WRMSD risks within the construction industry

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SUMMARY

The study sought to review in a systematic way the evidence comparing the rates of work-related musculoskeletal disorders in different construction occupations. The available data indicate that some occupations are significantly worse than others. The samples underlying the data are not sufficiently large to produce reliable estimates of prevalences in all but the largest occupations.

KEYWORDS

Construction, Work-related musculoskeletal disorders, Health and safety

Background

HSE tracks work-related ill-health through the annual Labour Force Survey (LFS). It estimates that 543 000 workers suffered from, and 7.8 million working days were lost, due to new or long-standing work-related musculoskeletal disorders (WRMSDs) in 2023/24 . WRMSDs such as low back pain are often associated with manual handling (such as lifting, carrying, pushing or pulling) of loads.

The LFS shows that the construction industry has a much higher rate of WRMSDs (approximately 1.7 times for the period from 2021/22 to 2023/24) than the average across all industries. Some tasks within construction create higher risks of WRMSD than others.

Aim

The specific aim of the project was to search for, collate and analyse existing information, particularly published scientific studies linking particular construction tasks and trades with increased risk of WRMSD risks in construction in order to rank tasks and activities by risk of WRMSDs.

Approach

The planned approach of the project was to carry out a systematic review of scientific literature on WRMSDs related to the construction sector, concentrating on the higher quality epidemiological studies. A search of databases of scientific literature for a wide range of terms related to “musculoskeletal disorders” AND “the construction industry” identified over 2000 publications. There were no geographical, language or date restrictions, except that the search terms were in English. Figure 1 is a PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses (Page *et al.*, 2021)) flow chart for the study, showing how relevant papers were identified.

Retrieved records were managed in EndNote (version X9, and later version 20), which automatically downloads electronic copies of Open Access papers. The three members of the study team worked independently to classify the 1708 papers remaining after removal of duplicates and irrelevant papers. Studies reporting epidemiological data on individual construction trades or tasks were included and classified by the type of epidemiological study. Studies of the construction sector as a whole without any breakdown were excluded as it is already known that construction is high risk compared to other sectors.

The study team then considered which articles should be included in the planned review by starting with the systematic reviews (the highest quality type) and working down the study hierarchy (Greenhalgh, 1997) until sufficient quality information was found that could be extracted that addressed the study question. Differences between the classifications of the three team members were resolved in team meetings. At this stage, titles, abstracts and, where already available, the full papers, were taken into consideration. Table 1 shows the numbers of papers included at each stage for the six main epidemiological study types identified. Each paper that was chosen for full-text review was allocated to two of the three team members who independently extracted relevant details into Excel spreadsheets. The team then met to compare findings and agree how to proceed.

Table 1: Results of the screening and selection of studies

Study type	Papers identified by the three reviewers from the titles and abstracts	Papers chosen for full-text review	Papers chosen for data extraction
Systematic reviews	9	5	0
Intervention studies	150	8	0
Prospective cohort studies	70	41	0
Registry/retrospective studies	63	40	23
Case-control studies	16	NA	NA
Cross-sectional studies	190	NA	NA

Nine papers were identified as reporting systematic reviews, of which five were chosen as suitable for full-text review. None were chosen for data extraction and, given the limited number of reviews found, their heterogeneity, their limited conclusions and the lack of data on individual trades and tasks, the team agreed that it was necessary to proceed to reviewing the intervention studies identified in the search.

The team had identified 150 papers as possible intervention studies. Of these, only eight were chosen for full review, but this found that only three had potentially useful information. Because the number was so small, the team agreed to proceed to reviewing prospective cohort studies. Of the 70 potential prospective cohort papers, 41 were chosen for full-text review. Of these, eleven, reporting six different studies, were identified as suitable for data extraction. However, the review team agreed that the studies were quite varied, and viewed overall, provided insufficient data to allow conclusions to be drawn about individual construction trades and tasks.

Through a process of sorting and evaluation, it was decided to concentrate on studies that examined data collected through injury and compensation claim and medical surveillance databases over periods of years (registry/retrospective longitudinal studies). Typically, these databases are available in countries that use Workers' Compensation (WC) insurance systems to pay for medical care / lost time when a worker is injured at work. They can include very large numbers of workers, but are limited when significant numbers of workers opt for other types of health cover.

