

1 **Description of outcomes of upper extremity musculoskeletal disorders in workers highly**
2 **exposed to repetitive work**

3 **Alexis Descatha, MD^{1,2,3}, Yves Roquelaure, MD⁴, Jean-François Chastang, PhD¹, Bradley**
4 **Evanoff, MD⁵, Diane Cyr, PhD¹, Annette Leclerc, PhD¹**

6 ¹INSERM, Villejuif; ²the Faculty of Medicine Paris-Ile-de-France-Ouest, University of
7 Versailles-Saint-Quentin, Guyancourt; ³The Occupational Health Department, Poincaré
8 University Hospital, Garches; ⁴the Laboratory of Ergonomics and Occupational Health,
9 University of Angers, Angers, France; ⁵the Division of General Medical Sciences, Washington
0 University School of Medicine, St. Louis, MO.

1 **Corresponding author: Alexis Descatha, MD, Unité de Pathologie Professionnelle, CHU**
2 **Poincaré, 104 bd R. Poincaré, 92380 Garches, France. E-mail : alexis.descatha@rpc.aphp.fr**
3

4 **ABSTRACT 186 words**

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

8 **Methods.** Data came from a survey focused on the health effects of repetitive tasks, with a
9 standardized physical examination by an occupational physician, in 1993-1994 and again in 1996-
0 1997. All workers with UEMS symptoms or disorders in 1993-1994 were included. Three-year
1 outcomes were classified into three categories in 1996-1997: neither UEMS disorder nor symptoms;
2 UEMS symptoms only; or UEMS disorder.

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

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

1 **Type of study:** outcome study

2 **Level of evidence: Level I** (High quality prospective study with 84.5% of follow up).

3

4 INTRODUCTION.

5 Even though upper extremity musculoskeletal (UEMS) disorders are an important problem in many
6 countries,(1) little is known about its natural history in workers exposed to repetitive tasks. Cole
7 and Hudak in 1996 reviewed the prognosis of non specific work-related UEMS disorders. Among
8 the 13 relevant studies, none of them had sufficient validity to provide more than weak evidence on
9 clinical course or prognosis of these disorders.(2) The authors recommended that closer attention be
0 made to the following criteria: clear operational definition of cases; documentation of prognostic
1 factors, including duration of symptoms and severity at baseline; incorporation of multiple follow-
2 up assessments; inclusion of a range of outcomes; and analysis using stratified or multivariate
3 methods. Hagberg, in 2005, reviewed the clinical assessment, prognosis and return to work of
4 UEMS disorders, and concluded that, despite the large number of patients with UEMS disorders,
5 the scientific evidence for clinical criteria to determine prognosis was low.(3) Kuijper et al
6 reviewed prognostic factors of shoulder disorders in cohort studies.(4) The authors emphasized that
7 the results needed to be interpreted with caution because of the small number of studies on which
8 these conclusions were based, and the large heterogeneity among studies regarding follow-up,
9 outcome measures, and analysis methods. We previously found that work with force was associated
0 with a poorer prognosis, as were age and pain intensity at baseline.(5)

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

3

4 MATERIALS AND METHODS

5 Subjects

6 This study used data from the repetitive task survey conducted in 1993-1994 with a follow-up in
7 1996-1997. The survey sample consisted in 700 subjects highly exposed to repetitive work in 1993-
8 1994 (figure 1). Subjects worked in one of five activity sectors: (i) assembly-line manufacturing of

9 small electrical appliances, motor vehicle accessories, or ski accessories, packaging excluded; (ii)
0 clothing or shoe industry, packaging excluded; (iii) food industry, packaging excluded (mainly the
1 meat industry); (iv) packaging (primarily in the food industry); and (v) supermarkets (cashiers). Our
2 overall study design, study population, and medical diagnostic criteria have been described in detail
3 in earlier publications.(5-7)

