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The French Musculoskeletal Disorders Surveillance Program: Pays de la Loire Network

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Abstract

Objectives: A pilot epidemiological surveillance system for work-related musculoskeletal disorders (MSDs) was implemented in 2002 in France's Pays de la Loire region by the French Institute for Public Health Surveillance, mainly to assess the incidence and prevalence rates of MSDs in the general and working populations, to identify the levels of exposure to physical and psychosocial work factors and to investigate the proportion of cases attributable to work exposure.

Methods: The surveillance program combines three main components. The first is the epidemiological surveillance of sentinel health events in the general population. Carpal tunnel syndrome (CTS) was chosen as sentinel event for upper limb MSDs. Incident cases of CTS occurring in patients aged 20 to 59 were included prospectively from 2002 to 2004. The second part of the program, based on a network of occupational physicians (OPs), assesses the prevalence of the main upper-limb MSDs and their risk factors in the workplace. The third approach is based on the registration of notification of work-related diseases related to MSDs, with the cooperation of a network of OPs.

Results: In the first part of the program, 1,168 incident cases of CTS were included during the 3 year-period. The estimated incidence of CTS was 1.00 per 1,000 person-years aged 20-59 (0.60 in men and 1.40 in women). The mean incidence rate was higher in employed than unemployed persons in the year of diagnosis (0.6 per 1,000 vs. 0.3 in men and 1.7 vs. 0.8 in women). Through the OP network, prevalence rates of clinically-diagnosed MSDs were high for both genders: about 13% of workers (11% of men and 15% of women) suffered from at least one of the six main upper limb MSDs. The most frequent disorders were rotator cuff syndrome, CTS and lateral epicondylitis. The survey on WRD showed that MSDs represented 65% of the notified work-related diseases.

Conclusion: The Pays de la Loire program already plays a significant role in informing the authorities and the public on the state of the current epidemic of MSDs. To our knowledge, such a program is unique. It is planned to extend it to a routine national epidemiological surveillance program in a few years.

Musculoskeletal disorders (MSDs) are impairments of bodily structures (such as muscles, tendons, nerves, vessels, cartilages) of the limbs and the back e.g. tendinitis and tenosynovitis (mainly shoulder tendinitis, lateral epicondylitis and hand-wrist tendinitis), peripheral nerve entrapment (mainly carpal tunnel syndrome and ulnar tunnel syndrome), bursitis, low-back pain and sciatica, and neuro-vascular syndromes (such as vibration white finger). Numerous non-specific peri-articular pain disorders have also been included under this umbrella term.¹

Work-related musculoskeletal disorders are a leading cause of morbidity and work disability in the European Union^{2,3} and represent one of the most disquieting issues in occupational health today. They cause considerable human, social and occupational burdens in terms of pain and distress in work and daily life, and may lead to irreversible functional after-effects, reduction of work capacity and risk of damage to a career. They have steadily increased in the last 15 years and represent the main cause of compensated occupational diseases in most of the industrialized countries. In France, more than 25,000 cases were awarded compensation for limb MSDs by the general National Health Insurance Fund (organisation that covers workers' compensation claims for more than 80% of the French population) in 2004, and more than 2,700 for chronic lower back disorders, representing 81% of all compensated diseases.⁴ These disorders entailed the loss of about 6.3 million days' work.⁴ MSDs are the first cause of disability before age 45 years and rank first among the causes of limitation in work for health reasons.⁵ Moreover, they represent an economic challenge because of their consequences for the operation of companies, and their constant increase reduces competitiveness. Upper-extremity MSDs and low-back pain will be increasing problems in the years to come because of the predictable combined effects of ageing of the working population and the intensification of work.

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The only source of information available in France to describe the current epidemic of MSDs is workers' compensation (WC) claims. However, this is known to be subject to considerable bias and to lead to underestimation of the extent of the phenomenon.⁶⁻⁹ As emphasized, accurate surveillance data on MSDs are needed to provide a basis for monitoring changes to target industries for additional prevention and regulatory actions over time.¹⁰ The Occupational Health Department of the French Institute for Public Health Surveillance (DST-InVS) therefore implemented a pilot epidemiological surveillance of MSD program in the Pays de la Loire region in 2002.

The aims of this program are: (i) to estimate the incidence and prevalence rates of the main MSDs in the general population of a French region and their time trends according to age, gender, economic sector and occupation; (ii) to assess the levels of the main occupational exposures; (iii) to determine the contribution of work-related physical and psychosocial risk factors to their development; (iv) to estimate the extent of under-declaration of work-related diseases (WRD) as compensatable occupational diseases; and (v) to assess the feasibility of such a system of surveillance before its extension to other regions in France. The program relies on 3 main components which were designed to provide a comprehensive view of the situation of the MSD epidemic in relation to work. The aim of this paper is to present the general design of the program and to illustrate the type of information that each of its components can provide.

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METHODS

This program combines 3 main components: (i) epidemiological surveillance of sentinel health events in the general population; carpal tunnel syndrome, the most commonly reported nerve entrapment syndrome, was chosen as the sentinel event for upper limb MSDs and sciatica with herniated disk as the sentinel event for back pain; (ii) epidemiological surveillance of the main upper-limb MSDs and their risk factors in the workplace; and (iii) registration of notification data on compensation claims for work-related diseases related to MSDs. The program was set up in the Pays de la Loire region (Loire Valley area, West Central France, 3,305,000 inhabitants and 1,247,839 wage-earning workers in 2002). This region represents 5.5% of the French population and 5.6% of the French working population. Its socioeconomic structure is diversified and close to that of the whole of France.¹¹

Epidemiological surveillance of sentinel health events in the general population

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Carpal tunnel syndrome (CTS) results from a compression of the median nerve at the wrist. It constitutes a major proportion of all registered and/or compensated work-related diseases in many countries. In France, nearly 40% of workers' compensation claims for limb MSDs in 2004 were for CTS, a higher proportion than for shoulder and elbow disorders. CTS occupational risk factors are well-established: highly repetitive work, force, combination of repetitive movements and force, extreme wrist postures and vibration. The purpose of this epidemiological approach was to assess the incidence of CTS according to age, gender, economic sector and occupation. This system of epidemiological surveillance of CTS was tested in the general population of Maine & Loire (one of the five "Departements" of the Pays de la Loire Region; 1.2% of the French population), aged 20-59 [193,802 men (49.9%) and 194,276 women (50.1%)].¹¹ The methods were recently reported in detail.¹² Incident cases of CTS occurring in residents of Maine & Loire were included prospectively by the four

