European Spine Journal
https://doi.org/10.1007/s00586-017-5393-z

REVIEW

# The Global Spine Care Initiative: a systematic review of individual and community-based burden of spinal disorders in rural populations in low- and middle-income communities

**Eric L. Hurwitz[1] · Kristi Randhawa[2,3] · Paola Torres[4] · Hainan Yu[2] · Leslie Verville[2] · Jan Hartvigsen[5] · Pierre Côté[2,3] · Scott Haldeman[6,7,8]**

Received: 11 July 2017 / Revised: 31 October 2017 / Accepted: 6 November 2017


## Abstract

**Purpose** The purpose of this review was to synthesize literature on the burden of spinal disorders in rural communities to inform the Global Spine Care Initiative care pathway and model of care for their application in medically underserved areas and low- and middle-income countries.

**Methods** A systematic review was conducted. Inclusion criteria included all age groups with nonspecific low back pain, neck pain, and associated disorders, nonspecific thoracic spinal pain, musculoskeletal chest pain, radiculopathy, or spinal stenosis. Study designs included observational study design (case-control, cross-sectional, cohort, ecologic, qualitative) or review or meta-analysis. After study selection, studies with low or moderate risk of bias were qualitatively synthesized.

**Results** Of 1150 potentially relevant articles, 43 were eligible and included in the review. All 10 low and 18 moderate risk of bias studies were cross-sectional, 14 of which included rural residents only. All studies included estimates of low back pain prevalence, one included neck pain and one reported estimates for spinal disorders other than back or neck pain. The prevalence of low back pain appears greater among females and in those with less education, psychological factors (stress, anxiety, depression), and alcohol consumers. The literature is inconsistent as to whether back pain is more common in rural or urban areas. High risk of bias in many studies, lack of data on disability and other burden measures and few studies on conditions other than back and neck pain preclude a more comprehensive assessment of the individual and community-based burden of spinal disorders in less-developed communities.

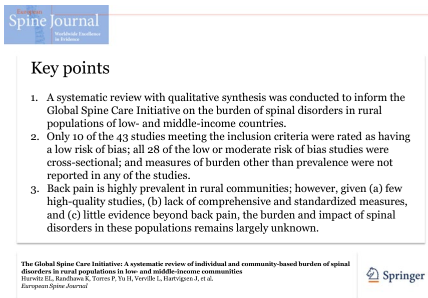
**Conclusion** We identified few high-quality studies that may inform patients, providers, policymakers, and other stakeholders about spinal disorders and their burden on individuals and communities in most rural places of the developing world. These findings should be a call to action to devote resources for high-quality research to fill these knowledge gaps in medically underserved areas and low and middle-income countries.

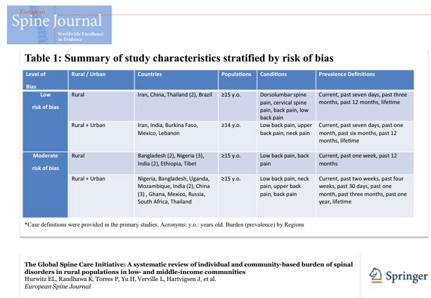
**Electronic supplementary material** The online version of this article (https://doi.org/10.1007/s00586-017-5393-z) contains supplementary material, which is available to authorized users.

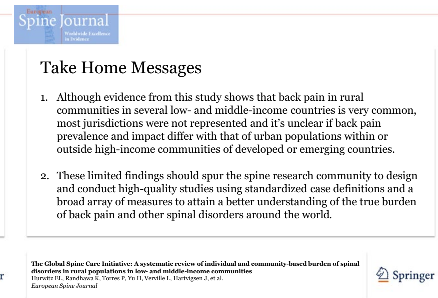
Extended author information available on the last page of the article

Published online: 27 December 2017

**Graphical abstract** These slides can be retrieved under Electronic Supplementary Material.




**Keywords** Spine · Neck pain · Back pain · Global burden of disease

## Introduction

Spinal disorders place a significant burden on global health [1, 2]. Spinal disorders are associated with decreased ability to perform daily activities [3], decreased work productivity, and increased healthcare utilization [4–7]. Spinal disorders are further associated with an increased risk of long-term disability [5, 8].

Back and neck pain are the number one cause of global years lived with disability (YLDs) and are the fourth leading cause of disability-adjusted life years (DALYs), affecting approximately one billion adults worldwide [9, 10]. Spinal disorders are a major cause of morbidity in high-income countries [2]; however, the prevalence of spinal disorders is an increasing concern in medically underserved areas and low- and middle-income countries [11]. Moreover, with an aging demographic worldwide, the burden of spinal pain is projected to continue to increase [2].

The mandate of the Global Spine Care Initiative (GSCI) is to develop evidence-informed, practical, and sustainable, spine healthcare models for communities and populations around the world with various levels of resources [12]. The current literature on the burden of spinal disorders in small communities and rural populations in low- and middle-income countries is limited. The objective of this systematic review was to assess the burden of spinal disorders and factors associated with spinal disorders in rural populations to inform the GSCI care pathway and model of care for their application in medically underserved areas and low- and middle-income countries. As a secondary objective, we assessed the burden of spinal disorders in rural populations compared to urban populations.

## Methods

### Literature search

A search strategy was developed in consultation with a health sciences librarian and reviewed by a second librarian using the Peer Review of Electronic Search Strategies Checklist [13]. The search strategy combined MeSH (Medical Subject Heading) terms and text (title and abstract) words for three major components: (1) spinal disorders (pain, disease, and injuries); (2) prevalence or burden; and (3) low literacy or developing countries. Low literacy was included as a text term to capture any articles assessing burden using tools developed for populations with low literacy or health literacy which may be more prominent in rural or underserved populations. We limited the search to English language and studies published since 2000. We ran the MEDLINE search in June 2015 (see Online Resource Appendix 1), then adapted the MeSH terms for other databases and also ran the search in EMBASE, PsycINFO, and AMED (Allied and Complementary Medicine). We used EndNote (Version X7, Clarivate Analytics, Philadelphia, PA, USA) to create a bibliographic database to manage search results.