Sixty-three studies were initially identified as registry/retrospective studies, and 40 identified as suitable for retrieval of the full-text. One could not be retrieved; one was found to be only a conference abstract and two did not report data specific to construction trades. Full text review of the remaining 36 reduced the number under consideration to 23. Of the 13 rejected, four had too limited data; three did not report WRMSD data separately to other injury data; two reported data also reported in related papers; one did not report data specific to construction trades; one did not report injury rate data; one reported data from a single trade and in one the data were very old in an area (hand tools) that has seen significant design changes since the paper was published.

Relevant data from the 23 papers were copied into Excel workbooks and examined in detail. After extraction of the data from the 23 papers, four were excluded, one due to duplicate publication, one due to not reporting separate WRMSD data and two due to not reporting incidence data. This meant that usable data were obtained from 19 papers. Four papers (Lipscomb *et al.*, 1997, Lipscomb *et al.*, 2008a, b, Lipscomb *et al.*, 2015) relating to WC insurance claims by unionised carpenters in Washington State in the USA. Five related to general WC claims made in Washington State (Silverstein *et al.*, 2002, Bonauto *et al.*, 2006, Schoonover *et al.*, 2010, Spector *et al.*, 2011, Anderson *et al.*, 2013). Two papers reported data from the US Bureau of Labor Statistics (BLS) annual Survey of Occupational Injuries and Illnesses (SOII) (Wang *et al.*, 2017, Dong *et al.*, 2019). A pair of papers (Kontio *et al.*, 2018, Solovieva *et al.*, 2018) reported rates of, and risk factors for, knee and hip osteoarthritis in Finland. Six papers were unrelated to the other included studies. Duguay *et al.* (2001) reported WC claim data from Quebec. Stocks *et al.* (2011) analysed cases of work-related ill-health reported to HSE. Andersen *et al.* (2012) analysed cases of hip and knee osteoarthritis in Denmark. Wahlström *et al.* (2012) discussed Swedish cases of lumbar disc disease that resulted in hospitalisation. Memarian and Mitropoulos (2013) analysed recordable incidents that occurred in a large construction company specialising in brick and blockwork. The final paper, Dale *et al.* (2015), compared the WRMSD medical claims for floor layers in Missouri with those for the general working population.

Examining the papers by Wang *et al.* (2017) and Dong *et al.* (2019) led to a decision to include more comprehensive US SOII data and therefore to draw on the similar GB LFS data. Injury reports/claims are classified by both the economic sector of the employer, eg using Standard Industrial Classification (SIC) codes, and by occupational groups, eg using Standard Occupational Classification (SOC) codes. This allows injuries to be considered by both the type of business employing the injured person and by the kind of work the injured person performs.

Separate LFS data files for illnesses and injuries analysed by both UK SIC code and UK SOC code were downloaded from the HSE statistics microsite, https://www.hse.gov.uk/statistics/index.htm. The SIC data are broken down to the lowest level of industry group. The SOC data are broken down to the smallest occupational group. For many of the lower level groups, the sample sizes were too small for HSE to be able to provide reliable estimates. The available prevalence / incidence data and prevalence ratio / incidence ratio data and associated 95% Confidence Intervals were extracted and the numbers of FTE workers in each occupational class estimated from them.

The UK SIC code data used were annual arithmetic means over the three year period from April 2016 to March 2019. The UK SOC code data used were the annual means over the period from April 2017 to March 2020. These two slightly different periods were selected as being recent but not significantly affected by the Coronavirus pandemic that started in early 2020.

The SOII data from the USA were downloaded from www.bls.gov for the ten year period from 2011 to 2020. Injury and illness rates were analysed by 35 North American Industry Classification System (NAICS) codes within the construction sector code of 23XXXX. Of these, 22 were ‘industries’ (codes 23XXX0), ten were ‘industry groups’ (codes (23XX00) and three were ‘subsectors’ (codes 23X000). The same data were also analysed by 64 construction occupations (US 2010 SOC code) in SOC codes 47-0xxx to 47-4xxx plus construction-related occupations in other top-level occupational groups, such as construction managers (SOC code 11-902x).

Rates from all sources were standardised as rates per 100 Full-Time Equivalent workers / per 200,000 hours worked, using a notional full-time rate of 2000 hours worked per year.

