

Work-related musculoskeletal conditions: evidence from the THOR reporting system 2002–2005

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Background	Musculoskeletal disorders (MSDs) are commonly encountered in current occupational health practice and comprise up to 45% of the workload for occupational physicians (OPs).
Aims	To compare the reported incidence of work-related (WR) MSDs by specialist OPs and specialist rheumatologists and to relate it to self-reported and general practitioners-reported WR MSDs.
Methods	Analysis of data reported to surveillance schemes within The Health and Occupation Reporting network and comparison to denominator data derived from the Labour Force Survey and occupational/work activity classifications.
Results	There are significant differences between the patterns of WR MSDs seen by the different specialist groups. Thus OPs report three times as many back and lower limb conditions. However, both specialist groups report similar numbers of cases of hand–arm vibration syndrome (12/9%) and ‘vague and ill-defined’ upper limb conditions (16/14%). The absolute risk of physician reported that WR MSDs increases 5-fold between ages 15–24 and 45–64.
Conclusions	The specialist reporting schemes give an indication of current practice and are useful both to update and to strategically inform planning. The data are amenable, with appropriate statistical analysis, for comparison with self-reporting and to the characterization of risk in broad categories of occupation and work activity.
Key words	Epidemiology; occupational musculoskeletal disease; reporting systems; surveillance.

Introduction

Musculoskeletal disorders (MSDs) and psychiatric illness are the two most common sets of conditions associated with work. Together, they account for ~90% of modern UK work-related (WR) morbidity; each set of conditions occupying about half of the field [1–3]. Both rheumatologists and occupational physicians (OPs) are as expert observers, frequently encountering and reporting these conditions. It is educative to understand the differences and similarities in the reported incidence and case profiles of conditions that come to the attention of these expert groups. It is also important to be aware of what is seen and reported in rheumatology and occupational medicine (which is not necessarily a representative sam-

ple) relates to unreported (or otherwise medically reported) morbidity.

The data to support observations on MSDs and psychiatric illness come from reporting methodologies for WR morbidity which have been developed to enhance the venerable (but chronically underused) UK statutory system created by health and safety legislation. The Health and Occupation Reporting network (THOR) is an expert reporting system which draws data directly from case reports from clinical specialists and general practitioners (GPs) with training in occupational medicine. Case reports are then coded clinically and occupationally by standard epidemiological methodologies [4]. A second system uses an extension of a long-established socio-demographic sampling system, the Labour Force Survey (LFS) [1], to address the incidence of self-reported medical conditions, self-attributed to work, in general population samples.

THOR originated in 1989 as a reporting scheme for occupational lung disease but has now developed into a cluster of monospecialty systems (including rheumatology). This study is concerned with the Musculoskeletal Occupational Surveillance Scheme (MOSS). Running alongside, the monospecialty systems are two

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occupational medical schemes which capture a wide range conditions: the Occupational Physicians Reporting Activity (OPRA) and THOR-GP, which operates among GPs with an interest in occupational medicine.

The existence of expert reporting schemes operating to common criteria permits comparisons to be made between the different strands, here within and between MOSS and OPRA. Our objectives are to address a range of outcomes of interest, including reporting rates, case frequency rates, age relatedness and attribution to work in different industrial/occupational/work activity sectors. We also discuss how these data may relate to the true incidence and prevalence of occupational musculoskeletal morbidity in the UK.

Methods

The operating methodologies of MOSS and OPRA have been described in detail elsewhere [5,6].

To summarize, new cases of occupational illness are reported by two categories of physicians: 'core reporters', who report all cases throughout the year and 'sample reporters' who report for one randomly selected month per year.

The criterion for case reporting is a clinical opinion that work has caused or aggravated a condition. MOSS covers MSDs alone, whereas in OPRA, MSDs are captured as part of the full range of occupational diseases.

Standard demographic and occupational data are sought from reporters, together with a diagnosis. For MSDs, the diagnoses can be attributed to a body part, an occupation and to a work activity. Coding uses International Statistical Classification of Diseases and Related Health Problems (ICD-10), Standard Occupational Classification [7], Standard Industrial Classification [8] and schemes to classify work and movement tasks.