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electrodiagnostic (EDX) centers of Maine & Loire from 2002 to 2004. All cases were defined by both clinical and electromyographical criteria and the diagnosis was established by physicians specialized in EDX techniques. The clinical criteria were the classic/probable symptoms according to Katz et al. (1990)¹⁵: numbness, tingling, burning, or pain in at least 2 of digits 1, 2 or 3; palm pain; wrist pain, or pain radiation proximal to the wrist were also included as symptoms for a probable CTS. Case definition agreed with consensus definitions for epidemiological surveillance of CTS and took into account the 2002 AAEM recommendations for the neurophysiological study of CTS.^{13,14} Demographic, clinical and neurophysiological information was provided by the physicians. A questionnaire was then mailed to each patient. Information was collected on medical and surgical history (obesity, diabetes mellitus, thyroid disease, gynecological history, upper limb MSDs) and employment during the 5 past years (economic sector and occupation). The final response rate to the questionnaire was 97%.

Incidence rates were estimated per patient (bilateral CTS counting as one case). The date of the electrophysiological examination was used as the date of diagnosis. Age- and gender-specific incidence rates were estimated by dividing the number of subjects suffering from CTS by the number of persons of the same age and gender in the general population according to the 1999 census.¹¹ The standardized incidence ratios (SIRs), as estimations of age-adjusted relative risks associated with an economic sector or an occupation, were calculated separately for each gender, using all economic sectors or occupations of the whole sample as reference. The age-adjusted relative risks (RR) of CTS according to industry sectors and occupation categories were computed using the Mantel-Haenszel method with the whole sample of subjects included in the study as reference, whether they were employed during the last 5 years or not. The attributable fractions of CTS among those employed in a certain economic sector or occupation category or subcategory (AFE [%]) were computed to

estimate the proportion of CTS cases attributable to work in the economic sectors and occupations at high risk (when at least 5 cases of CTS occurred) using the following formula:

$$AFE = (RR - 1)/RR.^{16}$$

The methods and results from the surveillance of sciatica will be published in the near future.

Epidemiological surveillance of upper-extremity MSDs in the working population

Occupational medicine is a medical speciality in France, and occupational physicians (OPs) receive four years specialist training. Their tasks include monitoring work exposure and performing annual health examinations, which are compulsory for all wage-earning workers. Most of the 7,000 currently practicing OPs work simultaneously across many companies and industries of the private sector which employs about 70% of France's 25 million labor force. The self-employed, civil servants, and public sector employees (such as Education sector employees) benefit from different occupational medicine arrangements.

To provide data comparable with other European countries, our surveillance protocol used the recommendations of a Criteria Document for evaluating the work relatedness of upper-extremity MSDs, published in 2001 by a group of experts (referred to as the Criteria Document in the remainder of the article).¹⁷ The aim of the surveillance system is to estimate prevalence rates of MSDs and their risk factors in the regional workforce according to age, gender, economic sector and occupation.

The methods were recently reported in detail.¹⁸ Briefly, the design was based on a network of occupational physicians (OPs). All OPs who practised in this region were invited to participate, and 80 of them (17.4% of the region OPs) volunteered to take part in the study. Subjects were randomly selected from workers undergoing a regularly-scheduled annual health examination. The presence of non-specific musculoskeletal symptoms of the upper

limbs during the preceding 12 months and the preceding 7 days was identified using the Nordic questionnaire.¹⁹ If symptoms had occurred during the last 12 months, a physical examination was performed by the physician using a standardized clinical procedure described in the Criteria Document for rotator cuff syndrome, lateral epicondylitis, ulnar tunnel syndrome, carpal tunnel syndrome, de Quervain's disease, and flexor-extensor peritendinitis or tenosynovitis of the forearm-wrist region. The final study population comprised 3,710 workers (2,162 men and 1,548 women), working primarily in manufacturing industries (33%), service industries (25%) or trade (13%), randomly included between April 2002 and April 2005. Women were slightly underrepresented in the sample (42% vs. 47% in the region). Overall, the distribution of economic sectors and occupations in the study sample was close to that of the regional workforce. Health status was assessed by a self-administered questionnaire and physical examination, and occupational risk factors were assessed by the same questionnaire. Exposure scores were computed for each anatomic area by combining the risk factors taken into account by the Criteria Document.

Work-related diseases

In France, compensation for an occupational disease is based on a limited number of "Tables". These Tables define the medical, technical and administrative conditions that are necessary and sufficient for the financial compensation of an occupational disease. Another category comprises "work-related diseases" (WRD) defined as diseases considered by the physician to be of occupational origin but not compensatable. The notification of putative WRD is an obligation for all physicians in order to update the Tables of occupational diseases. However, physicians seldom notify the diseases they believe to be linked to work conditions or occupational exposure.²⁰ Moreover, these notifications were not used for epidemiological surveillance due to the lack of information on the source population. The

purpose of this part of the program was to estimate the prevalence of WRD in the working population according to age, gender and economic sector, and to assess the extent of under-declaration of WRD as a compensatable occupational disease.

A pilot registration system based on one week surveys repeated over 3 periods of six months was implemented in 2003 in the Pays de Loire region with the co-operation of a network of OPs. All OPs who practised in this region were invited to participate. The OPs notified the WRD they observed during the compulsory annual workers' consultations for each one week survey. In order to estimate prevalence rates, we also collected data on age, gender and economic sector for all the workers seen by the same OPs during the same period. Nearly half of the region's OPs volunteered to take part in the pilot stage (about 30% of the region's OPs participated in each of the three week surveys). They were representative of the region's OPs in terms of economic sectors covered and were responsible for 339,485 workers in all in 2003 (about a quarter of all salaried workers in the region).

In all components of the program, economic sector and occupation were coded using the French Activities Nomenclature "Nomenclature des Activités Françaises" (NAF codes) and the "Profession et Catégorie Sociale", the French classification of occupations (PCS codes).^{21,22}

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Ethical approval for the program was provided by the French National Commission for Information Processing & Civil Liberties.