### Registration of review

This review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on October 30th 2015 (CRD42015027450).

### Study characteristics

Eligibility criteria for inclusion included: (1) English language; (2) study population including all age groups with nonspecific low back pain (LBP), neck pain and associated disorders, nonspecific thoracic spinal pain, musculoskeletal chest pain, radiculopathy, or spinal stenosis; (3) observational study design (case-control, cross-sectional, cohort, ecologic) or review or meta-analysis; and (4) reported a measure of disease frequency (incidence, prevalence), association (risk ratio, odds ratio), or impact (attributable proportion, individual, community or environmental burden); and (5) a rural source population. We define a rural population as those living outside metropolitan regions with urban centres and often having: (1) higher unemployment and underemployment rates; (2) a lower population density with higher percentages of poor, uninsured, and underinsured residents; (3) longer travel distances to workplace and needed healthcare services; and (4) fewer healthcare providers and healthcare facilities with limited scopes of service. Specifically, rural populations live or work in agricultural areas, villages or remote areas [14].

We excluded studies with the following characteristics: (1) spinal cord injuries and diseases; (2) non-spinal osteoarthritis and rheumatoid arthritis and other disorders not specific to the spine; and (3) experimental study design.

### Study selection

Random pairs of independent reviewers screened titles and abstracts in Phase I for relevant and possibly relevant citations based on the inclusion and exclusion criteria. Possibly relevant citations from Phase I were screened independently in Phase II. Reviewers met to resolve disagreements and reach consensus. A third reviewer independently screened the citation and determined eligibility if consensus could not be reached. Authors were contacted if additional information was necessary to determine eligibility.

### Assessment of risk of bias

Random pairs of independent reviewers critically appraised the internal and external validity of eligible studies using a modified risk of bias tool for prevalence studies [15] (see Online Resource Appendix 2), which consists of ten items and was modified by removing the first question specific to examining the burden in national populations. Reviewers reached consensus through discussion. An independent third reviewer was used to resolve disagreements if consensus could not be reached. We contacted authors when additional information was needed to complete the critical appraisal.

### Data extraction and synthesis of results

One reviewer extracted data from low and moderate risk of bias studies into a data extraction form modeled upon the STROBE Statement checklist for cross-sectional studies (see Online Resource Appendix 3) [16, 17]. All data on disease frequency based on standard epidemiological definitions (incidence, prevalence), association (risk ratio, odds ratio), and impact (attributable proportion, individual, community or environmental burden) were extracted into an evidence table. This extracted data included the relevant numerators, denominators and other data (e.g., time periods, including current prevalence, 3-months prevalence, 12-months prevalence, etc.), as well as any measures of association (either crude and/or adjusted, based on what was reported in each paper). A second reviewer independently checked the extracted data. A meta-analysis was not performed because of study bias heterogeneity. We performed a qualitative synthesis of findings according to principles of best-evidence synthesis [18]. When reporting the summary of evidence, evidence was deemed inconsistent if available studies disagreed on the prevalence of spinal disorders, or the presence or absence of an association.

### Statistical analyses

We computed the inter-rater reliability for the screening of articles using the kappa coefficient ($\kappa$) and 95% confidence intervals (CI). We computed the percent agreement for classifying studies as low or moderate risk of bias following independent critical appraisal.

## Results

### Study selection

Our search identified 2155 citations (see Online Resource Figure 1); 43 met our eligibility criteria and were critically appraised. Reasons for exclusion of 109 possibly relevant articles included: not a rural population, no relevant outcomes, or inability to assess prevalence. The inter-rater agreement for the screening of articles was $k = 0.88$ (95% CI 0.81 to 0.95). The inter-rater agreement for the independent appraisal was 72% (31/43). Disagreements were resolved through discussion between assigned reviewers.

### Methodological quality

We critically appraised 43 studies; of those 10 studies (23%) had a low risk of bias (see Online Resource Table 1); 18 studies (42%) had a moderate risk of bias (see Online Resource Table 2); and 15 studies (35%) had a high risk of bias (see Online Resource Table 3) [53–67].

