Global prevalence of hospital admissions for low back pain: a systematic review with meta-analysis

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ABSTRACT

Objectives To determine the proportion of low back pain presentations that are admitted to hospital from the emergency department (ED), the proportion of hospital admissions due to a primary diagnosis of low back pain, and the mean hospital length of stay (LOS), globally.

Methods We searched MEDLINE, CINAHL, EMBASE, Web of Science, PsycINFO and LILACS from inception to July 2022. Secondary data were retrieved from publicly available government agency publications and international databases. Studies investigating admitted patients aged >18 years with a primary diagnosis of musculoskeletal low back pain and/or lumbosacral radicular pain were included.

Results There was high heterogeneity in admission rates for low back pain from the ED, with a median of 9.6% (IQR 3.3–25.2; 9 countries). The median percentage of all hospital admissions that were due to low back pain was 0.9% (IQR 0.6–1.5; 30 countries). The median hospital LOS across 39 countries was 6.2 days for ‘dorsalgia’ (IQR 4.4–8.6) and 5.4 days for ‘intervertebral disc disorders’ (IQR 4.1–8.4). Low back pain admissions per 100 000 population had a median of 159.1 (IQR 82.6–313.8). The overall quality of the evidence was moderate.

Conclusion This is the first systematic review with meta-analysis summarising the global prevalence of hospital admissions and hospital LOS for low back pain. There was relatively sparse data from rural and regional regions and low-income countries, as well as high heterogeneity in the results.

BACKGROUND

Over-medicalisation of low back pain is a global health, social and economic problem. The Lancet series on low back pain, and its recent update contained a call to action, encouraging changes to health systems to reduce inappropriate care pathways while enabling access to the right treatment at the right time. Even though guidelines for low back pain recommend that these patients be managed in primary care, people with low back pain increasingly present to the emergency department (ED). In the USA, Canada and Australia, low back pain ranks in the top 10 reasons for ED presentation, where 4–5% of all ED attendances are attributed to low back pain.

Musculoskeletal low back pain in those presenting to the ED typically has a good prognosis. A recent systematic review, for example, demonstrated initial (pooled estimate of the mean) pain scores reported at 71.0 out of 100 (95% CI 64.2 to 77.9), reducing to 46.1 (95% CI 37.2 to 55.0) after 1 day and 41.8 (95% CI 34.7 to 49.0) after 1 week. Despite this, many of those who present to ED with low back pain are admitted as an inpatient. Hospital admission for musculoskeletal low back pain, while sometimes necessary, can result in unnecessary spinal imaging, prescription of complex analgesia such as opioids and benzodiazepines and hospital-acquired complications such as infections and falls.

Admission for low back pain is also costly, with an estimated mean cost per admission of ~$AUD 15 000.

In the USA, 65% of all low back pain admissions are unscheduled admissions through the ED. The estimated prevalence of low back pain admissions in low-income and middle-income countries has not been well studied, but the available studies suggest that it is a global healthcare issue.

A cost of illness study in Brazil identified 118 705 low back pain admissions over 5 years (2012–2016), with those aged 39–58 years identified as accounting for 48% (64 002/133 971) of inpatient hospital days.
We know that admission rates for low back pain as a proportion of ED presentations vary greatly even within similar healthcare settings. One study of 177 New South Wales (Australia) EDs reported that the admission rate for low back pain ranged from 7–66%. Two other recent Australian studies reported that 18% (public hospital) and 53% (private hospital) of low back pain presentations to the ED were subsequently admitted as inpatients.

Hospital length of stay (LOS) for those admitted primarily for low back pain has not been well explored across different countries. There appears to be significant variation in LOS, ranging from a median of 2-day stay for non-specific low back pain in New South Wales, Australia to 15.3 days for lumbago in Udine, Italy. Another way of examining global clinical variation is to consider low back pain hospital admissions standardised per 100 000 population, to allow direct comparison between countries.

A study in 2012 reported a wide range of admission rates for low back pain in 23 European Union countries (3.4 per 100 000 population in Portugal to 561.2 per 100 000 population in Austria), but there has been no update in the peer-reviewed literature. To inform healthcare delivery planning, it would also be useful to determine what proportion of all hospital admissions are due to a primary diagnosis of low back pain, and how this varies globally. However, this has not been previously explored.

A key challenge in describing clinical variation is that admission rates and LOS for low back pain are impacted by diagnostic definition of low back pain (eg, admissions defined by the patient reporting low back pain vs admissions where a clinician provides a musculoskeletal lumbar spine discharge diagnosis), as well as definition of the admitted cohort, and non-admitted population.

