Review Article

Prevalence of low back pain in hemodialysis patients: A systematic review and meta-analysis with Grading of Recommendations Assessment, Development, and Evaluation evidence classification

ABSTRACT

Background: Musculoskeletal pain complaints have a high epidemiological and clinical burden in hemodialysis patients. Previous original studies indicate that low back pain (LBP) may have an important contribution to these complaints. This systematic review aimed to estimate the global prevalence of LBP in chronic hemodialysis patients.

Methods: Systematic review and meta-analysis with Grading of Recommendations Assessment, Development, and Evaluation approach for quality of evidence. Searches were performed in CINAHL, Embase, LILACS, MEDLINE/PubMed, and Scientific Electronic Library Online databases until July 2023. The Inverse Variance Heterogeneity model was used to pool prevalence estimates.

Results: The review included 19 original articles that provided data from 2713 patients. The overall pooled prevalence of LBP was 30.2% (95% confidence interval [CI] =19.0%–42.0%; *k* = 19 articles). The sex-specific pooled prevalence of LBP was 29.6% (95% CI = 18.7%–41.2%; *k* = 6 articles) in females and 36.6% (95% CI = 26.0%–47.7%; *k* = 6 articles) in males. The duration-specific pooled prevalence of LBP was 13.2% (95% CI = 8.6%–18.4%; *k* = 2 articles) for acute and 30.7% (95% CI = 11.3%–52.2%; *k* = 7 articles) for chronic LBP. The frequency of LBP estimated over the total number of pain complaints was 39.6% (95% CI = 23.0%–56.8%; k = 10 articles).

Conclusion: The overall estimate shows that three out of 10 hemodialysis patients suffer from LBP. This condition is accountable for nearly 40% of pain complaints in such patients. The quality of evidence for the pooled estimates is low or very low, and future prevalence studies with adequate statistical power and definitions of LBP are needed to provide more accurate data.

Keywords: Grading of Recommendations Assessment, Development, and Evaluation approach, low back pain, prevalence, renal dialysis, systematic review

INTRODUCTION

Low back pain (LBP) is a complex and multifactorial symptom of the lumbar spine.[1] It is a major cause of morbidity in adult populations and may result in persistent complaints and disability.[2] With increasing life expectancy worldwide, it has become a great concern for public health due to the high burden for patients, healthcare systems, and governments.[3,4] The Global Burden of Disease (GBD) estimates showed that LBP cases increased by 60.4% in the period between 1990 and 2020, with 619 million people currently affected.[2] For 2050, it

Access this article online	
Website: www.jcvjs.com	Quick Response Code
DOI: 10.4103/jcvjs.jcvjs_192_24	

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Submitted: 27-Nov-24 **Accepted:** 24-Jan-25
Published: 01-Apr-25

How to cite this article: Milagres MV, Diz JB, Chaoubah A. Prevalence of low back pain in hemodialysis patients: A systematic review and meta-analysis with Grading of Recommendations Assessment, Development, and Evaluation evidence classification. J Craniovert Jun Spine 2025;16:16-25.

is estimated as an increase in total cases of 36.4%, with 843 million cases globally.[2]

Although most cases of back complaints do not have a specific cause, some chronic diseases may favor the occurrence of pain symptoms.[1,5] Especially, patients with end-stage renal disease (ESRD) on hemodialysis often report painful musculoskeletal problems due to several pathophysiological mechanisms that include bone loss, muscle atrophy, and uremic toxicity of peripheral nerves.[6-8] As kidney function decreases it may course with severe, persistent pain.[9] In this scenario, as well as the significant increase in LBP cases, an increase in hemodialysis patients worldwide is expected in the coming years,[10] many of them living with painful conditions. Recent systematic reviews have reported the prevalence of general musculoskeletal pain ranging from 31% to 92% in hemodialysis patients.[11-13]

Besides physical and functional disabilities, it is very possible that the interaction between ESRD and LBP contributes to other clinically relevant outcomes such as depressive symptoms, polypharmacy, hospitalization, and poor quality of life.[7,13,14] Indeed, the management of this interaction can be a challenge for healthcare professionals in hemodialysis services. Therefore, estimating the burden of LBP in ESRD patients not only broadens the clinical view of health problems arising from chronic kidney disease but also highlights the importance of holistic approaches for managing this complex condition. The present systematic review and meta-analysis aimed to estimate the prevalence of LBP in hemodialysis patients, including estimates for sociodemographic and clinical characteristics.