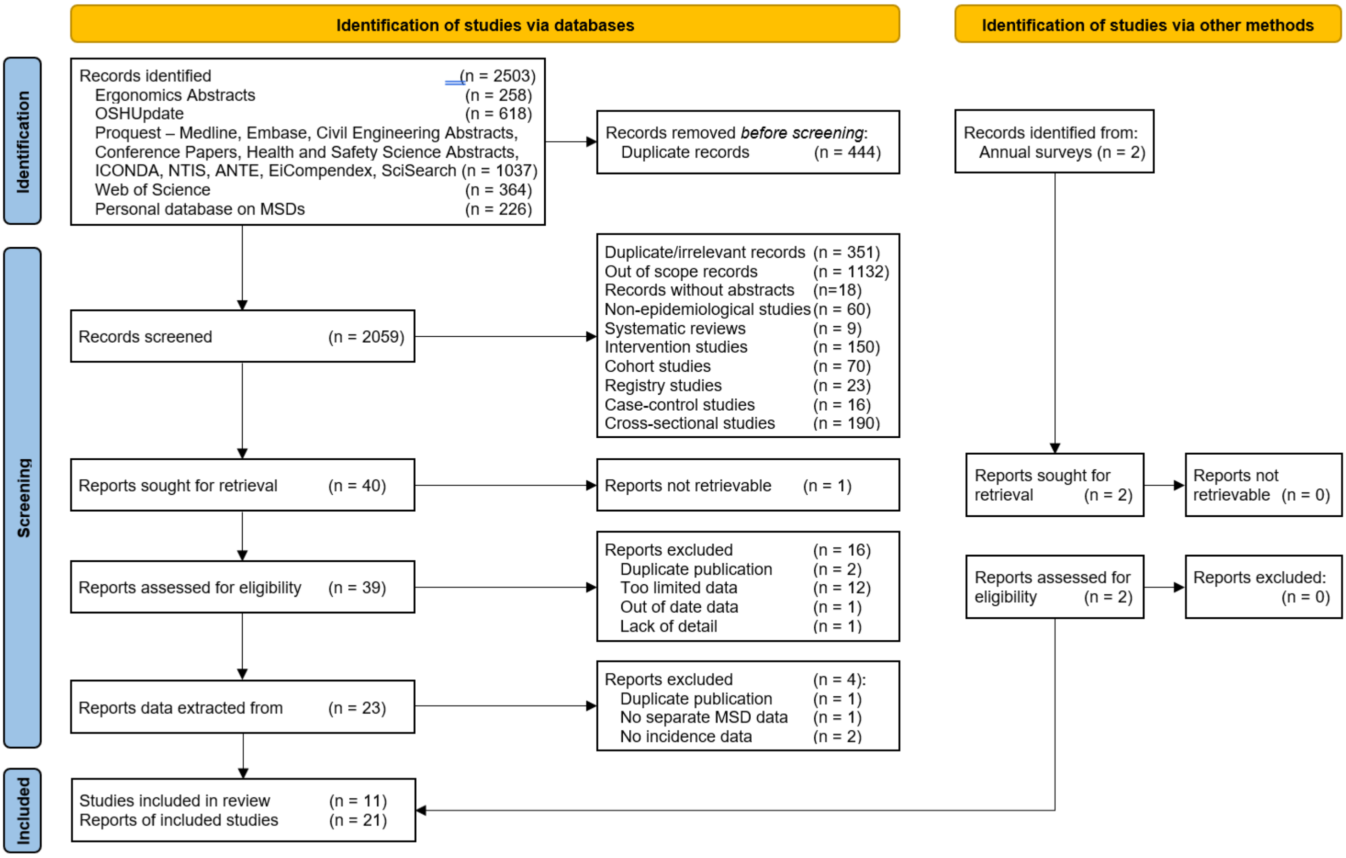

Figure 1: PRISMA 2020 flow diagram for the study (Page *et al.* (2021), licensed under CC BY 4.0)

Figure 1 is a flow diagram summarising the results of the search and selection process, from the number of records identified in the search to the number of studies finally included in the review. It uses the format provided by Page *et al.* (2021) as part of the recommendations of the *Preferred Reporting Items for Systematic reviews and Meta-Analyses* (PRISMA) statement.

Findings

Only limited findings from the analysis are reported here. They form part of the findings discussed in Pinder *et al.* (In press).

