# Heavy manual work, exposure to vibration and Dupuytren's disease? Results of a surveillance program for musculoskeletal disorders

Alexis Descatha,[1,2,3] Julie Bodin,[4] Catherine Ha,[5] Pierre Goubault,[4] Marine Lebreton,[4] Jean François Chastang,[2] Ellen Imbernon,[5] Annette Leclerc,[1,2] Marcel Goldberg,[1,2,5] Yves Roquelaure[4]

[1]Université de Versailles St-Quentin, UMRS 1018, Centre for Research in Epidemiology and Population Health, Population-Based Epidemiological Cohorts Research Platform, Villejuif, France
[2]Inserm U1018, Centre for Research in Epidemiology and Population Health, Epidemiology of Occupational and Social Determinants of Health, Villejuif, France
[3]AP-HP, Poincaré University Hospital, Occupational Health Unit, Garches, France
[4]LUNAN University, Laboratory of Ergonomics and Epidemiology in Occupational Health, University of Angers, Angers, France
[5]Département Santé Travail, Institut de Veille Sanitaire (DST-InVS), Saint-Maurice, France

**Correspondence to**
Dr Alexis Descatha, Inserm U1018, UVSQ, Unité de Pathologie Professionnelle CHU Poincaré, 104 bd Poincaré, 92380 Garches, France; alexis.descatha@rpc.aphp.fr

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## ABSTRACT

**Introduction** This study aimed to determine the prevalence of Dupuytren's disease in men and its relationship with work exposure, particularly heavy manual work with and without significant use of vibrating tools, using data from a surveillance program for musculoskeletal disorders.

**Method** This cross-sectional study was conducted in France between 2002 and 2005. Dupuytren's disease was diagnosed clinically by one of 83 occupational physicians. Exposure in relation to work status and occupational risk factors was assessed with a self-administered questionnaire, and categorised according to vibration exposure (defined as use of vibrating tools for ≥2 h/day), heavy manual work without vibration exposure (defined as use of hand tools for ≥2 h/day (use of vibrating tools for ≥2 h/day excluded) and Borg scale ≥15/20) and no such exposure. Bivariate and multivariate associations using logistic models were recorded in men and in those with >10 years in the same job.

**Results** Of 2161 men, 1.3% (n=27) had Dupuytren's disease (mean age 47.1±6.7 years). Heavy manual work without vibration exposure was significantly associated with the condition (adjusted OR (aOR) 3.9; 95% CI 1.3 to 11.5) adjusted on age and diabetes), as was use of vibrating tools (aOR 5.1; 2.1 to 12.2). These associations remained significant among subjects with >10 years in the same job, with increases in aOR of 6.1 (1.5 to 25.0) and 10.7 (3.4 to 34.6), respectively.

**Conclusion** Despite the limited number of cases, occupational exposure, including both vibration exposure and heavy manual work without significant vibration exposure, was associated with Dupuytren's disease.

## What this paper adds

- Studies over many years have suggested that Dupuytren's contracture could be associated with certain occupations, with conflicting results especially with regard to manual work.
- The prevalence of Dupuytren's disease was 1% among men in a large working population.
- Heavy manual work, with and without significant exposure to vibration, was significantly associated with Dupuytren's disease.

## INTRODUCTION

Dupuytren's disease is characterised by chronic contracture of the fourth and fifth fingers of the hand towards the palm, usually accompanied by thickening of the palmar skin.[1]

Since its description by Guillaume Dupuytren in 1831 following work by Henry Cline Sr. and Sir Astley Cooper, there has been debate whether acute traumatic injury or cumulative biomechanical work exposure might contribute to the development of this disorder.[2 3] To address this controversy, an exhaustive review was published in 1996 which concluded that there is good evidence of an association between vibration exposure and Dupuytren's disease, and a weak association with forceful work.[4] However, recent opinion still considers that exposure to forceful work and vibrations are not risk factors for Dupuytren's disease in manual workers.[5 6] Studies have been conducted on large populations but with exposure based only on job title or work status rather than on estimated amount of vibration exposure or specific working population.