METHODS

Study design and guidelines

This is a systematic review and meta-analysis. Methods were based on recommendations from the Joanna Briggs Institute – Manual for Systematic Reviews of Prevalence and Incidence,[15] the MOOSE Group – Meta-Analysis of Observational Studies in Epidemiology,[16] the Cochrane Collaboration – Handbook for Systematic Reviews of Interventions,[17] and reported as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist.[18] PROSPERO number: CRD42023448026.

Search strategy and inclusion criteria

Searches for primary studies from the earliest record to July 2023 were conducted in CINAHL, Embase, LILACS, MEDLINE/PubMed, and Scientific Electronic Library Online databases, without date and language restriction. Hand-searching was also performed in specialized journals, reference lists of previous studies, and by consulting professionals/researchers in the field. Search strategies were elaborated through combinations of descriptors/terms for each database, using English words such as "prevalence," "low(er) back pain," "lumbar pain," "chronic kidney disease," and "hemodialysis." Detailed search strategies are presented in Supplementary Table 1.

Published full-text articles reporting data on the occurrence of LBP in hemodialysis patients were considered for inclusion, regardless of pain symptoms' cause (i.e., specific, and nonspecific) and duration (i.e., acute, subacute, and chronic). Anatomically, LBP was defined as any pain and/or discomfort in the region between the costal margin and inferior gluteal folds, with or without radiation to the lower extremities.[1,5] A minimum sample size was not considered as an inclusion criterion to maximize the eligibility of primary studies. Articles reporting conditions and populations other than (strictly) LBP (e.g., back and spinal pain) and chronic hemodialysis patients (e.g., acute kidney failure), respectively, were excluded.

Study selection and data extraction

Two reviewers independently screened titles and abstracts of original studies retrieved from the searches. Full texts of potential articles were accessed and evaluated for eligibility. Those articles fulfilling the inclusion criteria were included in the review. Data extraction was also conducted by two independent reviewers to avoid overlooking relevant data. Disagreements were resolved by consensus.[15] Extractions were identification of the original article (author and date); country (where the study was conducted); sample (number, sex, and age); hemodialysis (time in treatment, and weekly frequency); prevalence (measure and, relative/absolute estimate); and burden (LBP/other pain complaints). Authors of original studies were contacted via email to clarify unclear/missing information and/or provide further data.

A hot deck imputation method was used for unclear/missing data (e.g., sample characteristics and hemodialysis treatment) by selecting a value randomly from the other included articles conducted in similar settings.[19] In addition, the participants' age and hemodialysis time were transformed and presented as mean and standard deviation by using Wan *et al*.'s[20] approach when the original articles reported it as median with interquartile range and/or minimum–maximum. These procedures were performed to improve the completeness and consistency of the extracted data.

Risk of bias assessment

Two reviewers independently judged the risk of bias for each included article using a tool that comprises nine items

addressing methodological issues of prevalence studies.[21] For this review, only the items 2, 3, 4, 6, 7, 8, and 9 were used to judge the risk of bias of the individual studies, since such items best apply to the review question (i.e., condition, context, and population). The items refer to sample recruitment, sample size, setting/participants description, diagnostic criteria, data collection, statistical analysis, and response rate,[22] respectively.[21] Each item was assessed according to the criteria presented in Table 1. Disagreements were resolved by consensus or by a third reviewer. Previous systematic reviews using this tool have shown good between-reviewer agreement and reliability coefficients to assess the risk of bias in prevalence studies with Cohen's kappa >0.70[24-26] and interrater values >90%.[24,26,27]

For each item of the risk of bias tool, it was answered as follows: "yes," when information in the included articles was sufficiently clear; "unclear," when information in the included articles was obscure/uncertain; or "no," when information in the included articles was absent. The answers "yes," "unclear," and "no" was classified as "low," "unknown," and "high" risk of bias, respectively. Disagreements were resolved by a third reviewer.[10] Authors of original articles were contacted via email if further information was required.

Table 1: Items and criteria used to assess the risk of bias for each included article

Item	Criterion
2	Considered acceptable if recruited at least a convenience sample of chronic kidney patients from hemodialysis centers/clinics ( ) yes ( ) unclear ( ) no
3	Considered acceptable if included at least a sample size ≥140 individuals (70 per gender), as obtained by the formula: $Z^2 \times \frac{P(1-P)}{d^2}$, where $Z=1.96$, $d=0.05$, and $P=0.1$* ( ) yes ( ) unclear ( ) no
4	Considered acceptable if provided a clear reporting of the study setting and participants' characteristics, with sufficient information on location, age, sex, and hemodialysis treatment ( ) yes ( ) unclear ( ) no
6	Considered acceptable if identified low back pain through appropriate clinical methods or medical records, including pain duration as acute, subacute, or chronic† ( ) yes ( ) unclear ( ) no
7	Considered acceptable if provided a clear reporting of data collection, including information on observer training, questionnaires, measurements, and outcomes ( ) yes ( ) unclear ( ) no
8	Considered acceptable if provided prevalence estimates with confidence intervals, and information on prevalence measures as point-, period-, or lifetime-prevalence ( ) yes ( ) unclear ( ) no
9	Considered acceptable if obtained a response rate ≥70%‡ from the eligible sample, at least for the outcome "low back pain" ( ) yes ( ) unclear ( ) no