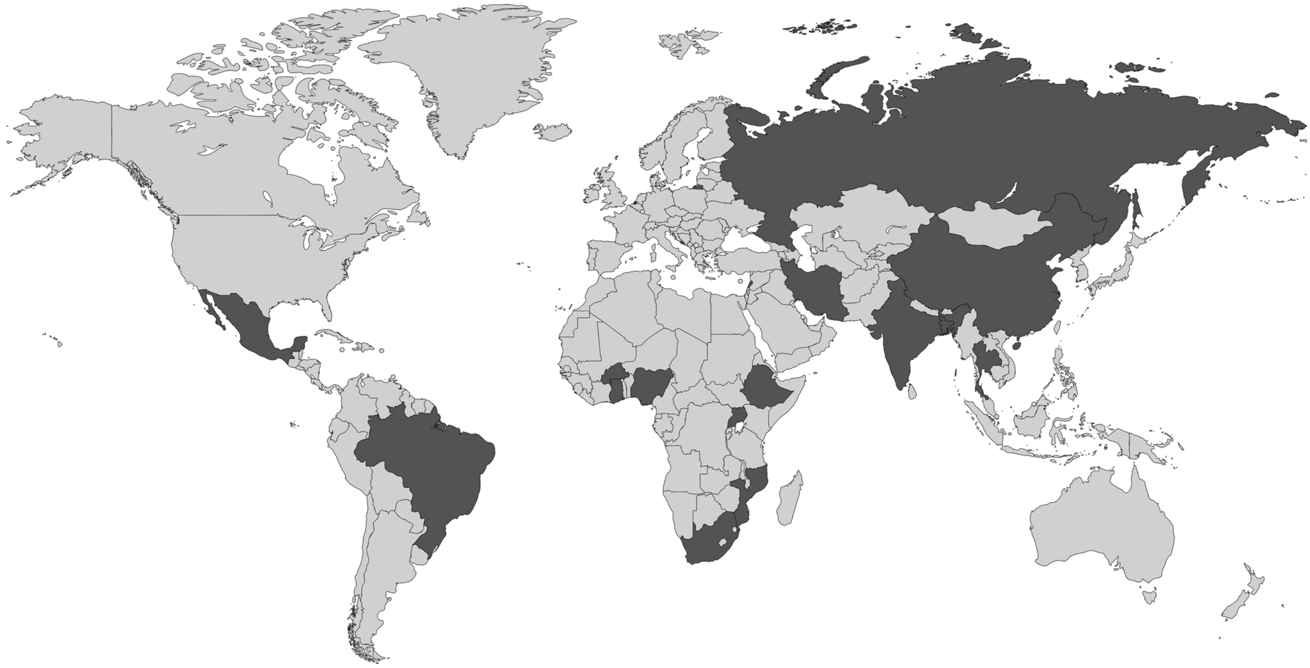


**Fig. 1** Map of regions studied in low and moderate risk of bias studies

**Table 1** Summary of study characteristics stratified by risk of bias

| Level of bias | Rural/urban | Countries | Populations | Conditions | Prevalence definitions |
|---|---|---|---|---|---|
| Low risk of bias | Rural | Iran, China, Thailand (2), Brazil | ≥ 15 y.o. | Dorsolumbar spine pain, cervical spine pain, back pain, low back pain | Current, past 7 days, past 3 months, past 12 months, lifetime |
| | Rural + urban | Iran, India, Burkina Faso, Mexico, Lebanon | ≥ 14 y.o. | Low back pain, upper back pain, neck pain | Current, past 7 days, past 1 month, past 6 months, past 12 months, lifetime |
| Moderate risk of bias | Rural | Bangladesh (2), Nigeria (3), India (2), Ethiopia, Tibet | ≥ 15 y.o. | Low back pain, back pain | Current, past 1 week, past 12 months |
| | Rural + urban | Nigeria, Bangladesh, Uganda, Mozambique, India (2), China (3), Ghana, Mexico, Russia, South Africa, Thailand | ≥ 15 y.o. | Low back pain, neck pain, upper back pain, back pain | Current, past 2 weeks, past 4 weeks, past 30 days, past 1 month, past 3 months, past 1 year, lifetime |

Burden (prevalence) by regions

Case definitions were provided in the primary studies. *y.o.* years old

## Summary of evidence

### Study characteristics

All studies reported prevalence; none of the studies reported on other burden variables. All ten low-risk bias studies were cross-sectional and were conducted in Asia, Africa, Central America, and South America (Fig. 1). Five of the studies represented rural populations [34–38], while the remaining five studies reported on both urban and rural populations [39–43]. Six studies assessed LBP [34, 36, 38, 39, 41, 43], four assessed back pain [35, 37, 40, 42], one assessed neck pain [34], and two studies assessed other conditions such as spondylosis and sciatica [34, 42] (Table 1).

All moderate risk of bias studies were cross-sectional studies. These studies were conducted in Asia, Africa, Central America and Russia (Fig. 1). Nine of the studies represented rural populations, while the remaining nine studies represented both rural and urban populations. Fourteen studies assessed LBP [44–57], three assessed back pain [58–60], eight assessed neck pain [45, 47, 50, 52, 56, 57, 60, 61], four assessed upper back pain [45, 47, 50, 56], and two assessed

**Table 2** Measures of prevalence by region

| Region | Condition | Prevalence (rural) | Prevalence (urban) | Prevalence (female) | Prevalence (male) |
|---|---|---|---|---|---|
| Southeast Asia | Neck pain | 3 months: 3.0% [36] | | | |
| | Low back pain | Current: 49.12% [38]<br>3 months: 52.9% [36]<br>12 months: 56.18% [38]<br>Lifetime: 77.39% [38] | > 1 day: 3.9–7.2% (rural and urban mixed) [53] | Current: 56.83% [38]<br>12 months: 55.97% [38]<br>Lifetime: 53.88% [38] | Current: 43.1% [38]<br>12 months: 44.03% [38]<br>Lifetime: 46.12% [38] |
| South Asia | Neck pain | Current: 6.5–35.4% [45, 50, 57, 61] | Current: 8.3–10.2% [57] | | |
| | Low back pain | Current: 4.54–68% [39, 45, 50, 57]<br>12 months: 6.11% [48] | Current: 3.84–18.4% [39, 57] | Current: 9.07% [39] | Current: 7.75% [39] |
| | Upper back pain | Current: 7.9–44% [45, 50] | | | |
| | Backache/back pain | Current: 30.6% [58] | Current: 15.3% [58]<br>Previous month: 39.1% (mixed urban and rural) [59] | | |
| | Lumbar spondylosis | Current: 5.0% [57] | Current: 2.0–2.3% [57] | | |
| | Cervical spondylosis | Current: 2.6% [57] | Current: 1.3–2.3% [57] | | |
| East Asia | Back pain | 3 months: 38.4% [35] | 1 month: 22% [59] (rural and urban mixed) | 3 months: 40.7% [35] | 3 months: 36.3% [35] |
| | Low back pain | Current: 34.1% [49]<br>12 months: 41.9% [49]<br>Lifetime: 12.1% [54] | Lifetime: 10.8% [54] | Lifetime: 11.9–14.4% [54] | Lifetime: 9.7–9.8% [54] |
| | Pain in lower lumbar region | Unclear period: 97% [49] | | | |
| West Asia | Musculoskeletal complaints | 7 days: 66.6% [34] | | 7 days: 72.4% [34] | 7 days: 51.6% [34] |
| | Cervical spondylosis | Unclear period: 2.2% [34] | | | |
| | Low back pain | Unclear period: 23.4% [34] | Current: 40.2% [41]<br>1 month: 55.9% [41]<br>6 months: 59.4% [41]<br>12 months: 76.2% [41]<br>(rural and urban mixed) | | |
| | Sciatica | Unclear period: 0.06% [34] | | | |
| | Seronegative spondyloarthropathies | Unclear period: 1.1% [34] | | | |