Two different sources of denominator information were used to calculate incidence rates. For cases reported by rheumatologists, 2002–05 LFS data were used as the denominator. The LFS is carried out annually by the Office for National Statistics and collects information to estimate people in employment in the UK [9]. As OPs only serve ~12% of the UK workforce, the OPRA denominator was obtained from a 2001 survey which collected information on the number of employed persons served by OPs participating in OPRA [10]. The 95% confidence intervals (CIs) were calculated (for absolute numbers and rates) using a formula which took account of the proportions of the cases reported by 'core' and 'sample' reporters. However, the extent to which the reporting physicians covered the LFS population cannot be exactly quantified or taken into account in these confidence limits.

This study addresses reporting and response rates during 2002–05, in addition to more complex analyses within schemes (MOSS and OPRA) and between schemes

(MOSS versus OPRA). The analyses reveal case numbers, population case number estimates, proportional morbidity, estimated case frequency, age-related reporting rates and attribution to work type and body activity in terms of risk rates. For these factors, comparisons were made between the experiences observed in MOSS, OPRA and LFS, as permitted by the scope and limitations of the data. Data for this study were extracted from the July 2005 THOR database and analysed using SPSS V 14.0. THOR has Multicentre Research Ethics Committee approval (MREC 02/8/72).

Results

During the study period 2002–05, MOSS had an average of 263 consultant rheumatologist reporters and OPRA had an average of 582 specialist OP reporters. Although not shown, overall response rate (or compliance) among reporters showed little secular fluctuation in MOSS (82%) or OPRA (90%). Positive case reporting, that is having one or more cases to report when sampled, also remained steady in MOSS (43%) and OPRA (60%). MOSS reporters registered 1534 cases, while OPRA reporters logged 2569 MSD cases. MOSS core reporters had higher case reporting rates than their 'sampled' colleagues, whereas in OPRA, the situation was reversed (Table 1).

The proportionate distribution of MSDs reported to MOSS and OPRA (2002–05) is shown graphically in Figure 1. Upper limb/girdle problems were commoner than lower limb MSDs. The proportion for MOSS was ~6:1 and for OPRA ~2:1, with the major differences being attributable to the larger proportion of lumbar spine/back and hip/knee conditions seen by OPs (Table 2).

The distribution of estimated diagnoses for MOSS and OPRA is shown in Figure 2a and b. The main differences between MOSS and OPRA reporting lay in the proportions of carpal tunnel syndrome (CTS) (10 versus 5%), tendon conditions (14 versus 6%) and Raynaud's phenomenon/hand–arm vibration syndrome (9 versus 12%). The reporting of ill-defined conditions was 14% in MOSS and 16% in OPRA. Proportions of spinal conditions (neck/back) were greater in OPRA, while lower limb disorder frequencies were low in MOSS and OPRA and did not vary greatly between reporting systems.

Absolute incidence rates (Figure 3a) show a 5-fold increase between ages 16–24 and 45–64. When examining overall musculoskeletal morbidity relating to work, the gradient rate of increasing incidence is similar for males and females.

Major subcategories include hand/wrist/arm, upper limb (which includes hand/wrist/arm, elbow and shoulder) and spinal (neck/back) disorders are shown by age and gender (Figure 3b–d). Female hand/wrist/arm disorder incidence reaches a peak early (45–54 years), whereas

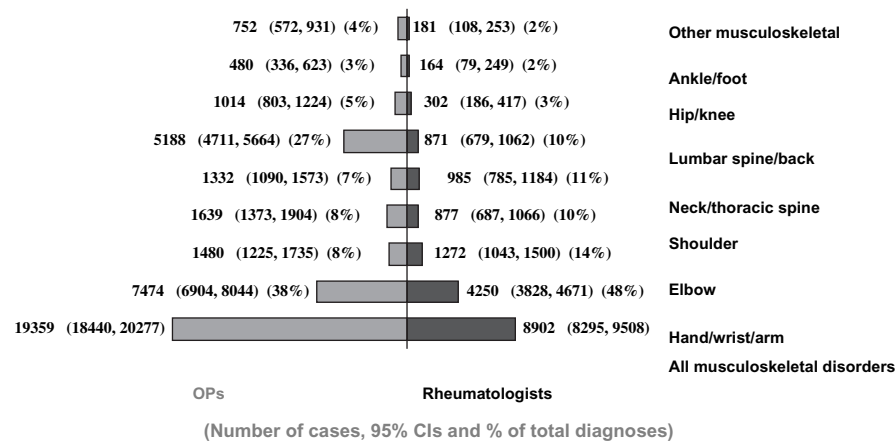
Table 1. Participation in MOSS and OPRA from 2002–05