RESULTS

Since the beginning of this program of epidemiological surveillance, several analyses have been performed both for surveillance purposes and to provide information for the public and for health authorities. We present here some results from each component of the program.

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including some already published, to illustrate its contribution to epidemiological surveillance and research^{23-27,29}

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Incidence of CTS in Maine & Loire

A total of 1,168 incident cases (349 men and 819 women) corresponding to 1,644 wrists affected by CTS were included during the 3-year period. A few eligible patients refused to participate. The number of refusals was estimated by the physicians to be less than 10%.

The crude average 12-month incidence of CTS over the 3-year period was 1.00 per 1,000 person-years aged 20-59 (0.6 in men and 1.4 in women), increasing with age ($p < 0.001$) in both genders regardless of employment status.

A total of 1,135 patients completed the postal questionnaire [320 men, mean age 43.3 (SD 9.5), and 815 women, mean age 44.9 (SD 9.4)]; most of them were working at the time of diagnosis (81% of men and 66% of women), and 92.1% (96.9% of men and 90.2% of women) had worked in the last 5 years. The unemployed persons comprised subjects who had never worked, mainly women and long-term unemployed persons. The crude mean incidence rate of CTS per 1,000 person-years was higher in employed persons than in those unemployed in the year of diagnosis [0.6 vs. 0.3 of men and 1.7 vs. 0.8 of women (both $p < 0.001$)].

SIRs varied between activity sectors (Table 1). Working in the quarrying industry (mainly sand, stone and clay in the Pays de la Loire region), manufacturing (basic metals; manufacture of metal products; motor vehicles; furniture; wood and wood products, food and beverages industries) and construction was associated with an excess of risk in men. Working in agriculture, manufacturing (manufacture of motor vehicles, electrical equipment, chemical industries, food and beverages industries), services (hotels and restaurants, health and social work) and retail trade was associated with an excess of risk in women.

Table 1 Standardized Incidence Ratios (SIR) of CTS according to economic sector (number of observed incident cases ≥ 5)

| Economic sector (French classification NAF) | Men | | | Women | | |
|---|-----|------|-----------------|-------|-------|-----------------|
| | O | E | SIR (95% CI) | O | E | SIR (95% CI) |
| A. Agriculture, hunting, forestry and fishing (NAF 01→05) | 35 | 29.8 | 1.2 [0.8-1.6] | 80 | 38.2 | 2.1 [1.7-2.6] |
| Agriculture (NAF 01) | 34 | 29.2 | 1.2 [0.8-1.6] | 80 | 38.0 | 2.1 [1.7-2.6] |
| C. Mining and quarrying (stone, sand and clay) (NAF 10→14) | 6 | 1.1 | 5.3 [1.9-11.6] | 0 | - | - |
| D. Manufacturing industries (NAF 15→37) | 105 | 69.5 | 1.5 [1.2-1.8] | 164 | 94.9 | 1.7 [1.5-2.0] |
| Food and drink industry (NAF 15) | 22 | 10.4 | 2.1 [1.3-3.2] | 38 | 14.9 | 2.5 [1.8-3.5] |
| Garment industry (NAF 18) | 1 | - | - | 13 | 10.9 | 1.2 [0.6-2.0] |
| Shoe and leather industry (NAF 19) | 11 | 5.8 | 1.9 [0.9-3.4] | 30 | 22.6 | 1.3 [0.9-1.9] |
| Manufacture of wood and wood products (NAF 20) | 6 | 2.1 | 2.9 [1.1-6.3] | 1 | - | - |
| Manufacture of pulp, paper and paper products (NAF 21) | 1 | - | - | 1 | - | - |
| Publishing, printing and reproduction of recorded media (NAF 22) | 2 | - | - | 5 | 3.1 | 1.6 [0.5-3.8] |
| Chemical industry (NAF 24) | 2 | - | - | 12 | 3.4 | 3.5 [1.8-6.1] |
| Manufacture of rubber and plastic products (NAF 25) | 5 | 8.8 | 0.6 [0.2-1.3] | 6 | 4.7 | 1.3 [0.5-2.8] |
| Manufacture of other non-metallic mineral products (NAF 26) | 0 | - | - | 0 | - | - |
| Manufacture of basic metals (NAF 27) | 6 | 1.1 | 5.6 [2.1-12.3] | 3 | - | - |
| Manufacture of fabricated metal products (NAF 28) | 15 | 8.5 | 1.8 [1.0-2.9] | 7 | 3.9 | 1.8 [0.7-3.7] |
| Manufacture of machinery and equipment n.e.c. (NAF 29) | 7 | 7.1 | 1.0 [0.4-2.0] | 0 | - | - |
| Manufacture of electrical and optical equipment (NAF 30→33) | 8 | 9.1 | 0.9 [0.4-1.7] | 23 | 14.0 | 1.6 [1.0-2.5] |
| Manufacture of motor vehicles (NAF 34) | 10 | 2.8 | 3.6 [1.7-6.6] | 12 | 2.8 | 4.3 [2.2-7.5] |
| Manufacture of other transport equipment (NAF 35) | 0 | - | - | 0 | - | - |
| Manufacture of furniture and wood industries (NAF 36) | 9 | 3.9 | 2.3 [1.1-4.4] | 9 | 4.9 | 1.8 [0.8-3.5] |
| Recycling (NAF 37) | 0 | - | - | 1 | - | - |
| E. Electricity, gas and water supply (NAF 40-41) | 4 | - | - | 1 | - | - |
| F. Construction (NAF 45) | 63 | 27.7 | 2.3 [1.8-2.9] | 6 | 6.4 | 0.9 [0.3-2.0] |
| G. Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (NAF 50→52) | 22 | 33.7 | 0.7 [0.4-1.0] | 79 | 58.2 | 1.4 [1.1-1.7] |
| Sale, maintenance and repair of motor vehicles and motorcycles (NAF 50) | 6 | 7.2 | 0.8 [0.3-1.8] | 8 | 5.0 | 1.6 [0.7-3.2] |
| Wholesale trade (NAF 51) | 6 | 14.5 | 0.4 [0.2-0.9] | 5 | 14.0 | 0.4 [0.1-0.8] |
| Retail trade; repair of personal and household goods (NAF 52) | 10 | 12.0 | 0.8 [0.4-1.5] | 66 | 39.3 | 1.7 [1.3-2.1] |
| H. Hotels and restaurants (NAF 55) | 4 | - | - | 26 | 15.8 | 1.6 [1.1-2.4] |
| I. Transport, storage and communication (NAF 60→64) | 16 | 16.0 | 1.0 [0.6-1.6] | 13 | 13.0 | 1.0 [0.5-1.7] |
| Land transport (NAF 60) | 6 | 8.5 | 0.7 [0.3-1.5] | 2 | - | - |
| Auxiliary transport activities (NAF 63) | 2 | - | - | 3 | - | - |
| Post and telecommunications (NAF 64) | 8 | 5.3 | 1.5 [0.7-3.0] | 8 | 8.6 | 0.9 [0.4-1.8] |
| J. Financial intermediation, insurance and pension funding (NAF 65→67) | 0 | - | - | 15 | 16.6 | 0.9 [0.5-1.5] |
| Insurance and pension funding, except compulsory social security (NAF 66) | 0 | - | - | 7 | 4.1 | 1.7 [0.7-3.5] |
| K. Real estate, renting and business activities (NAF 70→74) | 6 | 22.7 | 0.3 [0.1-0.6] | 33 | 36.3 | 0.9 [0.6-1.3] |
| Other business activities (legal, accounting, advertising...) (NAF 74) | 5 | 16.3 | 0.3 [0.1-0.7] | 25 | 27.3 | 0.9 [0.6-1.4] |
| L. Public administration, compulsory social security (NAF 75) | 17 | 19.7 | 0.9 [0.5-1.4] | 39 | 51.8 | 0.8 [0.5-1.0] |
| M. Education (NAF 80) | 10 | 15.0 | 0.7 [0.3-1.2] | 62 | 65.9 | 0.9 [0.7-1.2] |
| N. Health and social work (NAF 85) | 10 | 12.7 | 0.8 [0.4-1.5] | 164 | 115.8 | 1.4 [1.2-1.7] |
| O. Social and personal service activities (NAF 90→93) | 7 | 7.8 | 0.9 [0.4-1.8] | 25 | 23.5 | 1.1 [0.7-1.6] |
| P. Household activities (NAF 95) | 0 | - | - | 19 | 16.4 | 1.2 [0.7-1.8] |

