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# **Description of outcomes of upper-extremity musculoskeletal disorders in workers highly exposed to repetitive work**

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## **Abstract**

### **Purposes**

The outcomes of workers with upper extremity musculoskeletal (UEMS) symptoms or disorders were described over a three-year period, in a population highly exposed to repetitive work.

### **Methods**

Data came from a survey focused on the health effects of repetitive tasks, with a standardized physical examination by an occupational physician, in 1993–1994 and again in 1996–1997. All workers with UEMS symptoms or disorders in 1993–1994 were included. Three-year outcomes were classified into three categories in 1996–1997: neither UEMS disorder nor symptoms; UEMS symptoms only; or UEMS disorder.

### **Results**

A total of 464 workers were included (125 men, 339 women). At baseline, most of them suffered from a UEMS disorder (n=421, 90.7%). The three-year recovery rate differed according to the site of the disorders: high for elbow disorders only (10/21, 47.6%), moderate for neck/shoulder or hand/wrist disorders only (respectively 17/74, 25.7% and 22/119, 18.5%) and low for multiple sites of UEMS disorders (25/207, 12.1%).

### **Conclusion**

In this population exposed to repetitive work, a large proportion of workers have persistent UEMS symptoms or disorders, with recovery rates differing according to site involved and the presence of multiple disorders.

### **Type of study**

### **outcome study**

### **Level of evidence: Level I**

**(High quality prospective study with 84.5% of follow up).**

**MESH Keywords** Adolescent ; Adult ; Arm Injuries ; diagnosis ; epidemiology ; rehabilitation ; Carpal Tunnel Syndrome ; diagnosis ; epidemiology ; rehabilitation ; Cross-Sectional Studies ; Cumulative Trauma Disorders ; diagnosis ; epidemiology ; rehabilitation ; Disability Evaluation ; Female ; Follow-Up Studies ; France ; Health Surveys ; Humans ; Job Satisfaction ; Male ; Middle Aged ; Occupational Diseases ; diagnosis ; epidemiology ; rehabilitation ; Pain Measurement ; Prognosis ; Rehabilitation, Vocational ; statistics & numerical data ; Rotator Cuff ; injuries ; Tennis Elbow ; diagnosis ; epidemiology ; rehabilitation ; Young Adult

## **INTRODUCTION**

Even though upper extremity musculoskeletal (UEMS) disorders are an important problem in many countries, (1) little is known about its natural history in workers exposed to repetitive tasks. Cole and Hudak in 1996 reviewed the prognosis of non specific work-related UEMS disorders. Among the 13 relevant studies, none of them had sufficient validity to provide more than weak evidence on clinical course or prognosis of these disorders. (2) The authors recommended that closer attention be made to the following criteria: clear operational definition of cases; documentation of prognostic factors, including duration of symptoms and severity at baseline; incorporation of multiple follow-up assessments; inclusion of a range of outcomes; and analysis using stratified or multivariate methods. Hagberg, in 2005, reviewed the clinical assessment, prognosis and return to work of UEMS disorders, and concluded that, despite the large number of patients with UEMS disorders, the scientific evidence for clinical criteria to determine prognosis was low. (3) Kuijper et al reviewed prognostic factors of shoulder disorders in cohort studies. (4) The authors emphasized that the results needed to be interpreted

with caution because of the small number of studies on which these conclusions were based, and the large heterogeneity among studies regarding follow-up, outcome measures, and analysis methods. We previously found that work with force was associated with a poorer prognosis, as were age and pain intensity at baseline.(5 )

We aimed to describe the three-year outcome for workers suffering from UEMS symptoms or disorders in a population highly exposed to repetitive work.