The LFS data indicate that the prevalence of WRMSDs in the UK construction sector is 1.8 times (= 2.11/1.16) the prevalence averaged across all industries. The limitation of the LFS sample size meant that only seven of 33 unique UK SIC 2007 construction industry codes had sufficient data for reliable estimates to be provided in relation to WRMSDs. Nor did the sample size allow detailed analysis by affected body parts. Only two SIC codes were at the lowest level of 'industry classes': UK SIC 2007 code F41.20 'Construction of residential and non-residential buildings' (1.67 reports per 200 000 hours worked) and F43.32 'Joinery installation' (3.68 reports per 200 000 hours worked). F43.3 'Building completion and finishing' has twice (= 4.17/2.11) the prevalence of WRMSDs across the whole sector. F43.3 'Building completion and finishing' has 2.2 times the rate (= 4.17/1.93) of code F43.2 'Electrical, plumbing and other construction installation activities'.

Of the 62 UK SOC 2010 occupational groups relevant to construction, only 19 have sufficient LFS data for any estimates to be provided in relation to WRMSDs. The three (of 33) unit groups with sufficient data all had high WRMSD rates and were all within sub-major group 53 'Skilled construction and building trades' / minor group 531 'Construction and building trades': 5314

'Plumbers and heating and ventilating engineers'; 5315 'Carpenters and joiners'; and 5319 'Construction and building trades n.e.c.' (n.e.c. = not elsewhere classified).

US SOII data showed that averaged from 2011 to 2020, the four worst construction industries for WRMSD reports were NAICS codes 23835 'Finish carpentry contractors' (incidence rate (IR) = 0.563 absences per 200 000 hours), 23833 'Flooring contractors' (IR = 0.561), 23813 'Framing contractors' (IR = 0.551) and 23817 'Siding contractors' (IR = 0.539). The first two of these map onto UK SIC 2007 codes F43.32 'Joinery installation' and F43.33 'Floor and wall covering' respectively. The other two both map onto F43.99 'Other specialised construction activities n.e.c.'. The six worst construction occupations over that period were US 2010 SOC codes 47-4023 'Floor sanders and finishers' (IR = 3.581 absences per 200 000 hours),47-2042 'Floor layers, except carpet, wood and hard tiles' (IR = 1.119), 47-2142 'Paperhangers' (IR = 1.058), 47-2041 'Carpet installers' (IR = 0.966), 49-2022 'Telecommunications equipment installers and repairers, except line installers' (IR = 0.866), and 49-9021, 'Heating, air conditioning, and refrigeration mechanics and installers' (IR = 0.849). Codes 47-4021, 47-2042 and 47-2043 map to UK SOC 2010 code 5322 'Floorers and wall tilers', 47-2142 maps to 5323 'Painters and decorators', 49-2022 maps to 5242, 'Telecommunications engineers' and 49-9021 maps to 5225 'Air-conditioning and refrigeration engineers'

Of the 66 construction occupational groups in the US 2010 SOC, 54 (82%) had data from at least seven years in the period from 2011 to 2020, and 11 of these had statistically significant trends in incidence rates, all downward. Of these, eight were 'detailed occupations', the lowest level of classification. Correlations between year and incidence rate ranged between -0.70 and -0.93, so the amount of variability associated with the time trend ranged between 49% and 86%, indicating that these were consistent decreases in incidence rates. Such decreases over a 10-year period would suggest that longer-term trends are reducing WRMSD risks in these occupations.

The studies of unionised carpenters in Washington State (Lipscomb *et al.*, 1997, Lipscomb *et al.*, 2008a, b, Lipscomb *et al.*, 2015) indicated the highest risk was to workers performing drywall work. Residential and light commercial carpentry work was also at greater risk than other carpentry work. The data of Silverstein *et al.* (2002) show that certain construction activities were high risk for multiple body parts, suggesting that they were creating excessive demands on the whole body. These were Washington Industrial risk Classification (WIC) risk classes 0515 'Wallboard installation', 0518 'Building construction, NOC' and 0510 'Wood frame building construction'. Reinforcing steel installation was the most hazardous risk class for carpal tunnel syndrome.