In terms of occupation categories (Table 2), the workers affected by CTS belonged mainly to lower grade white collar and blue collar categories: material handlers, unskilled industrial, craft and agricultural workers of both genders; skilled craft workers in male workers; the categories for female workers were mainly trade and commerce employees (cashiers, food sales employees, self-service store employees), personal services employees (restaurant or café waitresses, hairdressers, domestic cleaners, child care workers), government executives and service workers (nursing auxiliaries, school cleaners, hospital cleaners).

Table 2 Standardized Incidence Ratios (SIR) of CTS according to occupation (French classification PCS)
(Number of observed incident cases ≥ 5)

| Women | Observed | Expected | SIR (95% CI) |
|--|------------|--------------|-----------------------|
| 1. Farmers (PCS 11→13) | 19 | 21.8 | 0.9 [0.5-1.4] |
| 2. Craftsmen, salesmen, employers (PCS 21→23) | 10 | 24.2 | 0.4 [0.2-0.8] |
| 3. Managers and professionals (PCS 31→38) | 23 | 38.5 | 0.6 [0.4-0.9] |
| 4. Teaching associate professionals, health and social work intermediate occupations, administrative intermediate occupations of public and private companies, technicians and associate professionals, supervisors (PCS 42→48) | 64 | 115.0 | 0.6 [0.4-0.7] |
| 5. Employees and clerks (PCS 52→56) | 384 | 252.1 | 1.5 [1.4-1.7] |
| Government executive officials and services workers (PCS 52) | 141 | 90.3 | 1.6 [1.3-1.8] |
| Government executive officials (PCS 5215) | 10 | 3.4 | 2.9 [1.4-5.4] |
| Nursing Auxiliaries (PCS 5221) | 38 | 18.2 | 2.1 [1.5-2.9] |
| School cleaners and related cleaners (PCS 5216) | 26 | 13.3 | 2.0 [1.3-2.9] |
| Hospital cleaners (PCS 5222) | 32 | 18.2 | 1.8 [1.2-2.5] |
| Trade and commerce employees (PCS 55) | 61 | 23.0 | 2.7 [2.0-3.4] |
| Shop cashiers (PCS 5519) | 18 | 4.4 | 4.1 [2.4-6.5] |
| Food sales employees (PCS 5512) | 12 | 5.0 | 2.4 [1.2-4.2] |
| Self-service store employees (PCS 5518) | 11 | 4.6 | 2.4 [1.2-4.2] |
| Personal services employees (PCS 56) | 117 | 69.1 | 1.7 [1.4-2.0] |
| Restaurant or café waitresses (PCS 5611) | 16 | 5.2 | 3.1 [1.7-5.0] |
| Hairdressers (PCS 5622) | 6 | 2.0 | 3.0 [1.1-6.5] |
| Child care workers (PCS 5631) | 64 | 41.9 | 1.5 [1.2-2.0] |
| 6. Skilled and unskilled workers (PCS 62→69) | 234 | 102.6 | 2.3 [2.0-2.6] |
| Material handlers and related equipment workers (PCS 65) | 11 | 1.8 | 6.2 [3.1-11.1] |
| Storekeeper (PCS 6515) | 8 | 1.5 | 5.2 [2.2-10.2] |
| Unskilled industrial workers (PCS 67) | 129 | 43.3 | 3.0 [2.5-3.5] |
| Agricultural and food industries (PCS 6754) | 24 | 3.6 | 6.7 [4.3-10.0] |
| Sorting, packaging and dispatch (PCS 6793) | 23 | 3.3 | 7.0 [4.4-10.5] |
| Mechanical machinery assemblers (PCS 6723) | 13 | 2.1 | 6.1 [3.3-10.5] |
| Electrical and electronic equipment assemblers (PCS 6711) | 14 | 4.6 | 3.1 [1.7-5.2] |
| Clothing industry (PCS 6772) | 12 | 5.2 | 2.3 [1.2-4.0] |
| Shoe and leather work (PCS 6773) | 19 | 11.0 | 1.7 [1.0-2.7] |
| Unskilled craft workers (PCS 68) | 23 | 12.6 | 1.8 [1.2-2.7] |
| Cleaners (PCS 6891) | 19 | 9.3 | 2.0 [1.2-3.2] |
| Unskilled agricultural workers (PCS 69) | 48 | 12.4 | 3.9 [2.9-5.1] |
| Orchard and vineyard (PCS 6914) | 17 | 2.5 | 6.9 [4.0-11.1] |
| Breeding (PCS 6912) | 7 | 1.3 | 5.2 [2.1-10.8] |