## **MATERIALS AND METHODS**

### **Subjects**

This study used data from the repetitive task survey conducted in 1993–1994 with a follow-up in 1996–1997. The survey sample consisted in 700 subjects highly exposed to repetitive work in 1993–1994 (figure 1 ). Subjects worked in one of five activity sectors: (i) assembly-line manufacturing of small electrical appliances, motor vehicle accessories, or ski accessories, packaging excluded; (ii) clothing or shoe industry, packaging excluded; (iii) food industry, packaging excluded (mainly the meat industry); (iv) packaging (primarily in the food industry); and (v) supermarkets (cashiers). Our overall study design, study population, and medical diagnostic criteria have been described in detail in earlier publications.(5 –7 )

### **Diagnosis**

In 1993–1994, subjects filled out a Nordic-style questionnaire about UEMS symptoms during the previous six months. The questionnaire included three pages for each anatomical region (shoulder, arm, elbow, forearm, wrist and hand) regarding pain, discomfort, ache with an anatomical diagram. The questionnaire was considered positive if the worker reported at least one symptom in the upper extremities for the recall period. Each worker was examined by one of 18 occupational physicians at baseline and again in 1996–1997. Examinations followed a standardised protocol and used a list of criteria for the diagnoses of UEMS disorders. These guidelines required the combination of symptoms and physical findings to meet criteria for UEMS disorders, and covered 33 diagnoses in 1993–1994 and 35 in 1996–1997. The only change between the two lists was limited to shoulder tendinitis, with more precision in the second questionnaire about the tendon involved). The questionnaires included rotator cuff syndrome, lateral epicondylitis and carpal tunnel syndrome but also thoracic outlet, medial epicondylitis, ulnar nerve entrapment at elbow, radial nerve entrapment at elbow, tendonitis of the forearm (extensor, flexor), De Quervain's disease, trigger finger, other tendonitis or nerve entrapment of upper limb, and other musculoskeletal painful problems. Participating occupational physicians attended one or two regional meetings before the baseline survey, where the guidelines were presented and training took place for the standardised physical examination. The guidelines were again presented at regional meetings organised before the second survey. Clinical examination classified UEMS disorders into one of three categories: (i) diagnosis from clinical examination, (ii) diagnosis based on previous clinical examination (for example, previous diagnosis by a specialist for a problem present in the last six month), and (iii) suspected diagnosis (clinical examination did not identify all diagnostic criteria, or the diagnosis was based on the description of symptoms during the last six months but not present at the time of examination). Our definition of UEMS disorders determined by the clinical examination included “proved”, suspected and prior diagnoses, as in previous studies.(5 –7 )

A self-administered questionnaire was also filled out in 1993–1994. The list of questions was based on the results from other studies on risk or prognosis factors in work-related upper-limb disorders. For this study, considering previous results about prognosis factors,(5 ) we took into account gender, age (in three categories: 16–30, 30–45, 45–60 years), “work with force” (any action performed with force), pain intensity in 1993–1994 (no strong pain versus strong and unbearable pain), and also satisfaction at work (yes or no).

Workers were also asked in 1996–1997 about changes in work tasks in the three-year follow-up period and whether they had upper extremity surgery. Other treatments (physiotherapy and infiltration) in the last six month were also recorded.

### **Statistical analyses**

Only workers with symptoms or UEMS disorders in 1993–1994 were included in the present study (figure 1 ). The outcome in 1996–1997 was considered in three categories: no symptom and no UEMS disorders, UEMS symptoms and no disorder in 1996–1997, and one or more UEMS disorder diagnosed in 1996–1997.

Statistical Analysis Software was used for all statistical analyses (SAS, v9.1, SAS Institute Inc, Cary, NC, USA), using  $\chi^2$  tests for bivariate comparisons. Associations were considered significant if the p-value was less than 0.05.

## **RESULTS**

Among the 549 workers included, 464 had been followed during the three-year period (84.5%).. The mean age was 38.5 years [20–59], with 33.8% of smokers (n=156) and 9.8 % of ex-smokers (n=45). The distribution for gender, pain intensity, and work with force are presented in the table I. Most of the subjects suffered from a UEMS disorder (n=421, prevalence 70.4%). Only 43 had self-reported symptoms without UEMS disorder.

There was a significant but very slight difference for age between the workers follow-up and those lost of follow-up (38yrs vs 36 yrs,  $P<0.05$ ). There was also a difference for the 'work with force' variable: 49.4% of the lost of follow-up subjects (n=42) worked with force and 61.9% of the follow-up subjects did (n=287,  $P<0.05$ ). No difference was observed considering symptoms or disorder: 14.0% of the subjects with symptoms only (7/50) were lost for follow-up, whereas 15.6% (78/499) of subjects with disorders were followed ( $P>0.05$ ).