The objectives of this systematic review were to estimate the global prevalence of hospital admissions for musculoskeletal low back pain and hospital LOS for these admissions.

METHODS
This systematic review follows the reporting recommendations in the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guideline. Study protocol was published as a preprint prior to data collection.

Patient and public involvement
Patients were not involved in the design and conduct of this study.

Search strategy
Peer-reviewed literature
The following electronic databases were searched from inception to July 2022: MEDLINE, CINAHL, EMBASE, Web of Science, PsycINFO and LILACS. Keywords included synonyms of ‘low back pain’, ‘emergency departments’, ‘hospital admissions and ‘prevalence’ (see online supplemental file 1 for full search strategy). Citation tracking was conducted in relevant systematic reviews and in the reference list of included studies. Searches were not restricted by language, and translations were accessed for non-English language studies.

Grey literature
Secondary data were retrieved from publicly available government agency publications and international databases from January 2000 up to July 2022 using the following keywords (back pain OR backache OR dorsalgia) AND (prevalence OR rate) AND (hospital OR emergency)’, restricting data extraction to the year 2000 onwards. To supplement online searches, we screened the reference lists of included studies and government reports retrieved by searches. To access reports from non-English speaking countries we contacted leading international low back pain experts to help identify publicly available data sets.

Selection criteria
Study types
We included cross-sectional and cohort studies investigating the prevalence of hospital admission and hospital LOS for low back pain and/or lumbosacral radicular pain. Hospital admission was defined as patients admitted to a hospital ward or inpatient medical unit following a presentation to the ED. Studies reporting admissions per 100 000 population were also eligible and reported separately. Studies that recorded the prevalence of low back pain admissions from the total amount of hospital admissions were also eligible and reported separately. Studies were excluded if they only recorded prevalence of ED visits for low back pain and not subsequent hospital admissions. Studies were also excluded if they clearly were not representative, for example, only including admission data from a specific insurance plan or occupation. Studies were restricted to those containing data from the year 2000 onwards to reflect contemporary hospital admission practices.

Participants
Studies investigating admitted patients aged >18 years with a primary diagnosis of musculoskeletal low back pain and/or lumbosacral radicular pain were included. The proportion admitted could be reported out of patients presenting to the ED, or at the population level. Those studies restricted to patients with serious spinal pathologies (such as infection, vertebral fracture, malignancy, cauda equina syndrome or axial spondyloarthritis) were excluded. Studies with mixed spinal pain populations, such as cervical or thoracic pain, were excluded unless separate data for low back pain and/or lumbar radiculopathy was reported or when more than 75% of the population was diagnosed with low back pain and/or lumbar radiculopathy. We also excluded studies assessing low back pain as a comorbidity during hospital admissions rather than the primary diagnosis. There were no restrictions for intensity or duration of symptoms.
For government reports, International Classification of Diseases (ICD)-Codes M54 (dorsalgia) and M51 (intervertebral disc disorders) were used to determine admissions and hospital LOS.

**Study selection**

Two authors screened each title, abstract and extracted data from the full text independently. A third author arbitrated any disagreements.

**Data extraction**

Data extraction was completed using a standardised data extraction form in Microsoft Excel including: study design; sample size; year of publication; prevalence period; participant characteristics such as age, sex, ethnicity and socio-economic status; country; source of hospital admission (such as ED or at the population level); coding system such as condition or an ICD-10 diagnosis code; setting such as urban or rural hospital; coverage such as regional or national study; type of ward/unit where patients were admitted; healthcare system funding; and hospital LOS.

Studies were categorised into WHO regions (African, Americas, South-East Asian, European, Eastern Mediterranean or Western Pacific Regions), country-level of income according to the World Bank’s categories (low, lower-middle, upper-middle or high income), study setting (urban, rural or mixed), study coverage (local, regional or national), low back pain case definition (condition or diagnostic code) and healthcare funding arrangement (predominantly public funding system or private funding system).

The proportion of low back pain ED presentations that were admitted to hospital was extracted or calculated from raw data when overall estimates were not available. Data were independently extracted from the included studies and government reports by two authors, with all disagreements resolved by discussion. In case of missing data, authors of included studies were contacted through email to request further information.