| Men | Observed | Expected | SIR (95% CI) |
|--|------------|--------------|----------------------|
| Growing of vegetables, horticultural specialities (PCS 6913) | 24 | 6.6 | 3.6 [2.3-5.4] |
| 1. Farmers (PCS 11→13) | 14 | 18.5 | 0.8 [0.4-1.3] |
| 2. Craftsmen, salesmen, employers (PCS 21→23) | 13 | 25.3 | 0.5 [0.3-0.9] |
| 3. Managers and professionals (PCS 31→38) | 17 | 34.8 | 0.5 [0.3-0.8] |
| 4. Teaching associate professionals, health and social work intermediate occupations, administrative intermediate occupations of public and private companies, technicians and associate professionals, supervisors (PCS 42→48) | 29 | 57.2 | 0.5 [0.3-0.7] |
| 5. Employees and clerks (PCS 52→56) | 24 | 24.4 | 1.0 [0.6-1.5] |
| 6. Skilled and unskilled workers (PCS 62→69) | 210 | 110.0 | 1.9 [1.7-2.2] |
| Skilled craft workers (PCS 63) | 55 | 25.9 | 2.1 [1.6-2.8] |
| Plumbers (PCS 6344) | 5 | 1.5 | 3.3 [1.1-7.7] |
| Gardeners (PCS 6301) | 6 | 1.8 | 3.3 [1.2-7.1] |
| Bricklayers (PCS 6341) | 9 | 4.6 | 1.9 [0.9-3.7] |
| Material handlers and related equipment workers (PCS 65) | 21 | 6.1 | 3.4 [2.1-5.2] |
| Lift truck drivers (PCS 6514) | 7 | 2.2 | 3.1 [1.3-6.5] |
| Storekeeper (PCS 6515) | 10 | 3.4 | 2.9 [1.4-5.4] |
| Unskilled industrial workers (PCS 67) | 59 | 21.1 | 2.8 [2.1-3.6] |
| Mechanical machinery assemblers (PCS 6723)) | 15 | 2.2 | 6.7 [3.7-11.0] |
| Agricultural and food industries (PCS 6754) | 11 | 2.0 | 5.5 [2.7-9.8] |
| Shoe and leather work (PCS 6773) | 6 | 2.0 | 3.0 [1.1-6.6] |
| Unskilled craft workers (PCS 68) | 22 | 8.5 | 2.6 [1.6-3.9] |
| Building construction (PCS 6841) | 12 | 1.7 | 7.1 [3.7-12.4] |
| Building installation and completion (PCS 6842) | 6 | 1.7 | 3.5 [1.3-7.6] |
| Unskilled agricultural workers (PCS 69) | 20 | 8.6 | 2.3 [1.4-3.6] |
| Breeding workers (PCS 6912) | 4 | - | - |
| Orchard and vineyard (PCS 6914) | 10 | 2.7 | 3.7 [1.8-6.8] |

The attributable fractions of CTS to work among exposed persons (AFE) in occupations at high risk showed that a substantial proportion of cases of CTS diagnosed in lower-grade white collar and blue collar workers were attributable to work: AFEs reached higher values in female blue collar workers (67%) and lower-grade services, sales, and clerical white collar workers (61%). The AFE in male blue collar workers was 76%. High AFE values were observed in agriculture (58% for women), in manufacturing industries (from 58 to 92% for men and from 42% to 93% for women), construction (66% for men), personal service activities (66% for women), trade and commerce (49% for women) and hotels and restaurants (44% for women).²⁹

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Epidemiological surveillance of upper-extremity musculoskeletal disorders in the working population

Among the 3,710 workers randomly included between April 2002 and April 2005, 52% of men and 57% of women had experienced upper-extremity non-specific musculoskeletal symptoms during the preceding 12 months, and 27% of men and 35% of women had experienced these symptoms during the preceding week. Prevalence rates of clinically-diagnosed MSDs were high for both genders: 645 cases were diagnosed in 521 workers. A total of 11.2% (95% confidence interval 9.9-12.6) of men and 14.8% (95% CI 13.0-16.6) of women suffered from at least 1 of the 6 main upper-extremity MSDs. The most frequent disorder was rotator cuff syndrome [6.6% (95% CI 5.6-7.6) in men and 8.5% (95% CI 7.1-9.9) in women], followed by CTS [2.4% (95% CI 1.8-3.0) in men and 4.0% (95% CI 3.0-5.0) in women] and lateral epicondylitis [2.4% (95% CI 1.8-3.0) in men and 2.5% (95% CI 1.7-3.3) in women]. Prevalence rates of the three other MSDs were lower (< 1%, except 2.1% [1.4-2.8] in women for De Quervain's disease). Prevalence rates increased with age for both genders, even after adjustment on seniority ($p < 0.001$). After age 50, 18% of men and 22% of women suffered from at least one MSD and 4% of men and 4% of women from at least two MSDs.

Prevalence rates of MSDs varied between economic sectors (Table 3). In men, prevalence rates were highest in the automotive industries [NAF code: 34], manufactured metal products [28], public administration [75], electrical and optical equipment [30-33], machine and equipment industries [29], rubber and plastic product industries [25]. In women, the highest prevalence rates were found in agriculture, several manufacturing industries (rubber and plastic industries [25], paper industry [21], garment industry [18], machine and equipment industry [29], furniture and wood industries [36]), and also in public administration [75], post and telecommunications [64] and hotels and restaurants [55].