4

5 **Diagnosis**

6 In 1993-1994, subjects filled out a Nordic-style questionnaire about UEMS symptoms during the
7 previous six months. The questionnaire included three pages for each anatomical region (shoulder,
8 arm, elbow, forearm, wrist and hand) regarding pain, discomfort, ache with an anatomical diagram.
9 The questionnaire was considered positive if the worker reported at least one symptom in the upper
0 extremities for the recall period. Each worker was examined by one of 18 occupational physicians
1 at baseline and again in 1996-1997. Examinations followed a standardised protocol and used a list
2 of criteria for the diagnoses of UEMS disorders. These guidelines required the combination of
3 symptoms and physical findings to meet criteria for UEMS disorders, and covered 33 diagnoses in
4 1993-1994 and 35 in 1996-1997. The only change between the two lists was limited to shoulder
5 tendinitis, with more precision in the second questionnaire about the tendon involved). The
6 questionnaires included rotator cuff syndrome, lateral epicondylitis and carpal tunnel syndrome but
7 also thoracic outlet, medial epicondylitis, ulnar nerve entrapment at elbow, radial nerve entrapment
8 at elbow, tendonitis of the forearm (extensor, flexor), De Quervain's disease, trigger finger, other
9 tendonitis or nerve entrapment of upper limb, and other musculoskeletal painful problems.
0 Participating occupational physicians attended one or two regional meetings before the baseline
1 survey, where the guidelines were presented and training took place for the standardised physical
2 examination. The guidelines were again presented at regional meetings organised before the second
3 survey. Clinical examination classified UEMS disorders into one of three categories: (i) diagnosis

4 from clinical examination, (ii) diagnosis based on previous clinical examination (for example,
5 previous diagnosis by a specialist for a problem present in the last six month), and (iii) suspected
6 diagnosis (clinical examination did not identify all diagnostic criteria, or the diagnosis was based on
7 the description of symptoms during the last six months but not present at the time of examination).
8 Our definition of UEMS disorders determined by the clinical examination included "proved",
9 suspected and prior diagnoses, as in previous studies.(5-7)

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

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

9

0 **Statistical analyses**

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

5 Statistical Analysis Software was used for all statistical analyses (SAS, v9.1, SAS Institute Inc,
6 Cary, NC, USA), using chi² tests for bivariate comparisons. Associations were considered
7 significant if the p-value was less than 0.05.

8

9 RESULTS.

0 Among the 549 workers included, 464 had been followed during the three-year period (84.5%)..

1 The mean age was 38.5 years [20-59], with 33.8% of smokers (n=156) and 9.8 % of ex-smokers
2 (n=45). The distribution for gender, pain intensity, and work with force are presented in the table I.
3 Most of the subjects suffered from a UEMS disorder (n=421, prevalence 70.4%). Only 43 had self-
4 reported symptoms without UEMS disorder.

5 There was a significant but very slight difference for age between the workers follow-up and those
6 lost of follow-up (38yrs vs 36 yrs, $P<0.05$). There was also a difference for the 'work with force'
7 variable: 49.4% of the lost of follow-up subjects (n=42) worked with force and 61.9% of the
8 follow-up subjects did (n=287, $P<0.05$). No difference was observed considering symptoms or
9 disorder: 14.0% of the subjects with symptoms only (7/50) were lost for follow-up, whereas 15.6%
0 (78/499) of subjects with disorders were followed ($P>0.05$).

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

6 The three-year natural history was significantly different for workers with UEMS symptoms in
7 1993-1994 than for those who met criteria for at least one UEMS disorder in 1993-1994 ($P<0.01$,
8 figure 2). Workers with only UEMS symptoms had a higher probability of no symptom or disorder
9 in 1996-1997 than those with at least one disorder in 1993-1994 (23.3% versus 12.1% respectively,
0 $P<0.05$). The evolution from 1993-1994 to 1996-1997 for various levels of diagnosis is illustrated
1 in table II. No significant difference in outcome was observed between workers who declared their
2 job changed in the last three years (n=114) and those who declared that it did not (n=350): 12
3 subjects (10.5%) who declared their job changed had no symptom or disorder in 1996-1997 versus

4 49 (14.0%) who declared that it did not. Similarly, the outcome was not associated with satisfaction
5 at work. Twenty-three workers had upper extremity surgery during the three years, and all of them
6 had disorder in 1993-1994. Among them, 15 (62.5%) suffered from association of UEMS disorders.
7 In 1996-1997, only three of them (13.0%) had no symptoms and no disorders. We have very little
8 information about other treatments: in the 1996-1997 questionnaire, 64 workers (14.4%) mentioned
9 they received physiotherapy in the last six months and 32 (6.9%) received infiltration in upper
0 extremity, which is highly associated with pain intensity at baseline ($P<0.05$).