**Table 2** (continued)

| Region | Condition | Prevalence (rural) | Prevalence (urban) | Prevalence (female) | Prevalence (male) |
|---|---|---|---|---|---|
| Africa | Neck pain | 7 days: 5% [60]<br>12 months: 6.2% [47] | 2 weeks: 24.5% [56] (rural and urban mixed) | 7 days: 6.2% [60] | 7 days: 3.8% [60] |
| | Shoulder pain | | 2 weeks: 42.1% [56] (rural and urban mixed) | | |
| | Upper back pain | 12 months: 1.2% [47] | 2 weeks: 35.7% [56] (rural and urban mixed) | | |
| | Low back pain | Current: 67.1% [46]<br>3 months: 38.5% [46]<br>12 months: 46–47% [44, 47] | 2 weeks: 37.8% [56] (rural and urban mixed)<br>1 month: 12% [55] (rural and urban mixed)<br>3 months: 41.8% [51]<br>12 months: 13.5% [55] (rural and urban mixed)<br>Lifetime: 28% [55] (rural and urban mixed) | Current: 59.55% [46]<br>12 months: 64.0% [44]<br>Unclear period: 16% [55] | Current: 77.27% [46]<br>12 months: 36.7% [44]<br>Unclear period: 11% [55] |
| | Back pain | 7 days: 16.7% [60] | 1 month: 38.5–40.5% [59] (rural and urban mixed) | 7 days: 22.7% [60] | 7 days: 10.7% [60] |
| South America | Back pain | Current: 39.3% [37] | | | |
| Central America | Back pain | 7 days: 2.2% [42] | 7 days: 7.5% (urban) [42]<br>1 month: 35.5% [59] (rural and urban mixed) | | |
| | Ankylosing spondylitis | | 7 days: 0.04% [42] | | |
| | Spine pain | | 7 days: 13.8% [42] | | |
| Russia | Back pain | | 1 month: 55.7% [59] (rural and urban mixed) | | |

spondylosis [52, 57]. Measures of prevalence by region is shown in Table 2 and evidence tables with inclusion criteria and detailed descriptions of the source and study populations from the low and moderate risk of bias rural and rural and urban studies are displayed in Online Tables 4 through 7 (see Online Resource Document). Studies were characterized as studying a rural population if the term rural was used in the study or based on the study location, if the location qualified as rural based on our definitions.

## Prevalence and factors associated with spinal disorders in rural populations

### Low risk of bias studies

Different time periods were utilised to describe spinal pain prevalence in low risk of bias studies including: current pain, pain in the previous 7 days, 3 or 12 months, or lifetime prevalence. Two studies provided consistent case definitions of spinal disorders; three did not [34, 38]. Point prevalence of back pain among rural Brazilian adults (≥ 18 years old) was 39.3% [37]. Prevalence of LBP in the previous week was reported by 23.4% (95% CI 17.8 to 28.9) of rural Iranian villagers 15 years of age and older [34]. Liu et al., reported the 3-months prevalence of back pain in Chinese villagers as 38.4% [35]. Moreover, 3-months prevalence of LBP among 15–60 year-old Thai rubber tappers was 52.9% (95% CI 48.1

to 57.7) [36]. Finally, point prevalence of LBP in rice farmers from Thailand (29–72 year olds) was 49.1%; 12-months prevalence was 56.2% and lifetime prevalence was 77.4% [38]. Further, Meksawi et al., reported the 3-months prevalence of neck pain in rural Thailand as 3.0% (95% CI 1.6 to 5.2) [36]; and finally, Davatchi et al., reported prevalence in the previous week of cervical spondylosis 2.2% (95% CI 0.66 to 3.8), sciatica 0.06% (95% CI 0.006 to 0.67), and seronegative spondyloarthropathies 1.10% (95% CI 0.29 to 41.6) in rural Iran [34].

### Factors associated with back pain

#### Demographics/socioeconomic factors

Evidence from low risk of bias studies suggested that back pain may increase with age. Point prevalence of back pain increased with age from 18 years of age and was highest among those greater than 50 years old [prevalence ratio (PR) 1.86 (95% CI 1.43 to 2.43)] in a rural Brazilian population [37], and 15.9% among 15–24 year olds to 48.3% among 75–84 year olds in a rural Chinese village population [35]. However, in a third study, looking at the 12-months prevalence of LBP in rice farmers in Thailand, no statistically significant associations were found between age and LBP, but prevalence was highest in the youngest age group 25–34 [38]. Females more frequently reported back pain (40.7%) compared to males (36.3%) [35] among rural Chinese villagers. In addition, point, 12-months, and lifetime prevalence were higher in rural Thai females than males (56.8 vs 43.2; 56.0 vs 44.0; 53.9 vs 46.1%), respectively [38]. However, no significant gender difference was identified among Brazilian villagers [37]. Point prevalence of back pain was higher among those without a completed elementary education 42.5% [PR 1.50 (95% CI 1.06 to 2.14)] [37] in Brazil; and primary school education (primary school: OR 2.4 (95% CI 1.04 to 5.53; reference: high school) was associated with 3-months prevalence of LBP in Thailand [36]. Social support [mild: OR 3.29 (95% CI 1.44 to 7.52); reference: high], and average income per month [less than 20,000 baht: OR 2.08 (95% CI 1.07 to 4.05)] were associated with 3-months prevalence of LBP in Thailand [36].