The surveillance program for musculoskeletal disorders implemented in the Pays de la Loire region of France by the National Institute for Public Health Surveillance in 2002[7 8] has allowed epidemiological analyses of the risk factors for Dupuytren's disease in a large study sample with various levels of work-related exposure. The study presented here aimed to assess the prevalence of Dupuytren's disease in the general male working population and the relationship with occupational risk factors, in order to determine risk factors associated with manual work with or without the use of vibrating tools.

## METHODS

### Study population

This cross-sectional study was conducted in the Pays de la Loire region in west-central France.

Between April 2002 and April 2005, 83 occupational physicians (OPs), representing 18% of the OPs of the region, participated in the study and contributed data on the workers for whom they provided health surveillance.[7 8] Subjects were randomly selected from workers undergoing a regularly scheduled mandatory health examination.

Taking into account the low prevalence of Dupuytren's disease among women, only men were selected for analysis. The population in this study

comprised men employed in the private sector; the self-employed, civil servants and public sector employees (about 30% of the labour force) were excluded.

### Outcomes

A subject was considered to have Dupuytren's disease if the OP found incomplete extension of the phalanges, a permanent flexion deformity or fibrous nodules in one of the four fingers. All OPs were trained to perform a standardised physical examination.

### Potential risk factors

Information on age, weight, height and diabetes mellitus was collected during the physical examination. Work status and occupational risk factors were assessed with a self-administered questionnaire including questions on the characteristics of the job and tasks in a typical working day in the preceding 12 months. For vibration exposure, use of vibrating tools was classified as never, uncommonly (<2 h/day), frequently or all the time (defined as ≥2 h/day); for manual work, use of hand tools (any hand tools, including vibrating tools) was classified according to similar category definitions; in addition, the Borg Rating of Perceived Exertion Scale (6–20) was used,[9 10] with three categories: <12 (more than the first quartile, calculated according to the distribution of answers); 12–14; and ≥15 (last quartile).

In order to clarify whether heavy manual work without use of vibrating tools was a risk factor for Dupuytren's disease, exposure was also divided into three categories: (1) no exposure to vibration (defined as 'no use of vibrating tools' or 'use of vibrating tools for <2 h/day') and no heavy manual work (defined as 'no use of hand tools' or 'use of hand tools for <2 h/day or Borg scale <15/20'); (2) no exposure to vibration (similar definitions) but exposure to heavy manual work (defined as 'use of hand tools for ≥2 h/day' ('use of vibrating tools for <2 h/day excluded') and 'Borg scale ≥15/20'); and (3) exposure to vibration ('use of vibrating tools for ≥2 h/day').

### Statistical analysis

As the outcome was defined by subject, bilateral Dupuytren's disease counted as one, not two cases.

The associations between the outcome and the relevant exposure variables were studied with a logistic model controlling for age and diabetes. Models restricted to workers with at least 10 years at the same work (threshold from the original questionnaire) were also performed.

One individual with Dupuytren's disease only filled out the beginning of the questionnaire (and not the questions related to exposure), and so most analyses considered him as missing data. Taking into account the small number of cases, further analyses were performed to check the stability of the results by recoding his exposure in all categories of manual work/vibration exposure. A multiple imputation by chained equations (MICE) was also used to check the stability of the results.[11]

Associations were considered significant if the p value was <0.05. All analyses were performed with the SAS statistical software package (V.9.1, SAS Institute), except the MICE study, which was performed with STATA software (Stata 10.0, StataCorp).

## RESULTS

The study population comprised 2161 men aged from 20 to 59 years (mean age 38.5 years). Of these, 1.3% (n=27) had Dupuytren's disease (mean age 47.1±6.7 years vs 38.4±10.4 years for those without Dupuytren's disease; p<0.001). Blue collar workers and those with diabetes mellitus had a higher risk of Dupuytren's disease (table 1). All selected occupational variables were significantly associated with Dupuytren's disease, with a dose–response relationship. Exposure variables were closely associated with each other (p<0.0001).

The association between heavy manual work without exposure to vibration was significant, and it was also significant for exposure to vibration (table 1). These associations remained significant for subjects with over 10 years in the same job, with an increase in adjusted OR (aOR) of 6.1 (95% CI 1.5 to 25.0) for manual work and 10.8 (3.4 to 34.6) for vibration exposure, again with a possible dose–response relationship.