	MOSS core reporters ^a	MOSS sample reporters ^a	OPRA core reporters ^a	OPRA sample reporters ^a
Total active reporters ^b ever in 2002–05	263		582	
Mean number of all reporters per month	13.4	19.6	27.8	40.4
Mean number of active reporters ^b per month	11.0	15.4	25.4	34.3
Number of case reports	899	635	1096	1473
Mean number of case reports per month	18.7	13.2	22.8	30.7
Mean number of case reports per active reporter ^b per month	1.7	0.9	0.6	1.7
Total estimated cases ^c	8519		18 772	

^aCore reporters submit year-round returns; sample reporters report in one month each year.

^bActive reporters = those who returned a reporting card (either including case reports or zero returns); for OPRA this includes the whole range of occupational diagnoses and not just for occupational musculoskeletal disease.

^cEstimated cases = (number of sample reporter reports × 12) + number of core reporter reports.

**Figure 1.** Proportionate (% age) distribution of musculoskeletal disease reported by OPs in OPRA and Rheumatologists in MOSS (2002–05).**Table 2.** Estimated average annual incidence rates (per 100 000 employed) of WR musculoskeletal disease reported by rheumatologists (to MOSS) and OPs (to OPRA) 2002–05

Diagnosis	MOSS				OPRA			
	n	95% CIs	Rate	95% CIs	n	95% CIs	Rate	95% CIs
Hand/wrist/arm	1063	852–1273	3.7	2.9–4.4	1869	1584–2154	57.9	49.0–66.7
Elbow	318	204–432	1.1	0.7–1.5	370	243–498	11.5	7.5–15.5
Shoulder	219	125–314	0.7	0.4–1.0	410	277–543	12.7	8.6–16.9
Neck/thoracic spine	246	147–346	0.7	0.4–1.0	333	212–454	10.4	6.6–14.2
Lumbar spine/trunk	218	122–314	0.7	0.4–1.0	1297	1059–1535	40.3	32.9–47.7
Hip/knee	76	18–133	0.3	0.1–0.5	254	148–359	7.8	4.6–11.1
Ankle/foot	41	–2 to 84	0.2	–0.0 to 0.3	120	48–192	3.7	1.5–5.9
Other	45	9–82	0.2	0.0–0.3	188	98–278	5.3	2.8–7.9
All	2226	1922–2529	7.4	6.4–8.4	480	4380–5299	150	136–164

male incidence continues to increase, and a similar pattern is shown for upper limb disorders.

For neck/back conditions, incidence to age 35 is identical for males and females but thereafter a sharp division occurs with male incidence reaching a plateau and female incidence continuing to increase.

For rheumatologists, the most frequently reported industrial sector for MSDs was the manufacture of metals and automotive manufacture (combined) (1007/2922; 34% of estimated cases) with annual average incidence rates (95% CIs) per 100 000 employed of 11.8 (6.6–7.0) for males and 12.0 (1.6–22.5) for females. A similar