**Risk of bias assessment**

Each included study was critically appraised by two reviewers independently. We assessed the risk of bias of included studies using the tool for population-based prevalence studies developed by Hoy et al, which has been found to have high inter-rater agreement. The tool consists of 10 items scored as low or high risk of bias. Items assess external validity (representative population, sampling frame, random sampling, response rate) and internal validity (data collection mode and method, case definition, prevalence period, valid and reliable research instrument, errors in reporting proportions), as well as a summary risk of bias assessment based on predicted impact of future research on confidence in the estimate (low, moderate or high).

The quality of government reports was evaluated using the AACODS (Authority, Accuracy, Coverage, Objectivity, Date, Significance) checklist, which was designed to enable evaluation and critical appraisal of grey literature for systematic reviews. Factors considered include the level of authority of the source, accuracy of data, geographic and sociodemographic coverage, date of collection and significance of the document. Reports received a final rating of high (no significant flaws), moderate (minor flaws impacting credibility/validation), low (some flaws likely to impact credibility/validation) or very low quality (significant flaws impacting credibility/validation).

**Analysis**

Descriptive analyses were used to report the characteristics of the studies. Hospital LOS across countries was reported as a median, IQR and range. We were unable to calculate pooled mean (95% CI) hospital LOS, as the available data did not provide estimates of variability such as range, SD or SE.

Individual study results are presented as admission rates and 95% CIs, and grouped per type of admission definition:
1. Admissions as a proportion of ED presentations.
2. Admissions per 100 000 population.
3. Admissions as a proportion of all hospital admissions.

Random-effects meta-analyses with meta-regression were conducted to generate pooled admission rates and explore potential sources of heterogeneity by including the following covariates in the model: low back pain case definition, WHO region and healthcare funding system (public or private). We used the F-statistic to measure what proportion of the observed variance was attributed to the variance in effect estimates rather than to sampling error. Homogeneity in country income level precluded inclusion in meta-regression, as all data were from upper-middle-income or high-income countries. High heterogeneity of data prevented us from reporting pooled admission rates; instead we report distribution of admission rate estimates as median and IQR. Statistical analysis was performed using Stata V.16.

**RESULTS**

Our search of electronic databases identified 7978 citations; we screened 220 full texts and included 31 studies from the electronic search. We identified an additional six eligible reports from alternative search strategies for a total of 37 publications meeting inclusion criteria (see Preferred Reporting Items for Systematic review and Meta-Analysis diagram, figure 1 and online supplemental file 2). Hospital admission data available from four individual national government websites that was duplicate to that from Organisation for Economic Co-operation and Development (OECD) or European Union (EU) data sets were not included.

**Study characteristics**

We included 37 publications (31 peer-reviewed publications and 6 government reports), conducted between
2000 and 2020. The most recently published government statistics available for the majority of OECD and EU countries were from 2018 or 2019.

Peer-reviewed publications came from 11 countries: Australia (11), Canada (5), USA (3), Brazil (3), Germany (2) and one each from England, Chile, Italy, Mexico, Argentina, Sweden and Switzerland. Studies provided either urban hospital data (18), district or state level hospital data (7) or nationwide data (6). Twenty-eight studies collected data retrospectively and three prospectively. All except two Spanish publications were available in English. Data on patient ethnicity (two studies), socioeconomic status (one study) or type of admitting hospital unit (four studies) was scarce.

Government publications included data from 41 countries, all considered upper-middle-income or high-income countries, covering three WHO Regions (European, Americas, Western Pacific).

Admissions as a proportion of ED presentations

We analysed the proportion of low back pain admissions from ED from 3 government reports and 20 peer-reviewed studies (table 1). Seven studies were from healthcare systems with predominantly private funding, 16 with predominantly public funding. Nineteen studies used ‘musculoskeletal back pain’ to report admissions and four studies used proportion of all mixed ‘back pain’ presentations.

There was high heterogeneity in the admission rates for low back pain, with admission rates ranging from 2% to 53% globally (figure 2). The median percentage of admitted patients with low back pain from ED was 9.6% (IQR 3.3–25.2). One study was excluded from this analysis due to selection bias: a Swedish report of low back pain admissions found an admission rate of 23%, however only patients transported to the ED by ambulance were included (see online supplemental table 1).

We found that a model including hospital funding, definition of low back pain diagnosis and WHO Region only explained 25% of the variance (R²=25.4%). Only WHO Region was statistically significant (p=0.003) for explaining variance in admission rates when these variables were entered into the model separately. Hospital funding (p=0.659) and definition of low back pain (p=0.855) did not significantly explain variance.