1 The outcome differed according to the site of the disorders: the three-year recovery rate was high
2 for elbow disorders only (10/21, 47.6%), moderate for neck/shoulder or hand/wrist disorders
3 (respectively 17/74, 25.7% and 22/119, 18.5%) and low for multiple sites of UEMS disorders
4 (25/207, 12.1%). Intensity of pain and pain duration at baseline were highly associated with
5 multiple UEMS disorders ($P<0.0001$). Older age and pain intensity were also associated with a
6 poorer outcome: 8.5% ($n=9$) of the workers older than 45 years old at baseline had no symptom and
7 no disorder in 1996-1997 versus 26.9% ($n=21$) of those younger than 30 ($P<0.001$); 8.1% ($n=27$) of
8 the workers who suffered from strong to unbearable pain at baseline had no symptom and no
9 disorder in 1996-1997 versus 25,8% ($n=34$) of those who had no strong pain ($P<0.0001$).

1 **DISCUSSION.**

2 Despite the large number of patients with UEMS symptoms or disorders, this study is one of the
3 first to describe the outcomes of workers with UEMS assessed by questionnaire and physical
4 examination. The survey was conducted in a population highly exposed to repetitive work. The
5 prevalence and incidence of UEMS disorders was consequently very high. There was a low
6 proportion of job loss or change, to study the biomechanical risk factors of UEMS disorders. (6).
7 No health difference between lost of follow-up workers and the rest of the sample was observed.
8 The survey sample included some activity sectors with more women and the follow up sample had

9 similar proportion of women than the lost of follow up sample (respectively 339/464, 73.1% versus
0 77.7% 66/85, $P>0.05$). A large proportion of workers had persistent or recurrent UEMS disorders,
1 especially among those suffering from multiple UEMS disorders. This result is consistent with
2 other studies of prognosis of UEMS disorders, though few studies in occupational or rehabilitation
3 research have measured long term outcomes of UEMS symptoms or disorders.(3,8-11)

4

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

2 In this study there was one follow-up assessment three years later. The design of this study provided
3 no information on events during the three years between examinations. That may be a limitation,
4 given the rapid and cyclic evolution of these disorders. Cole and Hudak, in a review about
5 prognosis of non specific UEMS disorders, recommended incorporation of multiple follow-up
6 assessments.(2) Furthermore, we have little information about co-morbidities and the medical
7 treatment given in these three years, especially surgery or common upper extremity medication in
8 the last six month. However, there is no major difference between workers regarding access to
9 health care in the French health care system, whatever the compensation status. The analyses
0 considered only the presence or absence of UEMS symptoms or disorders, without distinguishing
1 the sites or laterality involved. However, these limitations should not affect the results, since the
2 objective was to observe the outcome for the worker.

3

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

4
5 Several authors have discussed the transient nature of symptoms in the early stages of
6 musculoskeletal disorders. (12-14) We had previously found from the same survey data that the risk
7 of developing UEMS disorders was significantly increased to workers with UEMS symptom
8 compared with those without symptom. (7) We decided to include a range of outcomes to study the
9 difference in prognosis between subjects with UEMS symptoms and subjects without symptom.
0 The present results indicated that workers with symptoms who did not meet criteria for a UEMS
1 disorder had a better prognosis than those with a disorder at baseline. It is also interesting to note
2 that there is some difference between UEMS outcomes in 1996-97 according to gender and age. (5)
3 However, further studies are needed to appreciate the difference between outcome for workers with
4 symptoms only and those with UEMS disorders.