There is evidence (Andersen *et al.*, 2012) that individual construction trades have rates of musculoskeletal problems higher than for construction workers as a whole, for both work absences and increased rates of surgery for osteoarthritis (such as hip replacements) among floor layers, brick layers and pavers . Similarly, Solovieva *et al.* (2018) found skilled construction workers, such as electricians and plumbers, had higher rates of disability due to hip osteoarthritis than unskilled transport, construction and manufacturing workers. They also found that combining kneeling and squatting and heavy physical work increased the risk. This suggests that prevention strategies could focus on the risks of heavy physical work that occurs in awkward postures.

Conclusions

A large number of registry/retrospective studies reporting longitudinal WRMSD data for construction industry groups and construction trades were identified as useful for HSE's purpose of trying to identify construction trades and occupations at increased risk of WRMSDs. They largely came from North America and Europe. Most studies from the USA used data from insurance-based WC systems, so reported Claims Incidence Rates due to WRMSDs, while some European studies report hospitalisation rates for specific problems such as 'lumbar disc disease' or hip or knee osteoarthritis. The WC data exclude uninsured workers and are likely to exclude low-severity incidents that do not lead to claims. Annual survey data were also obtained from both the UK LFS and the US SOII.

Rates of injury are unrelated to the size of the construction industry group/trade concerned, meaning that both small and large groups of workers could have either low or high injury rates. Days absent from work due to WRMSDs were also unrelated to the size of the construction industry group/trade and its injury rate.

Cumulative / repetitive injury WRMSDs were shown to be much more common and more disabling than ‘acute onset’ or overexertion injuries. This suggests that prevention efforts should be focussed on reducing long-term exposures to WRMSD risk factors, such as lifting heavy weights, while not ignoring risk factors for acute injuries, such as extreme loads.

Methodological issues

Some of the studies from which data were extracted had limitations in their methodologies that made it very difficult to draw generalisable conclusions from them. For instance, Stocks *et al.* (2011) drew data from clinical reports of work-related illness via a voluntary reporting system that appears not to have been able to provide a large representative sample of the construction workforce.

A number of studies used construction sector-wide, or population databases to identify clinical outcomes and therefore have the advantage of comprehensive coverage of the at-risk population. However they often used very restrictive case definitions, such as hospitalisation (eg, Wahlström *et al.*, 2012). This will result in lower incidence rates than in employer surveys such as the US SOII (Dong *et al.*, 2019, Wang *et al.*, 2017) that include cases of WRMSDs with less severe outcomes, such as work loss. However, such surveys can suffer from differential reporting by employers.

The SOII data were quite variable from year to year, meaning that data averaged over multiple years give more reliable comparisons than the single year reported by Dong *et al.* (2019). The SOII data for days absent from work were even more variable, but their data for numbers of cases reported and hence injury rates were much more stable. This led to the conclusion that injury rates are the preferable measure when comparing industries and occupations.

Key takeaways

Classification systems evolve over time to reflect changes in the economy and in individual occupations, so it can be difficult to make comparisons over extended periods.

The WRMSD data available for the UK construction industry are limited in detail, so make detailed analysis at the level of occupation or employer type very challenging. In particular, the LFS sample size is too small for HSE to make reliable estimates of WRMSD prevalences in all but the largest construction industry occupations and industrial groupings. However, there is sufficient data to indicate that HSE should consider focussing on the building completion and finishing group of industries (UK SIC group F43.3) as a whole, and on the UK SOC classes 5314 ‘Plumbers and heating and ventilating engineers’, 5315 ‘Carpenters and joiners’ and 5319 ‘Construction and building trades n.e.c.’ in particular.

US data show a clear trend in the reduction of WRMSD reporting incidence rates over many years and across their economy, not just in their construction sector. This suggests that wider societal trends in materials handling equipment, employment and/or health may have had positive effects on musculoskeletal health among workers in the USA. The rates of reduction varied between occupations, suggesting that specific factors have reduced risk differentially. There is insufficient evidence available to show if such trends have occurred in the UK.

Ranking data from multiple industries or occupations by incidence rate shows that though the overall range is large, the steps between neighbouring groups are often small, and there are no distinct clusters. This suggests that focusing health and safety interventions on the highest risk occupations as the most likely way to reduce risk may not show clear-cut results because the differences between different occupations may be small.

Acknowledgements

This paper and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the author alone and do not necessarily reflect HSE policy.

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