#### Workplace factors

Several ergonomic factors for rubber tappers were associated with LBP in rural Thailand [36]. Chinese rice farmers experienced increased LBP associated with slouched sitting (56.2%), forward bending (70.8%) and lifting (83.2%) [38]. Finally, a single accident or injury was responsible for 51.8% of back pain cases, while accumulated injury from repeated activities was reported as the cause for the remaining cases (48.2%) [38].

#### Psychological factors

More rural Chinese residents reporting stress "regularly" (53.9%) experienced back pain than those who reported stress "sometimes" (33.4%) or never/rarely (31/3%) [35]. Moreover, those reporting familial stress (63.6%) reported back pain more often than those without (38.1%) [35].

#### Health behaviours

Alcohol consumption was associated with back pain, with current (41.2%) and former (51.3%) drinkers reporting back pain more often than those abstaining (36.5%) from alcohol [35]. Smoking was associated with back pain, with smokers (41.9%) reporting back pain more frequently than non-smokers (36.1%) in rural China [35], and back pain prevalence reported as greater among smokers than non-smokers [PR 1.39 (95% CI 1.15 to 1.68)] in rural Brazil [37]. Evidence suggests that increased physical activity was associated with less back pain as rural Brazilians engaging in physical activity (35%) reported back pain less frequently than those not engaging in physical activity (40.5%) [PR 1.16 (95% CI 0.93 to 1.45)]. Finally, a normal body mass index (BMI) (36.7%) was associated with less back pain than a BMI consistent with being overweight or obese (43.3%) [PR 1.18 (95% CI 0.99 to 1.41)] [37].

### Moderate risk of bias studies

Different time points were utilised in moderate risk of bias studies to describe spinal pain prevalence including: current pain, pain in the previous 7 days, or pain in the past 12 months. Two studies provided consistent case definitions of spinal disorders [46, 35]; seven did not. Point prevalence of LBP ranged from 11.9% in Indian residents (> 15 years) [45]; 34.1% (95% CI 27.9 to 40.3%) among rural Tibetans [49]; to 68% among weavers in India [50]. El-Sayed et al. reported a 1-week prevalence of back pain as 16.7% among Ethiopian parents [60]. Twelve-months prevalence of LBP ranged from 6.11% among rural Bangladesh residents; 47% among Nigerian adults (≥ 18 years) [47]; 41.9% (95% CI 35.5 to 48.3%) among rural Tibetans [49]; 46% among Nigerian hospital staff [44]; to 67.1% among Nigerian farmers [46]. Further, the point prevalence of neck pain among adults (> 15 years) in India was 6.5% [45] and 35.4% among Indian weavers [50]. The 7-day prevalence of neck pain was 5% among Ethiopian parents [60]; and the 12-months neck pain prevalence was 6.2% among Nigerian adults (≥ 18 years) [47]. Hassan et al. reported the prevalence of myofascial neck pain among Bangladeshi villagers as 0.48% [61].

### Factors associated with back pain

#### Demographics/socioeconomic factors

There is inconsistent evidence from moderate risk of bias studies suggesting that back pain increased with age. The prevalence of back pain with the previous 12 months increased from 31.7% among those < 30 years of age, to a high of 90.6% among those 41–50 years, and then decreased to 76.2% in 51–60 year olds among Nigerian farmers [46]. Further, 7-day prevalence of back pain increased with age from 11.4% among those < 20 years to 20.3% among 30–39 year olds, and then decreased to 14.3% in those > 39 years, among Ethiopian parents [60]. However, Omokhodion et al. reported no statistically significant association between LBP and age among Nigerian hospital staff [44]. There is inconsistent evidence for the relationship between gender and BP. Upper back pain point prevalence was greater in females (9.5%) compared to males (3.4%) among villagers in India [45]; 7-day prevalence of back pain was higher for female parents (22.7%) compared to male parents (10.7%) [60]; and 12-months prevalence of back pain was greater in female hospital staff (64.0%) than males (36.7%) [44] and in a rural Bangladesh population [OR 2.26 (95% CI 1.60 to 3.17)] [48]. However, among Nigerian farmers, 12-months prevalence of LBP was greater in males (77.3%) than females (59.6%) [46]. No relationship between education and back pain was identified among Nigerian farmers [46].

#### Workplace factors

There was inconsistent evidence that occupational tenure is associated with back pain. In one Nigerian study, those having practiced farming longer (5–10 years) were more likely to report LBP within the previous 12 months [46]; however, there was no significant association between number of years employed in a Nigerian hospital and back pain [44].

#### Psychological factors

Evidence suggests that there was an association between back pain and depression [OR 3.44 (95% CI 2.37 to 5.00)], anxiety [OR 2.88 (95% CI 1.98 to 4.20)], or post-traumatic stress (PTS) [OR 2.89 (95% CI 1.78 to 4.69)] among Ethiopian parents [60].

#### Health behaviours

There was not a statistically significant association (OR not reported and cannot be calculated based on raw data), between back pain and smoking status among Nigerian hospital workers [44].

### Factors associated with neck pain

Consistent evidence suggested that gender was associated with neck pain. The prevalence of neck pain was higher in female (6.2%) than male Ethiopian parents (3.8%) [60]. Similarly, the neck pain point prevalence was higher among female (9.5%) than male village residents in India (3.4%) [45]. Finally, neck pain prevalence was reported to increase with age: < 20 years (2.9%), 20–29 years (4.7%), 30–39 years (5.7%), and > 39 years (6.4%) [60].