Table 3 Sex-specific prevalence rates of at least 1 clinically diagnosed upper limb MSD according to the economic sector of employment

| Economic sector (French classification NAF) | At least 1 MSD | | | Men | | | Women | | |
|---|----------------|---|---|-----|---|---|-------|---|---|
| | N | n | % | N | n | % | N | n | % |
| | | | | | | | | | |

| | | | | | | |
|--|-------------|------------|-------------|-------------|------------|-------------|
| A. Agriculture, hunting, forestry and fishing (NAF 01 →05) | 31 | 2 | 6.5 | 25 | 7 | 28.0 |
| Agriculture (NAF 01) | 31 | 2 | 6.5 | 25 | 7 | 28.0 |
| C. Mining and quarrying (stone, sand and clay) (NAF 10→14) | 18 | 3 | 16.7 | 6 | 2 | 33.3 |
| D. Manufacturing industries (NAF 15→37) | 829 | 107 | 12.9 | 395 | 77 | 19.5 |
| Food and drink industry (NAF 15) | 182 | 22 | 12.1 | 113 | 15 | 13.3 |
| Garment industry (NAF 18) | 1 | 0 | 0.0 | 12 | 4 | 33.3 |
| Shoe and leather industry (NAF 19) | 8 | 0 | 0.0 | 28 | 3 | 10.7 |
| Manufacture of wood and wood products (NAF 20) | 24 | 3 | 12.5 | 6 | 3 | 50.0 |
| Manufacture of pulp, paper and paper products (NAF 21) | 52 | 6 | 11.5 | 12 | 4 | 33.3 |
| Publishing, printing and reproduction of recorded media (NAF 22) | 17 | 1 | 5.9 | 9 | 1 | 11.1 |
| Chemical industry (NAF 24) | 8 | 0 | 0.0 | 2 | 1 | 50.0 |
| Manufacture of rubber and plastic products (NAF 25) | 84 | 12 | 14.3 | 45 | 15 | 33.3 |
| Manufacture of other non-metallic mineral products (NAF 26) | 22 | 1 | 4.6 | 2 | 0 | 0.0 |
| Manufacture of basic metals (NAF 27) | 23 | 2 | 8.7 | 6 | 3 | 50.0 |
| Manufacture of fabricated metal products (NAF 28) | 91 | 17 | 18.7 | 11 | 2 | 18.2 |
| Manufacture of machinery and equipment n.e.c. (NAF 29) | 89 | 13 | 14.6 | 26 | 6 | 23.1 |
| Manufacture of electrical and optical equipment (NAF 30→33) | 89 | 7 | 15.7 | 69 | 10 | 14.5 |
| Manufacture of motor vehicles (NAF 34) | 63 | 16 | 25.4 | 2 | 0 | 0.0 |
| Manufacture of other transport equipment (NAF 35) | 9 | 1 | 11.1 | 2 | 1 | 50.0 |
| Manufacture of furniture and wood industries (NAF 36) | 57 | 6 | 10.5 | 45 | 8 | 17.8 |
| Recycling (NAF 37) | 7 | 0 | 0.0 | - | - | - |
| E. Electricity, gas and water supply (NAF 40-41) | 12 | 2 | 16.7 | 3 | 1 | 33.3 |
| F. Construction (NAF 45) | 189 | 25 | 13.2 | 25 | 1 | 4.0 |
| G. Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods (NAF 50→52) | 240 | 20 | 8.3 | 238 | 31 | 13.0 |
| Sale, maintenance and repair of motor vehicles and motorcycles (NAF 50) | 62 | 5 | 8.1 | 11 | 2 | 18.2 |
| Wholesale trade (NAF 51) | 96 | 9 | 9.4 | 50 | 7 | 14.0 |
| Retail trade, repair of personal and household goods (NAF 52) | 82 | 6 | 7.3 | 177 | 22 | 12.4 |
| H. Hotels and restaurants (NAF 55) | 40 | 1 | 2.5 | 47 | 7 | 14.9 |
| I. Transport, storage and communication (NAF 60→64) | 152 | 20 | 13.2 | 67 | 10 | 14.9 |
| Land transport (NAF 60) | 63 | 8 | 12.7 | 19 | 3 | 15.8 |
| Auxiliary transport activities (NAF 63) | 13 | 2 | 15.4 | 5 | 0 | 0.0 |
| Post and telecommunications (NAF 64) | 75 | 10 | 13.3 | 42 | 7 | 16.7 |
| J. Financial intermediation, insurance and pension funding (NAF 65→67) | 74 | 9 | 12.2 | 76 | 7 | 9.2 |
| Insurance and pension funding, except compulsory social security (NAF 66) | 54 | 7 | 13.0 | 54 | 6 | 11.1 |
| K. Real estate, renting and business activities (NAF 70→74) | 267 | 17 | 6.4 | 196 | 20 | 10.2 |
| Other business activities (legal, accounting, advertising...) (NAF 74) | 229 | 15 | 6.6 | 163 | 18 | 11.0 |
| L. Public administration, compulsory social security (NAF 75) | 174 | 29 | 16.7 | 140 | 25 | 17.9 |
| M. Education (NAF 80) | 15 | 0 | 0.0 | 20 | 3 | 15.0 |
| N. Health and social work (NAF 85) | 72 | 4 | 5.6 | 236 | 30 | 12.7 |
| O. Social and personal services activities (NAF 90→93) | 44 | 4 | 9.1 | 72 | 8 | 11.1 |
| P. Activities of households (NAF 95) | - | - | - | 1 | 0 | 0.0 |
| Total | 2157 | 243 | 11.3 | 1544 | 228 | 14.8 |

N = number of subjects in the study; *n* = number of cases

Prevalence rates of MSDs varied according to occupation (Table 4). For men, the highest prevalence rates were observed for public service employees (e.g., policemen and members of the armed forces) [PCS code: 51-53], skilled and unskilled industrial workers [62, 67] and storekeepers [65]. For women, the highest prevalence rates were observed for agricultural

workers [69], skilled craft workers [63], skilled and unskilled industrial workers [62, 67], personal services employees [56] (personal care employees), and public service employees [51-53].