Risk of bias tool developed by Munn *et al.*[21]: 2 - Participants' recruitment; 3 - Sample size; 4 - Subjects/setting; 6 - Condition's identification; 7 - Data collection; 8 - Statistical procedure; 9 - Response rate; *Prevalence of hemodialysis patients obtained from the study of Hill *et al.*;[23] †Definitions of low back pain as cited by Violante *et al*;[5] ‡Adequate response rate for prevalence studies according to Loney and Stratford.[22]

The frequency of answers for each item of the risk of bias tool was demonstrated using a bar chart.

Data analysis and evidence synthesis

Meta-analysis of prevalence was performed by pooling proportions obtained from included articles, using the Inverse Variance Heterogeneity model, which computes the pooled effect variance through a quasi-likelihood approach.[28,29] This model has shown a good performance in reducing the observed variance and improving the accuracy of estimates, especially when pooling original studies with small sample size and the heterogeneity is substantially high (e.g., $I^2 > 50\%$).[28,29] The proportions were previously normalized using the Freeman–Tukey double arcsine transformation to stabilize the within-/between-studies' variance when calculating study weights.[30]

Heterogeneity was evaluated using the Cochran Q test. Large Q values with $P < 0.10$ suggest important heterogeneity. The quantification of variability in percentage was assessed using the I^2 statistic. Values ≥75% indicate considerable heterogeneity.[17] Publication bias was investigated in meta-analyses with $k \geq 5$ articles using the Doi plot approach.[31] The quantification of asymmetry was examined by the LFK index as follows: values up to ≤±1 indicate "absent asymmetry" or no publication bias; values between >±1 and ≤±2 indicate "minor asymmetry" or minimal publication bias; >±2 indicates "major asymmetry" or important publication bias.[31] All meta-analyses were conducted using the MetaXL, version 5.3 (Sunrise Beach, Queensland, Australia: EpiGear International Pty Ltd, 2016).

The quality of evidence for prevalence estimates was rated by two independent reviewers using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system.[32] Quality levels of evidence are: high quality (means that pooled estimates are very close to actual estimates/rates, and differences are unlikely to exist); moderate quality (means that pooled estimates are close to actual estimates, but may differ); low quality (means that pooled estimates are uncertain and likely to differ from actual estimates); and very low quality (means that pooled estimates are very uncertain and likely very different from actual estimates).[33]

The overall quality of evidence for each meta-analysis result was rated initially as high and it was downgraded by one, two, or three levels (i.e., high to very low) if one of the following criteria were present: ≥50% of pooled articles scored < 5[34] (0–7) points in the total score of bias assessment (serious risk of bias); ≥50% of pooled

articles did not use valid/reliable methods to identify LBP[1,5,22] in hemodialysis settings (serious indirectness); ≥50% of pooled articles did not have a sample size ≥140[23] participants (serious imprecision); I^2 of pooled analysis was ≥75%[17] (serious inconsistency); and existence of "major asymmetry"[31] in the analysis of publication bias (serious publication bias). For meta-analyses with k <5 articles,[31] publication bias was not investigated, and therefore, it was not used as a criterion for rating the quality of evidence. This GRADE approach has been used previously.[34-36]

RESULTS

Flow and description of studies

The searches provided a total of 3215 records. Of these, 41 duplicates were identified and removed, and 3101 citations were excluded based on their titles/abstracts. Thus, 81 original studies were accessed in full text and examined for eligibility. After 62 exclusions for eight different reasons, 19 articles[37-55] fulfilled the inclusion criteria and were included in the review [Figure 1]. The included articles were published between 1982 and 2023, and they provided data of 2713 patients from 12 different countries. The lowest reported age was 4[51] while the highest was 93 years old.[53] The lowest reported time of hemodialysis treatment was 4 days,[42] whereas the highest was 390 months,[47,48] with an average frequency of three times a week [Table 2].