The case with the missing data was a 56-year-old, blue collar worker with diabetes mellitus. Recoding his exposure did not modify the associations observed, such as the MICE results.

## DISCUSSION

The study revealed that the prevalence of Dupuytren's disease in the general male working population in France was around 1%. Vibration exposure affecting the hand using the vibrating tool was an occupational risk factor associated significantly and strongly with the prevalence of Dupuytren's disease. Manual work without the use of vibrating tools was also significantly associated with Dupuytren's disease.

The limitations of the study include the cross-sectional design, with assessment of exposure by questionnaire and from the diagnosis. Workers with Dupuytren's disease may be more likely to describe their work as strenuous. However, the relative precision of the questions should have limited misclassification. A recent review revealed that self-reported answers to questions concerning physical work demands showed good reproducibility when using the Borg scale and hand-held vibrating tools.[12]

The threshold used to categorise and classify exposure to vibration is a matter for discussion. Here, daily exposure to vibration for <2 h was considered 'not exposed' or 'no significant exposure'. We could not define a threshold at 1 h of exposure, which is frequently recommended.[10] The alternative would have been to have a category 'heavy manual work only', limited to those who were never exposed to vibration. However, the number of subjects in this category was too small for a reliable estimate of the frequency of Dupuytren's disease, since fewer than 6% of the sample were in this situation. The OPs were aware of the exposure of the study subjects, since they are responsible for general medical surveillance at the workplace according to the French system for surveillance. However, misclassification (such as whether an individual has Dupuytren's disease or not) is expected to have been minimal as the OPs were enrolled in a specific surveillance project focusing on musculoskeletal disorders, with precise definitions and training in the whole range of diagnoses. In addition, early stages of Dupuytren's disease with palmar thickening were not considered, since these cases are probably more prone to misclassification or observer bias.

The missing data on exposure might have led to a selection effect. However, fewer than 1% of subjects had missing exposure data or results from missing data analyses including MICE results, thus suggesting that this effect is probably low.

There is also a possible residual confounding effect since the only personal and medical variables available were age and diabetes mellitus. Alcohol intake, smoking, genetic factors (family history of Dupuytren's disease), and epilepsy and anticonvulsant drug intake are associated with Dupuytren's disease and should be considered.[13 14] However, an association with the specific

**Table 1** Description of the sample and association between Dupuytren's disease and relevant factors

| | Total | Cases of Dupuytren's disease | Percentage of cases | Crude OR (95% CI) | Adjusted OR* (95% CI) |
|---|---|---|---|---|---|
| Age | | | | | |
| <30 years | 491 | 0 | 0.0% | 1.1 (1.05 to 1.15)† | |
| 30–39 years | 651 | 4 | 0.6% | | |
| 40–49 years | 621 | 12 | 1.9% | | |
| ≥50 years | 397 | 11 | 2.8% | | |
| Body mass index | | | | | |
| <25 kg/m$^2$ | 1207 | 11 | 0.9% | 1 | |
| 25–0 kg/m$^2$ | 755 | 13 | 1.7% | 1.9 (0.8 to 4.3) | |
| ≥30 kg/m$^2$ | 175 | 3 | 1.7% | 1.9 (0.5 to 6.9) | |
| Diabetes mellitus | | | | | |
| No | 2221 | 25 | 1.2% | 1 | |
| Yes | 40 | 2 | 5.0% | 4.4 (1.01 to 19.3) | |
| Over 10 years in the same job | | | | | |
| No | 1329 | 8 | 0.6% | 1 | |
| Yes | 809 | 19 | 2.4% | 4.0 (1.7 to 9.1) | |
| Social position | | | | | |
| Managers, professionals, technicians | 763 | 4 | 0.5% | 1 | 1 |
| Low skilled white collar | 187 | 2 | 1.1% | 2.1 (0.4 to 11.3) | 2.6 (0.5 to 14.3) |
| Blue collar | 1209 | 21 | 1.7% | 3.4 (1.1 to 9.8) | 4.0 (1.4 to 11.7) |
| Borg scale | | | | | |
| <12 | 838 | 4 | 0.5% | 1. | 1 |
| 12–4 | 810 | 11 | 1.4% | 2.9 (0.9 to 9.1) | 3.2 (1.02 to 10.2) |
| ≥15 | 503 | 12 | 2.4% | 5.1 (1.6 to 15.9) | 5.3 (1.7 to 16.6) |
| Use of hand tools‡ | | | | | |
| Never | 668 | 2 | 0.3% | 1 | 1 |
| <2 h/day | 323 | 2 | 0.6% | 2.1 (0.3 to 14.8) | 2.5 (0.3 to 17.8) |
| ≥2 h/day | 1159 | 22 | 1.9% | 6.4 (1.5 to 27.5) | 7.7 (1.8 to 32.9) |
| Use of vibrating tools‡ | | | | | |
| Never | 1423 | 8 | 0.6% | 1 | 1 |
| <2 h/day | 325 | 7 | 2.2% | 3.9 (1.4 to 10.8) | 4.8 (1.7 to 13.5) |
| ≥2 h/day | 407 | 11 | 2.7% | 4.9 (2.0 to 12.3) | 6.2 (2.5 to 15.7) |
| Manual work and vibration exposure‡ | | | | | |
| No exposure | 1528 | 10 | 0.7% | 1 | 1 |
| Heavy manual work only§ | 204 | 5 | 2.5% | 3.8 (1.3 to 11.3) | 3.9 (1.3 to 11.5) |
| Vibration exposure¶ | 407 | 11 | 2.7% | 4.2 (1.8 to 10.0) | 5.1 (2.1 to 12.2) |
| **Total** | **2161** | **27** | **1.3%** | | |