Hospital LOS

We analysed mean hospital LOS for dorsalgia and intervertebral disc disorders from 39 countries in the OECD and EU, for the year 2018 or 2019, depending on availability of most recent data (table 2). Hospital admission data available from individual national government websites that was a duplicate of the OECD data set was not included.

Median hospital LOS was 6.2 days for dorsalgia (IQR 4.4–8.6, range 2.8–14.9; two reports) (figure 3A) and 5.4 days for intervertebral disc disorders (IQR 4.1–8.4, range

Figure 1 Preferred Reporting Items for Systematic review and Meta-Analysis flow diagram. EU, European Union; OECD, Organisation for Economic Co-operation and Development.
<table>
<thead>
<tr>
<th>Study or report summary*</th>
<th>Mean patient age, gender†</th>
<th>% admitted, N admitted/N ED presentations of back pain</th>
<th>Case definition</th>
<th>ROB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaronson et al** 2017: Single, urban, university-affiliated ED, (90% insured) in Massachusetts, USA, January 1 2012 to 11 July 2014.</td>
<td>46.0±17.7, 44.0% F</td>
<td>4.1, (249/6094)</td>
<td>ICD-9 codes for ‘low-risk back pain’.</td>
<td>Low</td>
</tr>
<tr>
<td>Anderson et al 2022*: 147 public hospital EDs in NSW, Australia, for 2013.</td>
<td>53.2, 52.7% F</td>
<td>31.8, (54 530/171 552)</td>
<td>SNOMED CT, ICD-9 and ICD-10 for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Buchbinder et al 2021*: Single private, urban, university affiliated ED in Victoria, Australia, for 2015.</td>
<td>69.0, 60.0% F</td>
<td>52.9, (238/450)</td>
<td>ICD-10 codes for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Davidson 2022*: 37 public EDs across a large regional health district in NSW, Australia, from July 2014 to June 2019.</td>
<td>49.2±20, 51.7% F</td>
<td>18.4, (4888/26 509)</td>
<td>ICD-10 code M54.5.</td>
<td>Low</td>
</tr>
<tr>
<td>Edwards 2018*: Single urban, university-affiliated public ED in Nova Scotia, Canada, between 2009 and 2015.</td>
<td>45.0 (IQR 30–60), 53.4% F</td>
<td>1.8, (159/8716)</td>
<td>ICD-9 and ICD-10 codes for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Ferreira et al 2022*: 177 public hospital EDs in NSW, Australia, for 2016–2019.</td>
<td>51.8±19.5, 52.0% F</td>
<td>25.2, (44 549/176 729)</td>
<td>SNOMED CT, ICD-9 and ICD-10 for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Ferreira et al 2019*: 3 urban, university-affiliated public EDs in NSW, Australia, between 2016 and 2018.</td>
<td>51.8±20.4, 50.1% F</td>
<td>16.4, (1004/6103)</td>
<td>SNOMED CT codes for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Friedman et al 2010*: Representative sample of National tertiary care hospitals in the USA, between 2002 and 2006.</td>
<td>40.0 (median, IQR 30–50), 51.2% F</td>
<td>2.2, (90/4097)</td>
<td>ICD-9 codes for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Grande-Ratti 2020*: Random sample of patients seen with back pain at a single, private, urban, university-affiliated ED in Buenos Aires, Argentina, from January to December 2016.</td>
<td>53.3±19.9, 55.9% F</td>
<td>6.2, (68/1096)</td>
<td>‘Acute low back pain’, excluded cases related to trauma and infection.</td>
<td>Mod</td>
</tr>
<tr>
<td>Kawchuk et al 2022*: Prospective analysis of eligible presentations to an urban, university-affiliated public ED in Alberta, Canada, between 2017 and 2018.</td>
<td>49.0 (median), 50.0% F</td>
<td>9.6, (20/209)</td>
<td>Presenting problem of MSK low back pain.</td>
<td>Mod</td>
</tr>
<tr>
<td>Lovegrove et al 2011*: 3 urban, university-affiliated public EDs in WA, Australia, between 1 July 2000 to 31 December 2004.</td>
<td>46.3, 51.4% F</td>
<td>17.1, (1688/9926)</td>
<td>‘Muscular’ or non-specific low back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>McCaughey et al 2016*: Single, public, university-affiliated ED in NSW, Australia, in 2013.</td>
<td>60.5±21.8, 42.2% M</td>
<td>31.7, (365/1150)</td>
<td>Presenting problem of ‘back pain’.</td>
<td>Mod</td>
</tr>
<tr>
<td>Rizzardo et al 2016*: Single, public, urban, university-affiliated ED in Udine, Italy, in 2013.</td>
<td>67.2, 49.0% F</td>
<td>3.3, (43/1298)</td>
<td>ICD-10 codes for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Rodrigues et al 2020*: Single, public, urban, university-affiliated ED in Espirito Santo, Brazil, in 2017.</td>
<td>45.8, 51.4% F</td>
<td>3.5, (85/2434)</td>
<td>ICD-10 codes for MSK back pain.</td>
<td>Low</td>
</tr>
<tr>
<td>Sharma et al 2022*: 3 urban, university-affiliated public EDs in NSW, Australia, between March to May 2020.</td>
<td>51.9±19.4, 51.4% F</td>
<td>19.8, (94/475)</td>
<td>SNOMED CT codes for MSK back pain.</td>
<td>Mod</td>
</tr>
<tr>
<td>Shaw et al 2020*: Single, private, urban, university-affiliated ED in Victoria, Australia, from November 2012 to January 2014.</td>
<td>52.6 (±20.1), 46.9% M</td>
<td>41.6, (416/1000)</td>
<td>All back pain ICD codes (serious and non-serious spinal), MSK spine-related diagnosis=73.7%.</td>
<td>Mod</td>
</tr>
<tr>
<td>Singh et al 2014*: Routinely collected data from hospitals in a Nationwide Emergency Department Sample in the USA, for 2013.</td>
<td>Not reported</td>
<td>13.0, (1 645 200/12 290 000)</td>
<td>All ‘back pain diagnoses’.</td>
<td>Low</td>
</tr>
<tr>
<td>Soto-Padilla et al 2015*: Single, private, urban, orthopaedics and traumatology service in Mexico City, Mexico, from March 2012 to November 2014.</td>
<td>46.5 (±16.5), 53.7% F</td>
<td>3.3, (60/1827)</td>
<td>All ‘low back pain’ presentations.</td>
<td>Mod</td>
</tr>
<tr>
<td>Urrutia et al 2020*: 2 public, university-affiliated EDs in Santiago, Chile, from 1 January 2017 to 31 June 2017.</td>
<td>43.8±16.6, 57.8% F</td>
<td>3.1%, (16/519)</td>
<td>Presenting problem of MSK low back pain.</td>
<td>Mod</td>
</tr>
</tbody>
</table>