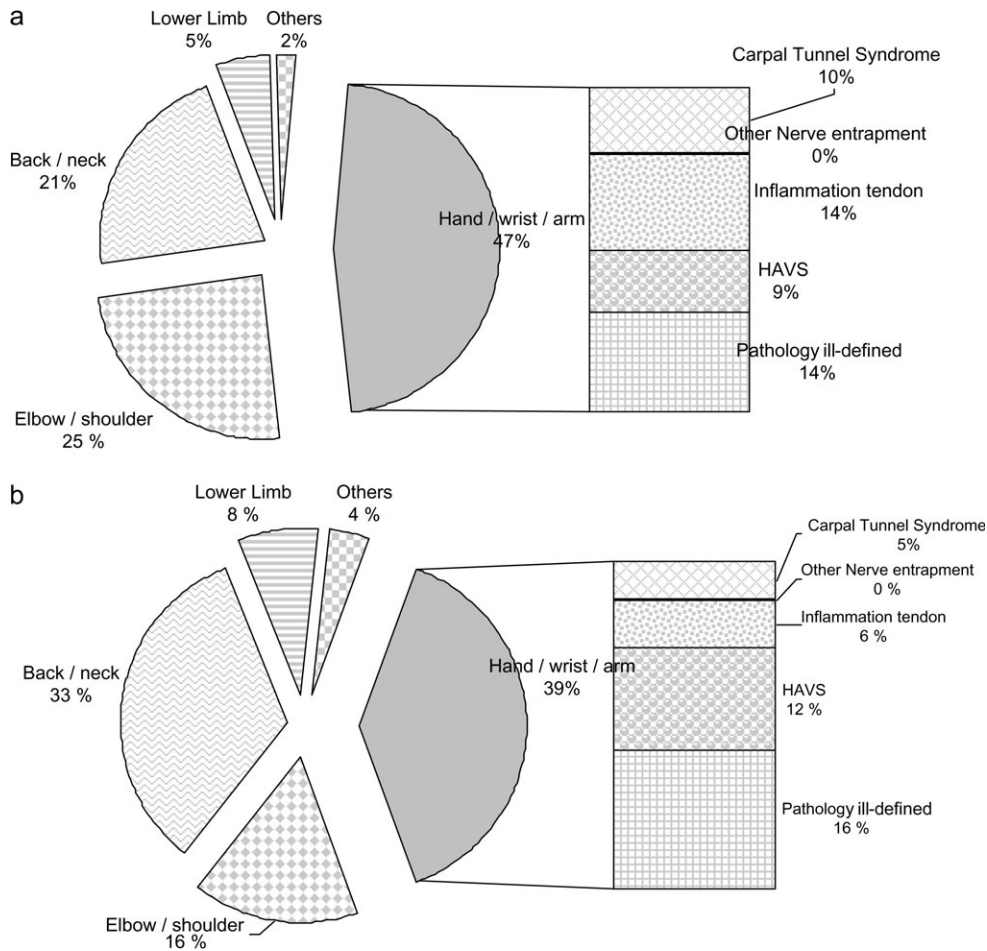


Figure 2. (a) Distribution of estimated diagnoses reported to MOSS from 2002–05. (b) Distribution of estimated diagnoses reported to OPRA from 2002–05.

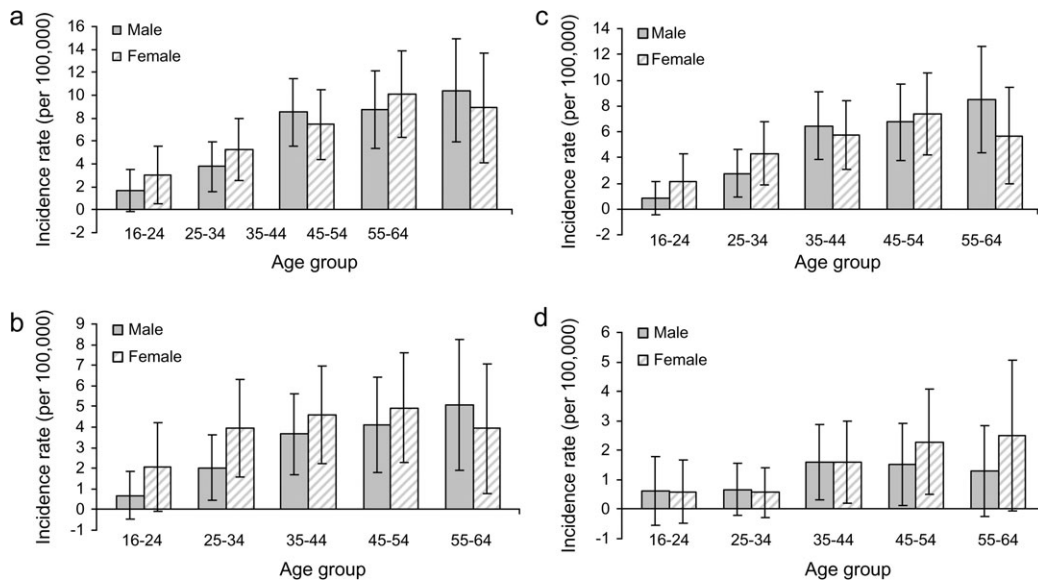


Figure 3. Incidence rates and 95% CIs per 100 000 employed per year of WR MSDs in MOSS (2002–05) by age and gender using LFS (2002–05) denominator data. (a) All MSDs; (b) hand/wrist/arm disorders; (c) upper limb disorders (including hand/wrist/arm, elbow and shoulder) and (d) neck and back disorders.

proportion (3000/9354; 32%) of cases reported by OPs was within this industrial sector, but male and female incidence rates were 521 (384–657) and 494 (186–803) per 100 000 employed, respectively.