Table 4 Specific prevalence rates of at least 1 clinically diagnosed upper limb MSD according to occupation

| Occupations (French classification PCS) | At least 1 MSD | | | Women | | |
|--|----------------|------------|-------------|-------------|------------|-------------|
| | N | n | % | N | n | % |
| 3. Managers and professionals (PCS 31→38) | 210 | 18 | 8.6 | 78 | 6 | 7.7 |
| Administrative managers (PCS 32→35) | 42 | 3 | 7.1 | 25 | 3 | 12.0 |
| Directors and chief executives (PCS 37) | 89 | 6 | 6.7 | 33 | 3 | 9.1 |
| Production and operations department managers (PCS 38) | 78 | 9 | 11.5 | 16 | 0 | 0 |
| 4. Associate professionals and technicians | 540 | 49 | 9.1 | 289 | 39 | 13.5 |
| Teaching, public services and health associate professionals (PCS 41→43, 45) | 96 | 8 | 8.3 | 137 | 20 | 14.6 |
| Administrative and commercial associate professionals (PCS 46) | 110 | 7 | 6.4 | 101 | 12 | 11.9 |
| Technicians (PCS 47) | 209 | 21 | 10.0 | 32 | 4 | 12.5 |
| Supervisors (PCS 48) | 123 | 13 | 10.6 | 19 | 3 | 15.8 |
| 5. Employees and clerks | 188 | 16 | 8.5 | 798 | 98 | 12.3 |
| Public services employees (PCS 51→53) | 80 | 13 | 16.3 | 219 | 35 | 16.0 |
| Administrative employees and clerks (PCS 54) | 48 | 0 | 0 | 328 | 28 | 8.5 |
| Trade and commerce employees (PCS 55) | 38 | 3 | 7.9 | 147 | 17 | 11.6 |
| Personal services employees (PCS 56) | 22 | 0 | 0 | 104 | 18 | 17.3 |
| 6. Skilled and unskilled workers (PCS 61→69) | 1209 | 158 | 13.1 | 377 | 84 | 22.3 |
| Skilled workers (PCS 61→65) | 832 | 111 | 13.3 | 111 | 24 | 21.6 |
| Skilled industrial workers (PCS 62) | 347 | 47 | 13.5 | 61 | 12 | 19.7 |
| Skilled craft workers (PCS 63) | 254 | 30 | 11.8 | 17 | 7 | 41.2 |
| Drivers (PCS 64) | 102 | 12 | 11.8 | 17 | 3 | 17.6 |
| Storekeepers (PCS 65) | 129 | 22 | 17.1 | 16 | 2 | 12.5 |
| Unskilled workers (PCS 67→69) | 377 | 47 | 12.5 | 266 | 60 | 22.6 |
| Unskilled industrial workers (PCS 67) | 273 | 39 | 14.3 | 206 | 45 | 21.8 |
| Unskilled craft workers (PCS 68) | 71 | 6 | 8.5 | 39 | 5 | 12.8 |
| Agricultural workers (PCS 69) | 33 | 2 | 6.1 | 21 | 10 | 47.6 |
| Total | 2160 | 243 | 11.3 | 1545 | 229 | 14.8 |

N = number of subjects in the study; *n* = number of cases

High numbers of workers were exposed to at least two risk factors for MSDs of the neck (43%), shoulder (44%), elbow (50%) and wrist (60%). Excluding the neck, only 10% of workers were free of exposure to any of the 17 biomechanical or psychosocial risk factors listed in the 'Criteria Document'; 25% were exposed to one risk factor, 66% to two or more risk factors (39 % were exposed to at least four and 9 % to seven or more). According to the 'Criteria Document', a high percentage of cases of MSDs could be classified as 'probably work-related' (85% in women and 89% in women age < 50, and 87% in men and 90% in men age < 50). Exposure varied according to economic sector and occupation. Exposure was particularly high in quarrying industries, several manufacturing industries, agriculture and

construction. The most exposed occupations were unskilled craft and industrial workers, skilled craft and industrial workers, storekeepers and agricultural workers.

Work-related diseases

For 23,416 workers seen in compulsory medical consultations during the three weeks of the pilot study (October 2003, April and October 2004), 1,056 notifications of WRDs were recorded. Work-related musculoskeletal disorders represented 65.1% of these WRDs, followed by mental and behavioral or psychological disorders (24.0%), diseases of the skin (4.9%), hearing problems (2.5%) and diseases of the respiratory system (1.9%). The prevalence of WRD was 4.6% of total diseases or symptoms, and 2.9% of work-related MSDs.

According to the OPs, 61% of the work-related MSDs could have been claimed as a compensatable occupational disease according to the conditions defined in the Tables. Only 11% (46 cases) of these 417 cases claimed compensation for an occupational disease. The absence of claims of MSDs for a compensatable occupational disease was explained in 43% of cases by the employee's refusal to claim, and in the remainder by recently diagnosed disease and lack of information about rights on the part of the employee or the physician. The body regions mostly affected for men were the lower back (32%), shoulder (25%), elbow and hand/wrist region (19%), and for women the hand/wrist (34%), shoulder (32%), lower back (20%) and elbow (17%).

The economic sectors with the highest prevalence rates of musculoskeletal disorders were identified for each gender separately. The highest prevalence rates for men occurred in mining and quarrying, agriculture, construction and several manufacturing industries (pulp and paper, food and drink industry, furniture, non-metallic mineral products, motor vehicles, rubber and plastic products, machines and electric equipment) and also in membership organizations.

The highest prevalence rates for women were observed in agriculture and in some of the same manufacturing industries as men (rubber and plastics, machines and electric equipment, pulp and paper, food and drink, furniture, automotive industries) and in others such as manufacturing of wood and wood products, clothing products, shoe and leather products.

DISCUSSION

The program described here is an epidemiological surveillance system intended to provide permanent information concerning the trends and course of the current MSD epidemic on a population scale.

