to insert breaks in combination with a low decision latitude.
 - A low percentage quite/very stressed individuals in combination with a high degree of interdependence.

In summary, three general tendencies can be detected throughout the above four comparison processes. The number of aggravated, new and permanent high wrist and neck complaints is in general smaller with workplaces:

- that have a frequent rotation between different types of tasks,
- that allow their employees to insert enough individual breaks and
- where the employees are less stressed.

V. ENHANCEMENT

Even if the research does not actually lead to new results, it proves again the multi-factor aetiology of the MSDs and the fact that a reduction of the biomechanical load and an improvement of the work organization and of the living environment should lead to a fall of the prevalence of MSDs of professional origin.

Different MSDs evaluation methods exist but few of them are oriented towards prevention and the search for solutions. For a few years, the Unité Hygiène et Physiologie du Travail of the Université catholique de Louvain developed the general prevention SOBANE strategy and the so called SOBANE - MSDs, concerning the risk factors of MSDs. This strategy was used in this research and permitted to find solutions at different workplaces. While it tackles physical and psychosocial (in the last points) risk factors, it appears now essential (and it would be an innovation at the scientific level) to develop intervention and management tools integrating the physical and psychosocial aspects.

The Federal Scientific Policy (FSP) service supported during the last 15 years a significant number of research concerning the psychosocial problems in general and the stress in particular. An overall enhancement of these researches and of the one discussed here would be the broadening of the

SOBANE strategy in its various levels, so that it takes into consideration, comprehensively the physical, organisational and psychosocial aspects.

These prevention measures must go with training of the workers.

In the study additional to the present report, we describe an approach by video and show its short-term interest. Video recordings are carried out at the workplaces and show behaviours, efforts, postures to avoid or to adopt preferably, with explanations of the risks and the advantages.

The return of such methods could only be demonstrated in the short term. Longer studies bearing on more working situations are necessary to determine the long-term advantages, the frequency with which the training and the motivation must be reactivated and the results in terms of reduction of morbidity.

Insofar as all the techniques and organisational means are implemented to reduce the risks, and an adequate training to the tasks is organized periodically, an action at the individual level (specific training, fitness...) is ethically feasible to reduce the influence of individual factors.

Another alarming aspect concerns the workers who, in spite of heavy physical work constraints, did not develop MSDs and remained at work. Getting older, remaining active professionally, these workers undergo however the chronic effects of their heavy or repetitive work: older workers report more MSDs problems, these disorders are the origin of a non neglected proportion of early retirement and disability pensioners

Any policy aiming at keeping at work these older workers must take account of these chronic effects and of their residual work aptitudes.

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