For OPs, the most frequently reported sector for MSDs was health and social care (4345/9354; 46% of estimated cases), with annual average incidence rates (95% CIs) of 52 (30–74) for males and 103 (79–126) for females. The equivalent incidence rates (95% CIs) for rheumatologist-reported MSDs for this sector (833/2922; 29% of estimated cases) were 4.2 (–0.9 to 9.2) for males and 6.6 (3.4 to 9.9) for females.

Both groups of physicians also saw a relatively large proportion of cases in the utilities and construction sector (37 and 21% of estimated MSDs reported to MOSS and OPRA, respectively).

The most frequently reported occupations for MSDs were nursing staff (nurses/nursing auxiliaries/nursing assistants), metal working production and maintenance fitters, assemblers of vehicles/metal goods and food/drink/tobacco operatives.

Work activities frequently leading to case reporting in both MOSS and OPRA included keyboard work (MOSS 17%, OPRA 11%), the guiding and holding of tools (MOSS 18%, OPRA 19%) and lifting (MOSS 22%, OPRA 24%). MSDs attributable to work accidents were far more often reported in OPRA (15%) than MOSS (3%).

In terms of specific movements, fine handwork (MOSS 16%, OPRA 8%), forceful upper limb movements (MOSS 25%, OPRA 19%) and lifting/carrying/pushing/pulling activities (MOSS 18%, OPRA 13%) were most commonly cited.

The different experiences of rheumatologists and OPs show the gross split between conditions of the upper limb and back to be 40:60 (MOSS and OPRA combined), but OPs see more back conditions than rheumatologists do.

Discussion

In this study, the pattern of WR MSDs affecting the upper limb, lower limb and back showed marked differences between MOSS and OPRA reporting in the period 2002–05. Analysis of THOR case reports also showed a 5-fold increase in MSD incidence between patients aged 16–24 and 45–64 years. As both MOSS and OPRA have shown remarkable stability in their core and sample reporter populations (participation exceeding 80% and no discernible drop off with time), it is reasonable to infer that the subject is important to reporters.

Over time, THOR's development has resulted in increasingly rich and varied evidence to inform interested parties about WR ill-health. Initial studies yielded outcomes such as case frequencies of MSDs, relative frequencies of different body regions affected and attribution to different occupations [3]. With the increas-

ing availability of denominator data, we have derived reporting rates and incidence rates to infer industrial sector risk [10], considered crude secular trends [2], applied multilevel models to diagnostic outcomes [11] and compared data from different specialist medical reporter groups.

The estimated number of incident cases of WR MSDs in this study may reflect the overall UK incidence. In a previous study [2], rates/million were calculated and the experience of rheumatologists and OPs was compared (OPs having higher reporting rates). This trend persists in the present study where rheumatologists see half as many work-related upper limb disorders (WRULDs) and encounter only a sixth of back/lower limb conditions than OPs.

Differences between rheumatologist- and OP-reported incidence of WR MSDs are unsurprising given the filtering or selective referral effects within the pyramidal, hierarchical system of UK specialist access. Similar phenomena are also likely within occupational health system hierarchies (e.g. first aider → nurse → OP). Experiences of both rheumatologists and OPs will therefore be attenuated by selection, and this will be further biased by referral preference (e.g. back cases being referred to orthopaedic surgeons). THOR-GP reports show that in 2006/07, 8% of MSDs reported by GPs were referred to a hospital specialist; in 2007, 66% of these referrals were to orthopaedic surgeons and 9% to rheumatologists. Thus, the overview from THOR data should be compared with other data sources (e.g. LFS), also taking into account our awareness of case-selection and referral biases associated with secondary/tertiary referral.

It also seems likely that new MSD outbreaks/trends may take time to 'appear' at clinical specialist level, whereas OPs may see such cases sooner. In making conclusions on work attribution, OPs rank the observation of similar symptoms in co-workers more highly than rheumatologists [2]; therefore, MOSS may identify geographic clusters of new conditions and trends, whereas OPRA is more likely to identify new industry or work activity trends.

Further comparison of MOSS and OPRA data (e.g. proportional morbidity) raises additional issues of how to subdivide attribution to body region. The categorizations chosen should reflect major groups of conditions having likely occupational and pathological differences. Both rheumatologists and OPs clearly act as major diagnostic foci for CTS, inflammatory tendon disease and hand–arm vibration. It is therefore likely that proportional differences reflect the (relatively) uniform geographical distribution of rheumatologists in comparison to the non-uniform concentration of OPs in certain occupational sectors (e.g. health care) and paucity in others (e.g. agriculture).