## Differences in prevalence and factors associated with spinal disorders in urban and rural populations

### Low risk of bias studies

Different time points were utilised in low risk of bias studies to describe spinal pain prevalence including: current pain, pain in the previous month, 6 or 12 months, or lifetime prevalence. All five studies investigated BP. Of those, two studies provided consistent case definitions [41, 42]. There was inconsistent evidence relating to prevalence of spinal disorders in urban versus rural populations. The odds of reporting current back pain was lower among rural pregnant females compared to their urban counterparts OR 0.46 [95% CI 0.29 to 0.71] [41]. Similarly, back pain point prevalence was lower among rural residents of Mexico [2.2% (95% CI 1.8 to 2.7)] than urban residents [7.5% (95% CI 6.8 to 8.3)] [42]. However, in contrast, rural residents of Lebanon reported a 12-months prevalence of lumbar pain that was greater among rural residents (47.0%) than urban residents (43.4%) [43]. Finally, no difference between urban and rural residents was identified in a study of low backache among adults in Burkina Faso [40] and in rural Indian residents [39].

### Factors associated with back pain

#### Demographic/socioeconomic factors

There was inconsistent evidence from low risk of bias studies regarding the association between back pain and age. The 12-months prevalence ratio of back pain was greater in all other age groups [25–34: 1.6 (95% CI 1.3; 2.0); 35–44: 2.6 (95% CI 2.0 to 3.3); 45–54: 3.2 (95 CI 2.4 to 4.3); ≥ 65 4.7 (95% CI 3.6 to 6.1)] compared to those 18–24 years residing in Burkina Faso [40]. However, in an Iranian population of pregnant women, there was an increased frequency of LBP associated with younger age [OR 1.19 (95% CI 1.02 to 1.38)] [41]. There was a relationship between gender and back pain, with the point prevalence greater among females

(90.7 per 1000) than males (77.5 per 1000) in India [39]; and the 12-months prevalence greater among females [PR 1.42 (95% CI 1.21 to 1.66)] among residents of Burkina Faso [40]. Education was associated with back pain prevalence with adults living in Burkina Faso with no formal education [PR 25 (95% CI 22.2, 28.1)] reporting greater back pain than those with some formal education [18 (95% CI 14.7 to 21.7)] [40]. Further, with the second poorest [PR 1.19 (95% CI 1.02 to 1.39)] and the wealthiest groups [PR 1.50 (95% CI 1.06 to 2.11)] reporting greater back pain compared to those living in extreme poverty [40]. In one study of pregnant women of Northern Iran, associations were found between LBP during pregnancy and (a) previous history of LBP [OR 2.8 (95% CI 2.1 to 3.6)] and (b) history of LBP in previous pregnancy [OR 3.1 (95% CI 2.0 to 4.7)] [41]. In the same population, prolonged standing and rest were reported by the woman to be aggravating and relieving factors for LBP (76.3 and 87.7% of women, respectively) [41]. Additionally, women who had help (a servant) with housework activities were less likely to report LBP [OR 1.46 (95% CI 1.14 to 1.87)] [41].

#### Health behaviours

Women in Iran who considered themselves healthy according to the general health questionnaire were less likely to experience LBP within the previous week [OR 0.65 (95% CI 0.51 to 0.83)] [41].

### Moderate risk of bias studies

Similarly, various time points were used in the moderate risk of bias studies to describe spinal pain prevalence: point prevalence, previous month, previous 3 months, previous year, and lifetime. Three studies provided consistent case definitions [52, 56, 57]; six did not. There was inconsistent evidence relating to prevalence of spinal disorders in urban versus rural populations. The odds of reporting chronic LBP was higher among rural population in adults in Jilin Province, China [OR 1.11 (95% CI 1.01 to 1.22)] [54] and current backache in rural areas of Chandigarh, India [OR 2.44 (95% CI 1.23 to 4.81)] [58]. One study suggests that the percent prevalence of lumbar complaints was higher in rural residents than urban residents in Shantou, China [52]. In contrast, nonspecific LBP was higher in urban slum populations in Bangladesh [9.9% (95% CI 8.4 to 11.7)], compared to rural [6.6% (95% CI 5.7 to 7.7)], and urban affluent [9.2% (95% CI 7.7 to 11.0)] populations [57]. No difference in LBP of various prevalence periods was found between urban and rural dwellers in Nigeria, Bangladesh, Uganda, Mozambique, and Thailand [51, 53, 65–67]. Similarly, no difference in back pain within the previous month in urban and rural inhabitants of a mix of low- and middle-income populations was found [59].

Similarly, inconsistent evidence was found for the prevalence of neck pain. In inhabitants in three localities in Bangladesh, point prevalence of neck pain was similar in urban and rural inhabitants [57]. Conversely, Zeng et al., found that in a population from Shantou, China, neck pain was more prevalent among individuals living in urban communities; however, no statistical analysis was performed [52]. There were no differences between urban and rural populations for the prevalence of ankylosing spondylosis in China [52], or prevalence of current lumbar or cervical spondylosis in Bangladesh [57].