Findings of the risk of bias

Critical appraisal of the 19 included articles showed the following classifications: 84% (k = 16) and 74% (k = 14) had "low risk" in items 1 and 4, respectively; 53% (k = 10) had "low risk" in item 7; 53% (k = 10) had "unknown risk" in items 6 and 9. Very poor scores were obtained in items 3 and 8, since 64% (k = 12) and 100% of the included articles scored as "high risk", respectively [Supplementary Figure 1]. There was a serious methodological issue with such items because most of the sample sizes from the included articles were small (i.e., <140 participants), and none of them provided confidence intervals for their prevalence estimates [Table 1]. The total mean of "low risk" scores was 3.4 (0–6) points [Supplementary Table 2].

Meta-analyses of prevalence

The prevalence of LBP by pooling estimates from the 19 included articles was 30.2%, 95% confidence interval [CI] =19.0%–42.0% [Figure 2]. The GRADE evidence for this outcome was downgraded up to very low-quality level because serious risk of bias, indirectness, imprecision (i.e., ≥50% of pooled articles scored <5

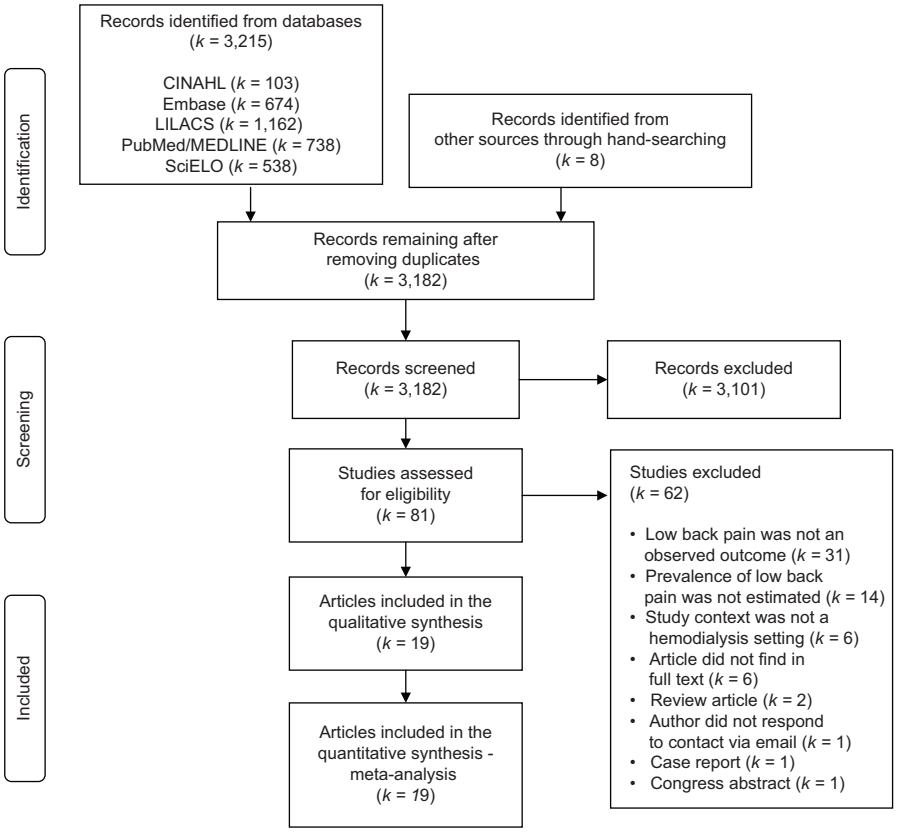

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of studies through the review (*k* = 19)

Table 2: Characteristics of the included articles in the review (k=19)