The CTS surveillance results provided the first estimation of the frequency of this MSD in the general population of a French district. This district is characterized by the high development of manufacturing and meat and poultry industries and by certain types of specialized cultivation (vineyards, horticulture and arboriculture). The limitations of the study were discussed in detail elsewhere.^{12,29} The main limitation was the lack of exhaustiveness of the surveillance network of physicians, which led to an underestimation of the incidence of CTS. The male/female ratio in the rate of CTS per 1,000 person-years was similar between employed (0.35) and unemployed persons (0.37). These results could indicate that non-occupational factors favouring a higher incidence in women have a similar influence in both genders. Similarly, AFEs values were about in the same proportion for both genders in blue collar workers and in manufacturing industries, suggesting that occupation factors have similar influence for men and women. The results showed variations according to sectors and occupations, in agreement with the results of Rossignol et al. in Quebec.²⁸ Our study identified 14 sectors with an excess risk of CTS: agriculture, quarrying, construction, manufacturing (food and drink industry, wood and wood products, chemical industries, basic

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metals and metal products, motor vehicles, electrical or optical equipment and electronic components, furniture), retail trade, hotels and restaurants, health and social work. These sectors represent about 22% of male employment and about 44% of female employment in Maine & Loire. Since many tests have been performed, we are aware that some of the significant results might be due to random effects.

Surveillance of the main MSDs in the working population revealed high prevalence rates for clinically-diagnosed MSDs: 11% (95% CI [10-13]) of men and 15% [13-17]) of women suffered from one of the six upper limb MSDs and about 4% from at least two disorders. A very few eligible workers refused to participate (they were estimated to be less than 5%). The high prevalence of clinically-diagnosed MSDs contrasted with the relatively low level of work compensation claims for upper limbs MSDs in the same region (in 2003, about 3.7 WCs for 1,000 workers). This confirms that in France, as in other countries, using WC claims as a source of information leads to underestimation of the frequency of MSDs. Contrary to French and regional WC claims figures, the most prevalent disorder was not CTS but rotator cuff syndrome. The high prevalence rate of this disorder is disquieting because of its poor medical and social prognosis.

Another finding that is of importance for the prevention of MSDs was the high prevalence rate after age 50. The accumulation of MSDs in older employees probably reduces their functional capacity and increases the risk of disability and dismissal.

The data generated by the epidemiological surveillance program were also used for research work. The feasibility of a job-exposure matrix for exposure assessment in studies of work-related musculoskeletal disorders of the upper extremities was explored²⁴. The factors associated with excess risk of upper limb musculoskeletal disorders in manual workers

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compared with other workers were investigated, and the variables which best summarized biomechanical exposure associated with upper-extremity disorders were identified^{25,27}

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Improved registration of WRD was observed during the three weeks of the pilot study, yielding more than 1,000 notifications instead of 845 and 536 for the whole of 2001 and 2002, respectively, for all the OPs of the region. If repeated regularly, these short periods of registration should provide valuable information on the frequency of work-related pathological disorders, as well as an estimate of the extent of undeclared compensatable occupational diseases.

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Geographic extension

The implementation of this pilot program of epidemiological surveillance of MSDs over three years (2002-2004) in the Pays de la Loire region identified the strengths and limitations of several sources of data and of different methods of collection. Based on that experience, we are currently preparing its geographic extension within the framework of a national program whose main objectives remain those of the Pays de la Loire pilot study. The program is being extended through its progressive implementation in several other regions chosen to be representative of French economic activity. The surveillance methods have been simplified for this extension. For the surveillance of sentinel health events in the general population, the program will rely on the use of the data of the French national hospital database for surgical cases. For the surveillance of the working population, a simplified self-administered questionnaire will be completed by a sample of workers, and only the three most frequent MSDs of the upper limb (shoulder tendinitis, carpal tunnel syndrome, lateral epicondylitis) will be investigated through a standardized clinical examination by OPs. For WRD surveillance, week-long surveys will be performed regularly.

Supprimé : (i) to estimate the incidence and the prevalence rates of the main MSDs in France; (ii) to identify the distribution according to occupations and economic sectors; (iii) to estimate the proportion of cases of MSDs attributable to work. ¶
The Pays de la Loire will continue its regional surveillance and will also serve as the reference center. As such, some improvements in the epidemiological surveillance methods, such as the investigation of other sources of data, will be developed and tested. The Pays de la Loire will apply the full protocol of the surveillance program, and provide reference data for the other regions. ¶

The first region to which the program is currently being extended is Provence - Alpes - Côte d'Azur (southeastern France), this region was chosen because its structure of the sectors of economic activity is quite different from that of the Pays de la Loire region (fewer manufacturing industries, more services sectors). The surveillance of WRD has already been implemented in 7 other regions, covering about 29% of the French population. Extension of the data collection to the rest of the country will precise and strengthen the results observed on only one region and increase the probability of decision-makers looking seriously at the inequities in this system. Different selection biases may be introduced by the variation of the participating rate of OPs according to the region and the period of registration. These potential selection biases will be explored when data are available.

The Pays de la Loire experimental program already plays a significant role in informing the authorities and the public on the state and course of the current epidemic of MSDs, although the data gathered have still to be fully exploited. We planned to repeat our surveillance periodically, the next step will be conducted in 2011-2012 to study time trends. To our knowledge, such a program is unique, and we intend to extend it to a routine national epidemiological MSDs surveillance program within a few years.

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Main messages

- The French Musculoskeletal Disorders (MSDs) Surveillance Program was implemented in 2002 by the French Institute for Public Health Surveillance.
- This program, firstly implemented in the Pays de la Loire region, is being extended to other regions of France.
- The crude mean incidence rate of carpal tunnel syndrome (CTS) per 1,000 person-years was higher in employed persons than in those unemployed in the year of diagnosis (0.6 vs. 0.3 of men and 1.7 vs. 0.8 of women). The attributable fractions of CTS to work among exposed persons were higher in blue collar and lower-grade white collar workers.
- Prevalence rates of clinically-diagnosed upper-limb MSDs were high for both genders (11.2% of male workers and 14.8% of female workers).
- According to the occupational physicians, 61% of the work-related MSDs could have been claimed as a compensatable occupational disease, but only a small number of them claimed for compensation.

Policy implications

- The aims of the French Musculoskeletal Disorders (MSDs) Surveillance Program are to:
 - Estimate incidence and prevalence rates of the main MSDs and their time trends according to age, gender, economic sector and occupation.
 - Assess the levels of the main occupational exposures.
 - Estimate the contribution of work-related physical and psychosocial risks to their development.
 - Estimate the extent of under-declaration of work-related MSDs as compensatable occupational diseases.
 - Contribute to research.
- The Pays de la Loire program has already played a significant role in informing the authorities and the public on the state of the current epidemic of MSDs in France.