The three major disorders diagnosed in 1993–94 were rotator cuff syndrome (n=169, prevalence=28.3%), carpal tunnel syndrome (n=130, prevalence=21.7%) and lateral epicondylitis (n=73, prevalence=12.2%), with a high proportion of associated disorders: in the 421 workers with at least one UEMS disorder at baseline, 207 had multiple UEMS disorders (prevalence=34.6%). The sites of the disorders differed according to age and pain intensity at baseline (Table I).

The three-year natural history was significantly different for workers with UEMS symptoms in 1993–1994 than for those who met criteria for at least one UEMS disorder in 1993–1994 ( $P<0.01$ , figure 2 ). Workers with only UEMS symptoms had a higher probability of no symptom or disorder in 1996–1997 than those with at least one disorder in 1993–1994 (23.3% versus 12.1% respectively,  $P<0.05$ ). The evolution from 1993–1994 to 1996–1997 for various levels of diagnosis is illustrated in table II. No significant difference in outcome was observed between workers who declared their job changed in the last three years (n=114) and those who declared that it did not (n=350): 12 subjects (10.5%) who declared their job changed had no symptom or disorder in 1996–1997 versus 49 (14.0%) who declared that it did not. Similarly, the outcome was not associated with satisfaction at work. Twenty-three workers had upper extremity surgery during the three years, and all of them had disorder in 1993–1994. Among them, 15 (62.5%) suffered from association of UEMS disorders. In 1996–1997, only three of them (13.0%) had no symptoms and no disorders. We have very little information about other treatments: in the 1996–1997 questionnaire, 64 workers (14.4%) mentioned they received physiotherapy in the last six months and 32 (6.9%) received infiltration in upper extremity, which is highly associated with pain intensity at baseline ( $P<0.05$ ).

The outcome differed according to the site of the disorders: the three-year recovery rate was high for elbow disorders only (10/21, 47.6%), moderate for neck/shoulder or hand/wrist disorders (respectively 17/74, 25.7% and 22/119, 18.5%) and low for multiple sites of UEMS disorders (25/207, 12.1%). Intensity of pain and pain duration at baseline were highly associated with multiple UEMS disorders ( $P<0.0001$ ). Older age and pain intensity were also associated with a poorer outcome: 8.5% (n=9) of the workers older than 45 years old at baseline had no symptom and no disorder in 1996–1997 versus 26.9% (n=21) of those younger than 30 ( $P<0.001$ ); 8.1% (n=27) of the workers who suffered from strong to unbearable pain at baseline had no symptom and no disorder in 1996–1997 versus 25.8% (n=34) of those who had no strong pain ( $P<0.0001$ ).

## DISCUSSION

Despite the large number of patients with UEMS symptoms or disorders, this study is one of the first to describe the outcomes of workers with UEMS assessed by questionnaire and physical examination. The survey was conducted in a population highly exposed to repetitive work. The prevalence and incidence of UEMS disorders was consequently very high. There was a low proportion of job loss or change, to study the biomechanical risk factors of UEMS disorders. (6 ). No health difference between lost of follow-up workers and the rest of the sample was observed. The survey sample included some activity sectors with more women and the follow up sample had similar proportion of women than the lost of follow up sample (respectively 339/464, 73.1% versus 77.7% 66/85,  $P>0.05$ ). A large proportion of workers had persistent or recurrent UEMS disorders, especially among those suffering from multiple UEMS disorders. This result is consistent with other studies of prognosis of UEMS disorders, though few studies in occupational or rehabilitation research have measured long term outcomes of UEMS symptoms or disorders.(3 , 8 –11 )

Some limitations could be discussed however, including the date of the survey, the number of examinations and the UEMS disorder definition. This initial survey was designed to analyse the impact of high biomechanical exposure and repetitiveness on some UEMS disorders, explaining the delay of publication of studies not initially planned. (6 ) However, the quality of the dataset allowed publishing results even fifteen years after the beginning of the study. (5 ) Furthermore, the definition used for these disorders based on symptoms and physical examination did not change in the last twenty years.