Study	Country	Sample Total (female/male), *n* Age (years), mean±SD	Hemodialysis Time in treatment Weekly frequency	Prevalence, measure=*n* (%)
Afifi *et al*., 2019[37]	Egypt	53 (17/36) 71.7% 49.24±10.79	71.7% >1 (11.97±6.02) years 3×/weeks	Point=9 (17.0)
Alcas-Clares *et al*., 2013[38]	Peru	68 (32/36) 52.1±21.1 (18–88)	≥6 (21.6±17.0 [6–72]) months 3×/weeks	Point=20 (29.4)
Boukhira *et al*., 2021[39]	Morocco	441 (192/249) 56.05±15.67 (≥18)	>3 (64.84±49.67) months 2–3×/week	Point=62 (14.1) CLBP
Cordeiro *et al*., 2016[40]	Brazil	240 (92/148) 75.0% (21–80)	≤1 year 3×/weeks*	Point=61 (25.4)
Cristofolini *et al*., 2008[41]	Brazil	205 (101/104) 63.9% 49.4±15.8 (18–80)	>3 (63.9% 8.0±5.3)† years 3×/weeks	Point=74 (36.1) Female=34 (33.7) Male=40 (38.5) CLBP
Dallé and Lucena, 2012[42]	Brazil	98 (32/66) 51±14 (17–77)	25.9±15.7 (4–88) days 3×/weeks*	Point=13 (13.3) ALBP
Evaristo *et al*., 2020[43]	Brazil	63 (30/33) 53.4±14.1 (21–89)	≤1 (1–12 months) years 3×/weeks	Point=11 (17.5) Female=5 (16.7) Male=6 (18.2)
Ezzat *et al*., 2020[44]	Egypt	200 (78/122) 50.6±10.7 (>18)	>1 (76.5% >5) years 3×/weeks*	Point=43 (21.5) 12-month=51 (25.5)
Fleishman *et al*., 2018[45]	Israel	336 (112/224) 63.9±14.8 (>18)	52.1% >24 months 3×/weeks*	Point=177 (52.7)
Gnionsahe *et al*., 2007[46]	Ivory Coast	26 (5/21) 50.6±10.7 (>18)*	77% >5 years 3×/weeks*	Point=15 (57.7)
Hishii *et al*., 2016[47]	Japan	72 (29/43) 72.9±10.8 (46.0–89.0)	89.0±87.1 (2.0–390.0) months 3×/weeks	Point=29 (40.3) Female=5 (17.2) Male=24 (55.8) CLBP
Hishii *et al*., 2020[48]	Japan	94 (40/54) 72.8±10.2 (47.0–92.0)	79.5±97.4 (2.0–390.0) months 3×/weeks	Point=38 (40.4) Female=16 (40.0) Male=22 (40.7) CLBP
Kesikburun *et al*., 2018[49]	Turkey	87 (46/41) 53.3±15.8 (21–80)	>3 months (7.0±6.3 years) 3×/weeks	Point=32 (36.8) Female=18 (39.1) Male=14 (34.1) ALBP=12.6, *n*=11 CLBP=24.1, *n*=21
Koga *et al*., 1982[50]	Japan	45 (18/27) 53.3±14.28* (18–73)	>3 months* 3×/weeks	Point=6 (13.3) Female=1 (5.6) Male=5 (18.5)
Kurer *et al*., 1991[51]	England	83 (NA) 38±15.8* (4–65)	>10 years 3×/weeks*	Point=6 (7.2)
Mizher *et al*., 2023[52]	Palestine	261 (95/166) 51±14.28* (≥18)	≥8 weeks (68.2% ≤4 years) 92.7% 3×/weeks	Point=39 (14.9) CLBP
Rao *et al*., 2022[53]	China	296 (170/126) 60.8% ≥60 (27–93)	>3 months (58.1% 1–5 years) 90.2% 3×/weeks	Point=204 (68.9) CLBP
Rosique *et al.,* 2003[54]	Spain	10 (7/3) 66.68±14.28 (33–81)	20 months 3×/weeks	Point=1 (10.0)
Silva *et al*., 2014[55]	Brazil	35 (16/19) 62.86% >50 (≥18)	51.43% >5 years 3×/weeks*	Point=12 (34.3)

*Imputed data using a hot deck method according to Andridge and Little;[19] †Mean±SD obtained from median (minimum–maximum) and sample size according to Wan *et al*.[20] CLBP - Chronic low back pain; ALBP - Acute low back pain; NA - Not available; SD - Standard deviation

points in the total score of bias assessment, did not use valid/reliable methods to identify LBP as indicated by the item 6 of the risk of bias tool, and did not have a sample size ≥ 140 participants, respectively), and inconsistency (i.e., I^2 = 96% in the pooled analysis). Publication bias was not detected [Supplementary Figure 2].

Prevalence of sex-specific LBP by pooling estimates from six included articles[41,43,47-50] was 29.6%, 95% CI = 18.7%–41.2% in females, and 36.6%, 95% CI = 26.0%–47.7% in males [Figure 3a and b]. For females, the GRADE evidence was downgraded up to very low-quality level because serious risk of bias, imprecision (i.e., ≥50% of pooled articles