*Adjusted on age and diabetes mellitus, five different models separately.
†Crude OR on age (continuous).
‡One case had no exposure data available.
§Heavy manual work only defined as use of hand tools for ≥2 h/day (use of vibrating tools for ≥2 h/day excluded) AND Borg scale ≥15/20.
¶Vibration exposure defined as use of vibrating tools (for ≥2 h/day).

occupational exposure considered here is unlikely for genetic factors, or for epilepsy and anticonvulsant drug intake. Alcohol intake and smoking may be associated with social position and manual work. Nevertheless, a previous study found that work exposure was independently associated with Dupuytren's disease without any interaction with non-occupational factors[13]: the crude ORs for work exposure were compared with the ORs adjusted on alcohol consumption, epilepsy and previous trauma. For a medium level of exposure, the crude OR was 1.83 and the adjusted OR was 2.20 (+20%). For a high level of exposure, adjustment led to a decrease of 31%, from 4.49 (crude OR) to 3.10 (adjusted OR).

The main strength of the study was the estimation of prevalence in a sample representative of the working population with a high participation rate. Comparison of the socio-economic status in the sample with the last available French census (1999[7]) showed no major differences for either gender. The distribution of occupations in the study sample was relatively close overall to that of the regional workforce, except for some occupations not monitored by OPs (eg, shopkeepers and self-employed workers). The prevalence of Dupuytren's disease in the literature varies from 0.2% to 56%, depending on the characteristics of populations, exposure to risk factors and methods.[3 5] The prevalence found in this study (1%) was consistent with the literature. The prevalence in the general population (as in this study) is expected to be lower than in samples of exposed subjects; in addition, the criteria for diagnosis were fairly restrictive.

Despite the comprehensive review by Liss and Stock in 1996 that concluded that there is good evidence of an association between exposure to vibration and Dupuytren's contracture,[4] this relationship is still a matter of debate.[1 5 15] This study clearly identified vibration exposure as a risk factor, with a dose–response relationship, in agreement with other authors.[16 17] The association observed with heavy manual work was also consistent with previous literature reports.[13 18–20]

The role of high levels of repetitive strain with cumulative microtrauma is plausible, especially as a result of the local hypoxia and chronic ischaemia hypothesised in Dupuytren's contracture.[14 21]

In conclusion, despite the limitations discussed, this study emphasised that occupational exposure is associated with Dupuytren's disease, including heavy manual work without significant exposure to vibration. The possibility for compensation in some cases with documented high levels of exposure (vibration and/or heavy manual work) should be discussed, as should improvement of working conditions with a view to prevention.

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**Competing interests** None.

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