*Routinely collected data.
†Gender as reported.
ED, emergency department; ES, Effect Size (proportion); F, female; ICD, International Classification of Diseases; M, male; Mod, moderate; MSK, musculoskeletal; NSW, New South Wales; ROB, risk of bias.
2.4–12.8; two reports) (figure 3B). The shortest hospital LOS for dorsalgia occurred in Norway, Turkey and Chile (<3 days), and the longest in the Czech Republic (12 days) and Hungary (15 days). The shortest hospital LOS for intervertebral disc disorders occurred in the Netherlands and Chile (<3 days), and the longest in Serbia and Hungary (>12 days).

Eleven studies were excluded from the figure due to variation in low back pain definition and/or year of data collection, as well as not being representative country level data. Australian retrospective observational studies indicate a mean hospital LOS ranging from 4 to 6 days9 16 48 for mixed low back and radicular pain, and 2 days (IQR 1–5) 18 for non-specific low back pain only. Similarly, a study on admission for dorsalgia in England14 found a LOS of 2.7 days in 2014. Brazilian studies report a longer hospital LOS of 6.857 to 8.356 days, while earlier US studies suggest an average of 3.711 to 4.8 days.58 A study from Switzerland reports a hospital LOS of 7.841 days, while a study from neighbouring Italy reports a hospital LOS of ~15 days for lumbago and lumbosciatica.

Variation in low back pain definition, year of data collection and representativeness of the sample limit direct comparison between studies.

Admissions per 100 000 population

We analysed admissions for dorsalgia and intervertebral disc disorders during 2018–2019 (table 2). There was high heterogeneity in the admission rates, with a median of 159.1/100 000 population (IQR 82.6–313.8) (figure 4). The lowest admission rates were in Mexico, Costa Rica, Cyprus and Portugal (≤34/100 000), and the highest in Austria, Bulgaria and Republic of Korea (>700/100 000).