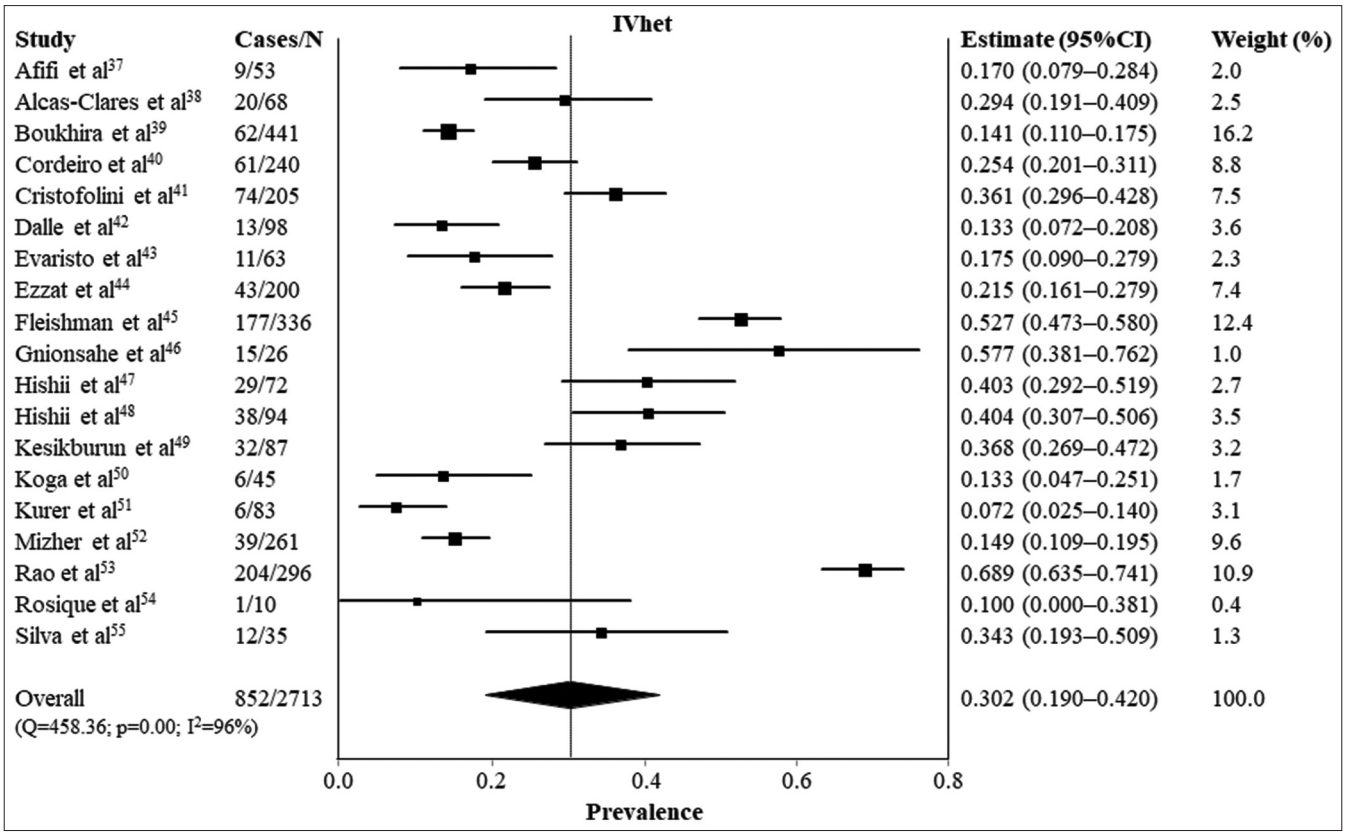

Figure 2: Meta-analysis pooling prevalence estimates of low back pain in hemodialysis patients (*k* = 19)