### Factors associated with back pain

#### Demographic/socioeconomic factors

There was inconsistent evidence from moderate risk of bias studies regarding the association between spinal pain and age. Chronic back pain was more prevalent in individuals over 45 compared to those age 18–44 in combined urban and rural populations [OR 2.33 (95% CI 2.08 to 2.61)] [54]. In contrast, in a mix of low- and middle-income communities, no association between back pain prevalence in the previous month and age was found [59]. In a mix of low- and middle-income countries, back pain was more prevalent in females compared to males [OR 1.6 (95% CI 1.4 to 1.8)] [59]. Similarly, in a population of rural and urban school children, the odds of having LBP of greater than 1 day was higher among females [OR 2.20 (95% CI 1.53 to 3.17)] [56]. An association was found between having less than completed university or college education and back pain in the previous month in a mix of low- and middle-income countries [completed secondary/high OR 1.4 (95% CI 1.1 to 1.7); completed primary OR 1.6 (95% CI 1.1 to 2.2); no primary completed OR 2.0 (95% CI 1.5 to 2.5)] [59]. Prevalence of back pain in the previous month was associated with being in the lowest or poorest wealth status compared with being in the highest-wealthiest [OR 1.4 (95% CI 1.1 to 1.7)] [59]. There was inconsistent evidence that marital status was associated with BP. In a mix of low- and middle-income countries, back pain in the previous month was more prevalent among those who were married/cohabiting [OR 1.6 (95% CI 1.1 to 2.2)] and those who were separated, divorced, or widowed [OR 1.5 (95% CI 1.1 to 2.2)] compared to those who were never married [59]. In contrast, LBP greater than one day was lower in males who were married [OR 0.72 (95% CI 0.60 to 0.85)] and married females [OR 0.78 (95% CI 0.68 to 0.90)] [53]. In Jilin Province, China, not having medical insurance was also associated with chronic LBP [OR 1.54 (95% CI 1.26 to 1.87) [54].

#### Health behaviours

There was inconsistent evidence that back pain was associated with smoking. In a population from Jilin Province, China, being a current or former smoker was associated with a higher prevalence of chronic LBP [current smoker OR 1.31 (95% CI 1.16 to 1.49); former smoker OR 1.30 (95% CI 1.09 to 1.59)] [54]. In males from Thailand, smoking was associated with LBP of > 1 day when compared to non-regular smokers [OR 1.31 (95% CI 1.11 to 1.53)]; however, there was no association in females [53]. In a mix of low- and middle-income countries, back pain in the previous month was not associated with being a current smoker compared to not being a current smoker [59]. The majority of the evidence found an association between drinking alcohol and BP. The prevalence of back pain in the previous month was associated with being a current drinker in a mix of low- and middle-income countries [59]. However, in Thailand, there was only an association between being a female regular drinker and LBP [OR 1.37 (95% CI 1.10 to 1.70)]; no association was found for males [53]. Overweight and obesity were associated with LBP. In Thailand, obesity was associated with LBP in females [OR 1.58 (95% CI 1.35 to 1.85)] and males [OR 1.21 (95% CI 1.03 to 1.41)] [53]. Overweight was associated with LBP in only females from the same population [OR 1.28 (95% CI 1.07, 1.52)] [53]. In school children from Kampala, Uganda and Maputo, Mozambique, LBP was more prevalent in urban children walking longer periods of time [OR 2.67 (95% CI 1.38 to 5.16)] [56], and urban and rural children walking > 30 min compared to ≤ 30 min [OR 4.76 (95% CI 1.61 to 14.28)]. Occurrence of LBP was associated with sitting 2–4 h every evening compared to less than 2 h in children from Uganda (OR not reported and cannot be calculated based on raw data) [56]. Furthermore, in children from Mozambique, time watching tv, and usual sports activity were not associated with LBP.

### Factors associated with neck pain

#### Demographic/socioeconomic factors

In a population from Shantou, China, neck pain was more prevalent in females compared to males in both urban and rural populations; however, the difference may not be statistically significant as no statistical analysis was done [52].

## Discussion

This is the first known systematic review to report on the prevalence of spinal disorders in rural/small populations in low- and middle-income countries. Our review shows that spinal disorders (as defined by the literature primarily as LBP and neck pain to a lesser extent) are common in various populations around the world. The results of our included studies indicate that back pain is more prevalent among females [35, 48–40, 44, 45, 56, 59, 60], increases with age [35, 37, 40, 46, 54, 60], and that less education [21, 44], psychological factors [35, 60], and regular alcohol consumption [35, 53, 59] are associated with prevalence of back pain. Heterogeneous data preclude definitive inferences about whether back pain is more prevalent in rural or urban populations. Estimates of neck pain prevalence are lower than those of back pain in both rural and urban areas, but the precise magnitude of these differences is uncertain due to the small number of studies and large variability in estimates. Similar to back pain, neck pain was also associated with female gender [45, 52, 60]. Our findings are roughly consistent with a recent systematic review focusing on chronic pain in low- and middle-income countries, showing an overall prevalence of LBP of 21% (95% CI 15 to 27%) in general population samples and higher prevalence in the elderly [28% (95% CI 16 to 42%)] and in workers [52% (95% CI 26 to 77%)] [62]. Our findings highlight the limitations of the burden literature (e.g., focus on prevalence and not on other burden measures, lack of standard case definitions, low quality of many studies, lack of prospective designs) that should be considered by researchers in the field so that future burden studies will be more useful for public health and healthcare. We did identify some factors, such as low education, psychological distress, and alcohol consumption that may be important contributors to back pain burden that would be important to study further. For example, given that prevalence appears higher in those with less education, we need to make sure that outcome data are valid and reliable in populations with relatively lower health literacy, and obtain a better understanding of the influence of education and health literacy on risk, prognosis, and management of spinal disorders.

### Strengths

Our health sciences librarian carried out a broad and methodologically rigorous literature search, which was reviewed by a second librarian. We outlined detailed inclusion/exclusion criteria to identify relevant studies. Pairs of independent trained reviewers screened and critically appraised the literature. We used a critical appraisal tool developed by Hoy et al. to determine risk of bias in cross-sectional studies [2]. Additionally, we used the STROBE statement to standardize extraction of data from the studies [17].