Two studies were excluded from the figure due to variation in back pain definition and year of data collection. A retrospective cohort study in Ontario, Canada, found an admission rate of 80.4/100 000 population for non-traumatic spinal conditions in 2013–2014, 59 while a retrospective analysis of admissions (M50–M54 dorsopathies, including dorsalgia and intervertebral disc disorders) in Rio Grande do Sul, Brazil found an admission rate of 255.2/100 000 population during 2008–2016.57

Admissions as a proportion of all hospital admissions

We analysed the percentage of all low back pain admissions for dorsalgia and intervertebral disc disorders from 28 OECD countries from 2018 to 2019, as well as Brazil (2016) 60 and Denmark (2018) 29 (table 2). There was high heterogeneity with back pain admission rates ranging from 0.1% to 4.8% of all hospital admissions for any health condition (figure 5). The median proportion of admitted patients was 0.9% (IQR 0.6–1.5). The lowest percentage of admissions were in Brazil, Portugal, Costa Rica and Mexico (<0.5%) and the highest in Austria, Hungary, Slovak Republic (~3%) and Republic of Korea.
<table>
<thead>
<tr>
<th>ICD code</th>
<th>LBP admissions per 100 000 population</th>
<th>LBP admissions as % of all hospital admissions</th>
<th>Length of stay for LBP admissions (mean days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M54</td>
<td>M51</td>
<td>M54+M51</td>
</tr>
<tr>
<td>Country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia*</td>
<td>143.8</td>
<td>92.1</td>
<td>235.9</td>
</tr>
<tr>
<td>Austria*</td>
<td>426.9</td>
<td>299.9</td>
<td>726.8</td>
</tr>
<tr>
<td>Belgium*</td>
<td>39.1</td>
<td>212.3</td>
<td>251.4</td>
</tr>
<tr>
<td>Brazil (Carregaro et al 2019)*</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Bulgaria†</td>
<td>72.1</td>
<td>685.6</td>
<td>757.7</td>
</tr>
<tr>
<td>Canada*</td>
<td>21.5</td>
<td>30.2</td>
<td>51.7</td>
</tr>
<tr>
<td>Chile*</td>
<td>28.3</td>
<td>55.6</td>
<td>83.9</td>
</tr>
<tr>
<td>Costa Rica*</td>
<td>4.6</td>
<td>16.0</td>
<td>20.6</td>
</tr>
<tr>
<td>Croatia†</td>
<td>86.9</td>
<td>89.1</td>
<td>176.0</td>
</tr>
<tr>
<td>Cyprus†</td>
<td>15.7</td>
<td>17.9</td>
<td>33.6</td>
</tr>
<tr>
<td>Czech Republic*</td>
<td>316.9</td>
<td>153.3</td>
<td>470.2</td>
</tr>
<tr>
<td>Denmark (Statbank 2018)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Finland*</td>
<td>123.0</td>
<td>77.5</td>
<td>200.5</td>
</tr>
<tr>
<td>France*</td>
<td>79.2</td>
<td>77.2</td>
<td>156.4</td>
</tr>
<tr>
<td>Germany*</td>
<td>345.4</td>
<td>260.7</td>
<td>606.1</td>
</tr>
<tr>
<td>Hungary*</td>
<td>125.7</td>
<td>409.8</td>
<td>535.5</td>
</tr>
<tr>
<td>Iceland‡</td>
<td>49.6</td>
<td>23.0</td>
<td>72.6</td>
</tr>
<tr>
<td>Ireland*</td>
<td>48.5</td>
<td>34.1</td>
<td>82.6</td>
</tr>
<tr>
<td>Israel*</td>
<td>38.1</td>
<td>38.1</td>
<td>76.2</td>
</tr>
<tr>
<td>Italy*</td>
<td>8.2</td>
<td>58.0</td>
<td>66.2</td>
</tr>
<tr>
<td>Korea, Republic*</td>
<td>132.0</td>
<td>685.7</td>
<td>817.7</td>
</tr>
<tr>
<td>Latvia*</td>
<td>27.6</td>
<td>83.5</td>
<td>111.1</td>
</tr>
<tr>
<td>Liechtenstein†</td>
<td>65.4</td>
<td>36.6</td>
<td>102.0</td>
</tr>
<tr>
<td>Lithuania*</td>
<td>42.3</td>
<td>413.7</td>
<td>456.0</td>
</tr>
<tr>
<td>Malta§</td>
<td>37.3</td>
<td>52.0</td>
<td>89.3</td>
</tr>
<tr>
<td>Mexico*</td>
<td>8.9</td>
<td>5.4</td>
<td>14.3</td>
</tr>
<tr>
<td>Montenegro†</td>
<td>72.6</td>
<td>241.2</td>
<td>313.8</td>
</tr>
<tr>
<td>Netherlands*</td>
<td>17.8</td>
<td>58.1</td>
<td>75.9</td>
</tr>
<tr>
<td>New Zealand*</td>
<td>58.8</td>
<td>47.3</td>
<td>106.1</td>
</tr>
<tr>
<td>Norway*</td>
<td>64.7</td>
<td>100.9</td>
<td>165.6</td>
</tr>
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<td>Poland*</td>
<td>35.8</td>
<td>124.2</td>
<td>160.0</td>
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<td>Portugal*</td>
<td>4.2</td>
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<td>32.4</td>
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<tr>
<td>Romania†</td>
<td>260.4</td>
<td>312.5</td>
<td>572.9</td>
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<tr>
<td>Serbia§</td>
<td>165.8</td>
<td>83.1</td>
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<td>256.6</td>
<td>552.6</td>
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<td>83.9</td>
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<tr>
<td>UK*</td>
<td>57.1</td>
<td>48.8</td>
<td>105.9</td>
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| Median (IQR) | 58.8 (58.3–123) | 77.5 (38.7–212.3) | 159.1 (82.6–313.8) | 0.9 (0.6–1.5) | 6.2 (4.4–8.6) | 5.4 (4.1–8.4) |