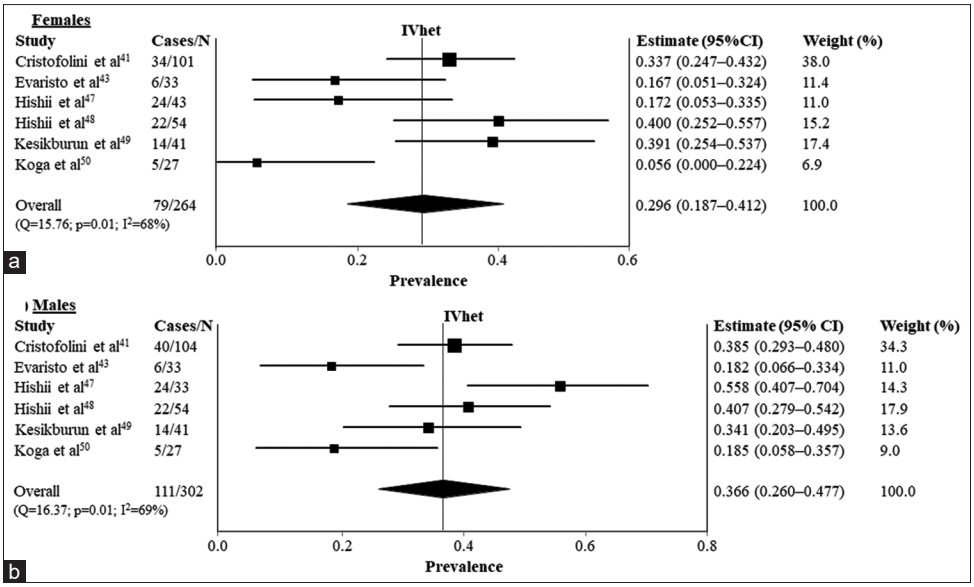

Figure 3: (a and b) Meta-analyses pooling sex-specific prevalence estimates of low back pain in hemodialysis patients (*k* = 6)

scored <5 points in the total score of bias assessment and did not have a sample size ≥ 70 participants, respectively), and presence of important publication bias [Supplementary Figure 3]. For males, the GRADE evidence was downgraded up to low-quality level because serious risk of bias and imprecision (i.e., ≥50% of pooled articles scored <5 points in the total score of bias assessment and did not have a sample size ≥70 participants, respectively). Important publication bias was not detected [Supplementary Figure 4].

Prevalence of duration-specific LBP by pooling estimates from eight included articles[39,41,42,47-49,52,53] was 13.2%, 95% CI = 8.6%–18.4% for acute, and 30.7%, 95% CI = 11.3%–52.2% for chronic LBP [Figure 4a and b]. For acute, the

GRADE evidence was downgraded up to low-quality level because serious risk of bias and imprecision (i.e., ≥50% of pooled articles scored <5 points in the total score of bias assessment and did not have a sample size ≥140 participants, respectively). Publication bias was not investigated (i.e., k <5 articles). For chronic, the GRADE evidence was downgraded up to low-quality level because of serious risk of bias and inconsistency (i.e., ≥50% of pooled articles scored <5 points in the total score of bias assessment and I^2 = 98% in the pooled analysis, respectively). Important publication bias was not detected [Supplementary Figure 5].

The frequency of LBP over the total number of pain complaints reported in 10 included articles[37-40,44,45,51-53,55] was 39.6%, 95% CI = 23.0%–56.8% [Figure 5 and Supplementary Table 3]. The GRADE evidence for this outcome was downgraded up to very low-quality level because serious risk of bias, indirectness, (i.e., ≥50% of pooled articles scored <5 points in the total score of bias assessment and did not use valid/reliable methods to identify LBP as indicated by the item 6 of the risk of bias tool, respectively), and inconsistency (i.e., I^2 = 97% in the pooled analysis). Publication bias was not detected [Supplementary Figure 6].

DISCUSSION

General findings

The present review included 19 original articles providing prevalence data on LBP in hemodialysis patients. The main methodological problems found in assessing the risk of bias were sample size (item 3) and statistical analysis (item 8). Meta-analyses by pooling the prevalence of LBP (total, sex specific, and duration specific) and frequency of LBP over the total number of pain complaints provided estimates with quality of evidence as low or very low according to the GRADE system.