5
6 We found that a large proportion of workers had persistent UEMS symptoms or disorders in this
7 population exposed to highly repetitive tasks, depending on the site involved. Workers with
8 multiple UEMS disorders had a high proportion of persistent or recurrent disorders. Hand surgeons

9 could thus give this information about the outcome to their patients, especially those highly exposed
0 to biomechanical constraints, and those injured from multiple sites. Those with symptoms and no
1 UEMS disorder had a better prognosis than the workers with a UEMS disorder at baseline. Further
2 studies with repeated clinical measures of UEMS disorders, work, and disability factors are needed
3 to clarify the role of personal and work-related factors in determining the prognosis of UEMS
4 disorders in working populations. Details about treatments should also be obtained to clarify the
5 strategy in specific populations.

6
7

8 REFERENCES

- 9 1. Buckle P, Devereux JJ. Work-related neck and upper limb musculoskeletal disorders.
0 European Agency for Safety and Health at Work, 1999:1-117
- 1 2. Cole DC, Hudak PL. Prognosis of nonspecific work-related musculoskeletal disorders of the
2 neck and upper extremity. *Am J Ind Med* 1996;29:657-68.
- 3 3. Hagberg M. Clinical assessment, prognosis and return to work with reference to work related
4 neck and upper limb disorders. *G Ital Med Lav Ergon* 2005;27:51-7.
- 5 4. Kuijpers T, van der Windt DA, van der Heijden GJ, Twisk JW, Vergouwe Y, Bouter LM. A
6 prediction rule for shoulder pain related sick leave: a prospective cohort study. *BMC*
7 *Musculoskelet Disord* 2006;7:97.p1-11
- 8 5. Descatha, A., Roquelaure, Y., Chastang, J. F., Evanoff, B., Cyr, D., and Leclerc, A. Work, a
9 prognosis factor of upper extremity musculoskeletal disorders? *Occup Environ Med*. 2008.
0 1p. In Press
- 1 6. Leclerc A, Landre MF, Chastang JF, Niedhammer I, Roquelaure Y. Upper-limb disorders in
2 repetitive work. *Scand J Work Environ Health* 2001;27:268-78.
- 3 7. Descatha A, Roquelaure Y, Evanoff B, Chastang JF, Cyr D, Leclerc A. Do workers with self-
4 reported symptoms have an elevated risk of developing upper extremity musculoskeletal
5 disorders three year later? *Occup Environ Med* 2008;65:205-7.
- 6 8. Roquelaure Y, Mariel J, Fanello S, Boissiere JC, Chiron H, Dano C, et al. Active
7 epidemiological surveillance of musculoskeletal disorders in a shoe factory. *Occup Environ*
8 *Med* 2002;59:452-8.
- 9 9. Kaergaard A, Andersen JH. Musculoskeletal disorders of the neck and shoulders in female
0 sewing machine operators: prevalence, incidence, and prognosis. *Occup Environ Med*
1 2000;57:528-34.
- 2 10. Kuijpers T, van der Windt DA, van der Heijden GJ, Bouter LM. Systematic review of
3 prognostic cohort studies on shoulder disorders. *Pain* 2004;109:420-31.
- 4 11. Cassou B, Derriennic F, Monfort C, Norton J, Touranchet A. Chronic neck and shoulder pain,
5 age, and working conditions: longitudinal results from a large random sample in France.
6 *Occup Environ Med* 2002;59:537-44.
- 7 12. Dougados M. La mesure. Méthodes d'évaluation des affections rhumatismales. Paris:
8 Expansion scientifique (Elsevier), 1997:1-541.
- 9 13. Silverstein B, Fine LJ, Armstrong TJ. Hand wrist cumulative trauma disorders in industry. *Br*
0 *J Ind Med* 1986;43:779-84.

- 2 14. Werner RA, Franzblau A, Gell N, Ulin SS, Armstrong TJ. Predictors of upper extremity
3 discomfort: a longitudinal study of industrial and clerical workers. *J Occup Rehabil*
4 2005;15:27-35.

5

6 Figure 1. Flow diagram of the actual study (based on the Repetitive task survey).

7

8 Figure 2. Three-year evolution of UEMS symptoms and disorders.

9