ICD-10 codes: M54=dorsalgia, M51=intervertebral disc disorders.
*OECD 2018 data.
†Eurostat 2018 data.
§OECD 2019 data.
∥Eurostat 2019 data.
ICD, International Classification of Diseases; LBP, low back pain; OECD, Organisation for Economic Co-operation and Development.
Figure 3  (A) Length of stay for dorsalgia (M54), n=39 countries. (B) Length of stay for intervertebral disc disorders (M51), n=39 countries.
Figure 4  Admissions per 100 000 population for ‘dorsalgia’ and ‘intervertebral disc disorders’, 2018–2019, n=39 countries. Data from Cyprus, Malta, Liechtenstein, Croatia, Montenegro, Romania and Bulgaria sourced from Eurostat 2018/2019, all other data sourced from Organisation for Economic Co-operation and Development 2018/2019. ES, Effect Size (proportion).
Four studies were excluded from the analysis due to variation in low back pain definition and/or year of data collection. US data shows that in 2013, ‘back pain’ admissions (a broad category including medical and surgical diagnoses) made up 8.5% of all hospital admissions. In a regional German hospital, admissions for ‘dorsopathies’ accounted for 1.5% of all admissions in 2012, while another German study recently reported an admission rate of 1.9% for ‘dorsalgia’. A study in a tertiary Western Australian hospital found that 7% of all admissions on a specific day in 2016 were due to a back pain issue.

**Risk of bias and quality of the evidence**

Our analysis was based on 19 studies with low risk of bias and 12 with moderate risk of bias (online supplemental table 2). For studies with moderate risk of bias, the main concerns were representativeness of the study population, and an acceptable case definition of musculoskeletal back pain. No included studies had a high risk of bias.

Four government reports scored a final high-quality rating, meaning there were no significant flaws impacting credibility or validity, and they were deemed to have low risk of bias. These reports were retrospective national level data, using comparable ICD-10 codes or diagnostic labels. Two reports were deemed to be of moderate quality, due to variation in back pain definitions or recency (online supplemental table 3).

Overall, included studies had low-to-moderate risk of bias, high heterogeneity and were not generalisable across global health regions. Therefore, we judged the overall quality of evidence to be moderate, and judged that further research could modify our estimate of hospital admissions and LOS for low back pain.

**DISCUSSION**

**Summary of principal findings**

This systematic review provides the first comprehensive synthesis of studies investigating the global prevalence of low back pain admissions and hospital LOS. Estimates of the prevalence of low back pain admissions from ED were highly heterogenous, with an estimated median percentage of 9.6% (IQR 3.3–25.2). The considerably higher admission rate seen in Australia (ranging from 17.1% to 52.9%) is of interest, and has been the focus of a recent hospital-based back pain trial.
Combined admission rates per 100 000 population for dorsalgia and intervertebral disc disorders also ranged widely, with a median of 159.1 per 100 000 people globally (IQR 82.6–313.8). Median hospital LOS for dorsalgia (6.2 days, IQR 4.4–8.6) was typically longer than for intervertebral disc disorders (5.4 days, IQR 4.1–8.4), with high clinical variation between countries.