In this study there was one follow-up assessment three years later. The design of this study provided no information on events during the three years between examinations. That may be a limitation, given the rapid and cyclic evolution of these disorders. Cole and Hudak, in a review about prognosis of non specific UEMS disorders, recommended incorporation of multiple follow-up assessments.(2 ) Furthermore, we have little information about co-morbidities and the medical treatment given in these three years, especially surgery or common upper extremity medication in the last six month. However, there is no major difference between workers regarding access to

health care in the French health care system, whatever the compensation status. The analyses considered only the presence or absence of UEMS symptoms or disorders, without distinguishing the sites or laterality involved. However, these limitations should not affect the results, since the objective was to observe the outcome for the worker.

The definition of UEMS disorders used in the study, as determined by the clinical examination, included “proved”, suspected and prior diagnoses. Three levels of diagnosis were initially distinguished to explore different aspects of clinical examination (table II), with the hypothesis of different prognosis in the three subgroups. However, prior diagnosis was mainly related to medical practices of the company: for instance, occupational physicians of large companies followed workers more closely than occupational physicians of small ones, and tended to mention “prior diagnosis” instead of “proved” or suspected diagnosis. Suspected diagnosis could correspond to incomplete criteria fulfilled or evocating symptoms (without objective physical signs); the difference with “proved” diagnosis was weak in many cases. We thus combined the three levels of diagnosis.

Several authors have discussed the transient nature of symptoms in the early stages of musculoskeletal disorders. (12 –14 ) We had previously found from the same survey data that the risk of developing UEMS disorders was significantly increased to workers with UEMS symptom compared with those without symptom. (7 ) We decided to include a range of outcomes to study the difference in prognosis between subjects with UEMS symptoms and subjects without symptom. The present results indicated that workers with symptoms who did not meet criteria for a UEMS disorder had a better prognosis than those with a disorder at baseline. It is also interesting to note that there is some difference between UEMS outcomes in 1996–97 according to gender and age. (5 ) However, further studies are needed to appreciate the difference between outcome for workers with symptoms only and those with UEMS disorders.

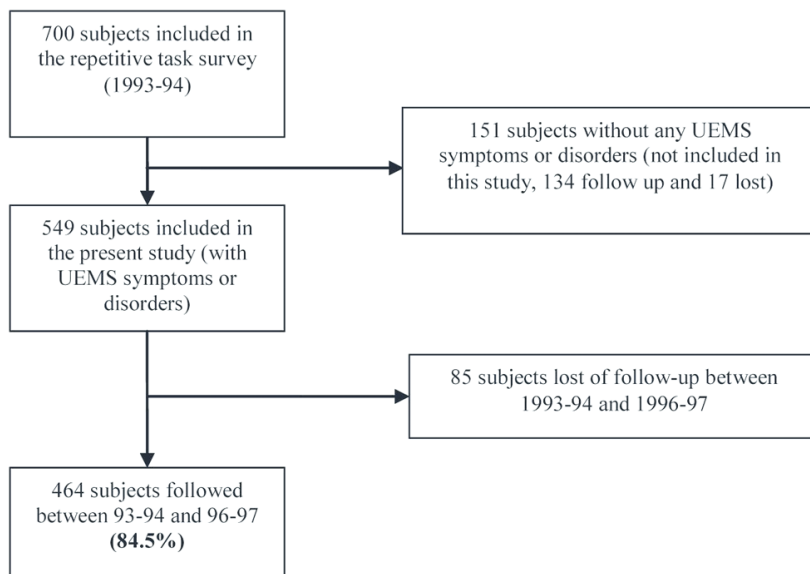
We found that a large proportion of workers had persistent UEMS symptoms or disorders in this population exposed to highly repetitive tasks, depending on the site involved. Workers with multiple UEMS disorders had a high proportion of persistent or recurrent disorders. Hand surgeons could thus give this information about the outcome to their patients, especially those highly exposed to biomechanical constraints, and those injured from multiple sites. Those with symptoms and no UEMS disorder had a better prognosis than the workers with a UEMS disorder at baseline. Further studies with repeated clinical measures of UEMS disorders, work, and disability factors are needed to clarify the role of personal and work-related factors in determining the prognosis of UEMS disorders in working populations. Details about treatments should also be obtained to clarify the strategy in specific populations.

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**Figure 1**

Flow diagram of the actual study (based on the Repetitive task survey).



**Figure 2**

Three-year evolution of UEMS symptoms and disorders.