An area where rheumatologists and OPs share a substantial and similarly sized workload is the 'pathologically ill-defined conditions' (14–16%), e.g. WRULDs. Since these cases are common, and present substantial case-

management challenges, they should be the subject of further attention in terms of elucidation, consensus and research.

The overall age-related trends of MSD reporting within THOR are unsurprising but may conceal a number of occupational factors; UK males continue (in part at least) to be employed in heavier work and might therefore be expected to show more MSDs than females. Similarly, the secular trend may conceal job movements with age with the creation of 'survivor' working populations, thus disguising a higher general population morbidity than presented here. This would also be supported by our WRULD data, which are more likely to be associated with overtly exertive jobs; these disorders were common in men. Survivor populations may also be a factor in back disorders, where the ongoing upward age-related trend in females may be associated with the secondary impact of work on the loss of hormonal protection and consequent osteoporotic propensity.

The (rheumatologist-reported) incidence rates were estimated using data relating to the whole UK workforce as the denominator. If all rheumatologists in the UK reported to MOSS—and there was no under-reporting by these physicians—we could assume complete capture of rheumatologist-diagnosed cases in MOSS, so applying UK workforce data as the denominator would be appropriate. However, we cannot assume that 100% of rheumatologists who could potentially report to MOSS do so, so the true denominator that should be applied is less than the figures relating to the whole UK workforce. It is therefore likely that the incidence rates for MOSS described here are artificially low, and the 95% confidence limits are not exact. Recent work (M. Carder, R. McNamee, S. Turner, A. Money and R. M. Agius, in preparation) has been carried out to improve the accuracy of incidence rates provided by THOR by gaining a better understanding of the populations covered by the different schemes within THOR. In lieu of a direct measure of 'missing cases', the first step in this process was to estimate the percentage of eligible physicians (i.e. those seeing patients of working age) reporting to THOR within a calendar year and, from this fraction, to estimate the number of cases believed not to be captured. Using this approach, we estimated that ~40% of eligible rheumatologists were reporting to MOSS during 2005. Further work is being carried out to refine THOR's incidence rate estimations, and in future, these 'adjusted' rates will also be available (in addition to the unadjusted or 'crude' incidence rates presented here).

THOR uses a permissive common methodology for attribution to work, but this has been investigated further to examine the likelihood of over/under attribution. Chen's study concluded that with current, dominant belief systems, under-reporting was more likely than the opposite [3]. The headline annual prevalence figure in the Health & Safety Executive's scheme for self-reporting of WR ill-

health of upper limb MSDs is ~300 000 per year [12]. Inferences drawn from the self-reported data have been challenged [13]. However, THOR data are different in relying on a clinical common methodology for attribution to work.

Generalizations about population experience derived from the inferences from specialist encounters should be made with caution, but work by Hussey *et al.* [14] and Carder *et al.* (M. Carder, R. McNamee, S. Turner, A. Money and R. M. Agius, in preparation) has indicated how extrapolations from THOR data can be made more precise. Their estimate is that a likely true level of UK population incidence of WR MSDs in general practice is ~128 000 cases (incidence rate in 2006 = 805/100 000 persons employed), while that seen by a rheumatologist is between 8000 and 9000 (annual average incidence rate 2005–07 = 7.3 per 100 000). This is in concordance, in terms of order of magnitude, to the inferences of other researchers' recent work.

In summary, while we acknowledge the limitations of information produced by surveillance schemes such as THOR, we also believe that THOR is an important source of WR ill-health data in the UK. Such data continue to be important in the recognition, evaluation and control of workplace hazards and when planning programmes of disease prevention for employees.

Key points

- There are substantial differences between the pattern of work-related musculoskeletal disorders seen by different groups of clinical specialists, with occupational physicians reporting three times as many back and lower limb conditions as rheumatologists.
- THOR reporting showed a 5-fold increase in musculoskeletal disorders incidence between patients aged 16–24 and 45–64.
- In future, information from clinical specialist and general practitioner reporting and patients' self-reports should allow incidence rates for work-related musculoskeletal disorders to be calculated across its whole range of severity in the UK.

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Conflicts of interest

None declared.

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