Overall, the lowest admission rates and shortest hospital LOS (lowest quartile) for low back pain occurred in Chile, Mexico, Israel and the Netherlands (<4.5 days), while the highest occurred in Austria, Germany, Hungary and South Korea (>10 days). Given that these countries all offer publicly-funded healthcare, healthcare system constraints and priorities beyond the funding model alone need to be considered. For example, Korean hospitals commonly offer a course of inpatient therapy combining Western and traditional Korean therapies. In Germany, use of an inpatient rehabilitation model of care for low back pain is common, despite limited evidence of efficacy. However, in the Netherlands gradual de-implementation of non-evidence-based therapies such as prolonged bed rest may explain the difference in hospital LOS compared with central Europe.

Back pain admissions represented ~1% (IQR 0.6–1.5%) of all hospital admissions for any health condition globally. Again, Central European countries as well as South Korea, had higher than median admissions, perhaps reflecting cultural acceptability of hospital admission for back pain. Importantly, a Korean cost of illness study found that low back pain had the highest socioeconomic disease burden for women overall, and for both men and women aged 50–59, with an estimated direct cost of US$6.6 billion in 2015 alone.

Strengths and limitations
A strength of this review is the thorough search strategy, including grey literature searches and contacting international back pain experts. We also did not restrict studies by language, adding to the breadth of included studies.

The issue of methodological and clinical heterogeneity in observational studies is well known and impacts interpretation of meta-analysis. We chose not to provide a pooled estimate of hospital admission rates due to high heterogeneity of included studies. We were also unable to pool mean hospital LOS, as the available data did not provide estimates of SD or other measures of variability. Therefore, we summarised the results as median and IQR. The majority of included studies were from urban, university-affiliated tertiary care centres. Only two included studies, both from New South Wales, Australia, presented a breakdown of admission data from both urban and rural settings.

An inherent limitation in using ICD-10 coding to define back pain is that codes such as dorsalgia (M54) cover broad spinal categories, and include spinal regions other than low back pain. However, use of broader coding allowed comparison between regions and countries.

Included studies reported a median age ranging from 43 to 69 years for people with back pain, who presented to the ED and were admitted as inpatients. Age stratified admission rates would likely reflect higher admission rates in older people presenting to hospital, given the higher rates of ED low back pain presentations for those aged >75 years, and the higher low back pain admission rates seen for cohorts of greater median age.

Unanswered questions and future research directions
Definition of a hospital ‘admission’ impacts the interpretation of results. For example, Shaw et al. report an overall admission rate of 41.6% (416/1000), but 356 of these admissions were to an ED short stay unit, and 60 to other units. Therefore, a clear definition of what constitutes an ‘admission’ would enable fairer comparison of clinical variation.

Considering an inpatient stay for back pain averages approximately a working week, hospitalisation will likely have a significant impact on productivity losses at both personal and societal levels. The relationship between admission rates, LOS and socioeconomic costs should be explored further. High clinical variation in admission rates and LOS for low back pain in upper-income and middle-income countries warrants further research. Community and clinician perceptions around the need for hospital admission, and the capacity of hospitals to accept admissions are possible underlying factors for variation. Primary studies from low-income countries are needed to gain insight into clinical variation at the global level.

CONCLUSION
This is the first systematic review with meta-analysis summarising the global prevalence of hospital admissions and hospital LOS for low back pain, and can be used to guide future research, inform clinicians and assist with healthcare delivery planning. The ability to benchmark admission rates against other countries with similar healthcare systems is essential in informing quality improvement health research, and guiding development of policies regarding clinical pathways. Our results show high global variation in admission rates and LOS for low back pain. The overall quality of the evidence was judged to be moderate; there was relatively sparse data from rural, regional, and low-income country settings, as well as high heterogeneity in the results, which impacts generalisability of the findings to some settings.

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Contributors GCM and CM conceived the research evaluation. AM, DC and HJL completed screening and data extraction. JZ, GCM, AM and CM completed data analysis. All authors contributed to and reviewed the final manuscript. GCM acts as guarantor for this study,

Funding This study has received an HCF Research Grant: Optimising outcomes for patients with back pain by preventing hospital admission. ($A315 000) HCF Health Services Research Grant, HCF Research Foundation. Grant number: N/A.

Competing interests None declared.
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