### Limitations

Fifteen of the 43 studies (78%) that were deemed relevant in our screening were not included in the qualitative synthesis due to a high risk of bias. Common shortcomings were a lack of a clear case definition, non-response, non-random sample selection, and absence of a reliable and valid tool to collect data affecting the validity of study findings (see Online Resource Tables 1 and 2). The cross-sectional design of all studies precludes causal inferences between putative risk factors for spinal disorders as well as prognostic factors for persons with these disorders. The dearth of prospective studies, studies focused on spinal disorders other than LBP, and measures of burden other than prevalence are major omissions in the literature. All ten low risk of bias studies measured LBP prevalence, and of these, only one study measured neck pain [34] and one measured other spinal disorders [39]. We only included studies published in English, which may have resulted in relevant studies in other languages being excluded. Previous systematic reviews of clinical trials have found that English language restrictions do not appear to bias expected results [63, 64]. However, there is limited literature that looks at the impact of excluding English language studies for systematic reviews on prevalence. Yet, we believe that it is unlikely that this restriction biased our results as the majority of articles are published in English. For studies that compared urban and rural populations, we accepted their definitions of urban and rural which may have differed between studies.

A major methodological challenge in determining the prevalence of spinal disorders in populations globally is a lack of a standardized tool for diagnosis or case definition. Until these are developed, substantial variation in measures of disease frequency (e.g., prevalence, incidence) will continue. Having a standardized case definition for spinal disorders will facilitate comparisons between populations, and will contribute to a greater understanding of the burden of spinal disorders. All 28 studies with low or moderate risk of bias used a self-reported questionnaire as a measurement of spine pain, an approach whose appropriateness has been extensively debated [65, 66]. Self-report questionnaires may result in misclassification and are prone to memory and social desirability biases [67], and responses may be sensitive to income, literacy or personal expectations [68, 69]. However, their benefits clearly outweigh their drawbacks in terms of feasibility, cost, and the amount of information they provide. Self-reported morbidity is a useful measure, allowing public health researchers to obtain data from a random population sample and not only from those who seek medical assistance. Adequate response rate is another challenge in obtaining data through surveys. It is important that comparisons be provided between responders and non-responders so that selection bias affecting the internal validity and generalizability of the study can be determined.

Comparing the prevalence of spinal disorders among various populations and countries can be problematic, due to the variability of various factors such as setting, age, type of work, and cultural differences, as well as investigators' failure to specify the prevalence period in many cases. Our findings not only show important heterogeneity in methods of data acquisition but also major differences in demographic factors, resulting in differing prevalence between studies. In future studies, it is important that a standard definition of spinal disorders (neck, back and thoracic) is developed and agreed upon by experts. Use of standardized definitions will facilitate comparisons among spine disorder studies internationally.

## Conclusion

Our review shows that spinal disorders (primarily back and neck pain) are common in various populations around the world. The current evidence suggests that back pain is more prevalent among females, increases with age, and is associated with lower education, depression and other psychological factors, and alcohol consumption. Similar to back pain, neck pain is more prevalent in females. When carrying out future studies that assess the burden of spinal disorders in rural populations, researchers should consider including broader outcome measures to gain a better understanding of the burden of spinal disorders in medically underserved areas and low- and middle-income countries. Furthermore, methodological quality of these studies needs improvement; using valid and reliable measurement instruments and standardized case definitions will help increase the usefulness and interpretation of results.

**Acknowledgements** We thank Leslie Verville for her contributions to this paper.

### Compliance with ethical standards

**Funding** The Global Spine Care Initiative and this study were funded by Grants from the Skoll Foundation and NCMIC Foundation. World Spine Care provided financial management for this project. The funders had no role in study design, analysis, or preparation of this paper.

**Conflict of interest** EH declares he is a consultant for: RAND Corporation; EBSCO Information Services; Southern California University of Health Sciences; Western University of Health Sciences. Data and Safety Monitoring Committee Chair, Palmer Center for Chiropractic Research. Research Committee Co-chair, World Spine Care. KR declares funding to UOIT from Skoll Foundation, NCMIC Foundation through World Spine Care. PT declares no COI. HY declares funding to UOIT from Skoll Foundation, NCMIC Foundation through World Spine Care. LV declares funding to UOIT from Skoll Foundation and NCMIC Foundation through World Spine Care. JH declares his research group has extensive funding from Danish public funding agencies, the European Union, and Danish charities. PC is funded by a Canada Research Chair in Disability Prevention and Rehabilitation at the University of Ontario Institute of Technology, and declares funding to UOIT from Skoll Foundation, NCMIC Foundation through World Spine Care. Canadian Institutes of Health Research Canada. Research

Chair Ontario Ministry of Finance. Financial Services Commission of Ontario. Ontario Trillium Foundation, ELIB Mitac. Fond de Recherche and Sante du Quebec. SH declares funding to UOIT from Skoll Foundation, NCMIC Foundation through World Spine Care. Clinical Policy Advisory Board and stock holder, Palladian Health. Advisory Board, SpineHealth.com. Book Royalties, McGraw Hill. Travel expense reimbursement-CMCC Board.

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## Affiliations

**Eric L. Hurwitz[1] · Kristi Randhawa[2,3] · Paola Torres[4] · Hainan Yu[2] · Leslie Verville[2] · Jan Hartvigsen[5] · Pierre Côté[2,3] · Scott Haldeman[6,7,8]**

✉ Eric L. Hurwitz
ehurwitz@hawaii.edu

[1] Office of Public Health Studies, University of Hawai`i, Mānoa, Honolulu, HI, USA

[2] Faculty of Health Sciences, University of Ontario Institute of Technology, Oshawa, Canada

[3] UOIT-CMCC Centre for Disability Prevention and Rehabilitation, Toronto, Canada

[4] Rehabilitation Centre, San Cristobal Clinic, Santiago Spine Group, Santiago, Chile

[5] Department of Sports Science and Clinical Biomechanics, University of Southern Denmark and Nordic Institute of Chiropractic and Clinical Biomechanics, Odense, Denmark

[6] Department of Epidemiology, School of Public Health, University of California Los Angeles, Los Angeles, USA

[7] Department of Neurology, University of California, Irvine, CA, USA

[8] World Spine Care, Santa Ana, CA, USA