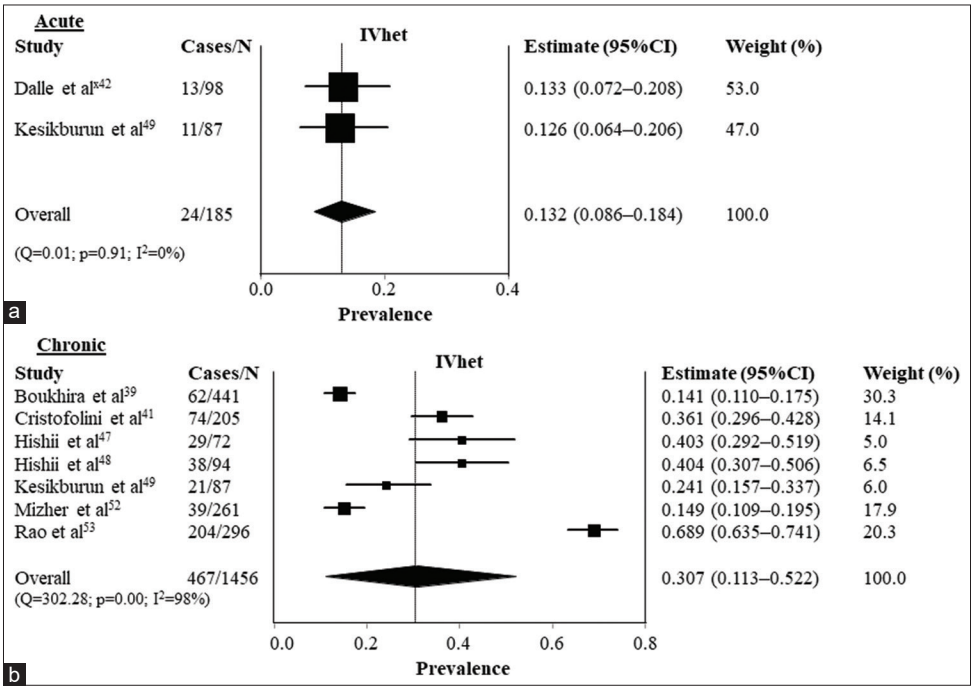

Figure 4: (a and b) Meta-analyses pooling duration-specific prevalence estimates of low back pain in hemodialysis patients (k = 8)

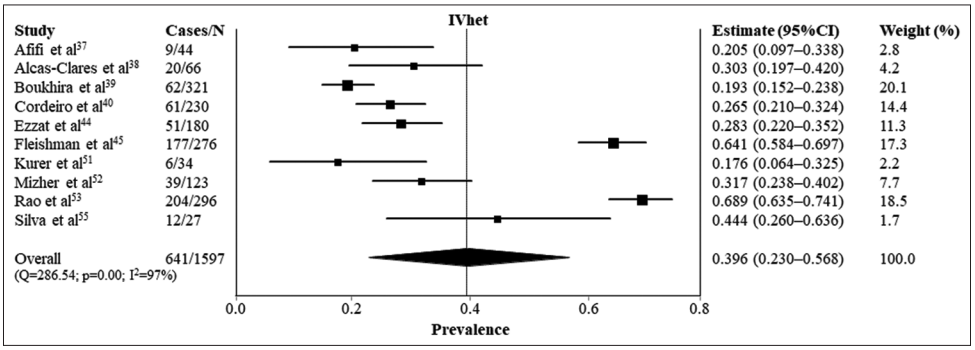

Figure 5: Meta-analyses pooling frequency estimates of low back pain over the total number of pain complaints in hemodialysis patients (k = 10)

Prevalence of low back pain

At least one in four hemodialysis patients appears to experience LBP at any given time. Although the quality of evidence for this estimate was very low, a range of pathophysiological mechanisms and biomechanical changes may explain the high burden of LBP in hemodialysis patients. First, with the progression of CKD, it is well documented that such patients often present with abnormalities of hormonal, mineral, and bone metabolism, including loss of bone mass, Vitamin D deficiency, and hyperparathyroidism, which are associated with the development of bone diseases (e.g., osteodystrophy and osteoporosis) and fractures, mainly, in the lumbar spine.[6,49] Second, painful neuropathy is a common condition in patients with ESRD. Previous systematic reviews report a prevalence of neuropathic pain between 10% and 40% in hemodialysis patients.[9,12] These high estimates may be due to uremic neuropathy secondary to chronic hyperkalemia and hyperphosphatemia, which cause a pathological depolarization of nerves and symptoms of paresthesia and hyperalgesia.[8] Third, ESRD patients remain seated for long periods during hemodialysis sessions (i.e., at least three times a week, for a minimum of 4 h), which may contribute to risk factors associated with LBP such as postural overload, muscle weakness, and physical inactivity.[56] Other common causes of LBP in hemodialysis patients include polycystic kidney disease and infectious spondylodiscitis.[57,58]

The prevalence of LBP was higher in male (36.6%) than in female (29.6%) patients. This finding is inconsistent with the literature. Current estimates from the GBD showed that the global prevalence of LBP in the general population is higher in females than in males, regardless of age group.[2] Likewise, previous systematic reviews that investigated the prevalence of pain in hemodialysis settings have also shown conflicting findings. While Brkovic *et al*.[9] and Lambourg *et al*.[12] reported a higher prevalence of neuropathic pain in males, Santos *et al*.[13] and Brkovic *et al*.[7] reported a higher prevalence of chronic pain in females. It is possible that other factors such as the presence of comorbidities, level of physical activity, and musculoskeletal status influence the prevalence of LBP differently between sexes in hemodialysis patients.[11,41,47]

Chronic LBP was almost 18% more prevalent than acute LBP according to duration-specific meta-analysis estimates. It seems that chronic pain is much more investigated than acute pain of musculoskeletal origin in hemodialysis patients.[11-13] Indeed, this review found only two original articles that investigated acute LBP,[42,49] and although the prevalence estimates from both original articles were similarly low (13.3% and 12.6%), the pooled estimate should be interpreted with parsimony. Future well-conducted research with adequate sample size may improve confidence in this result. On the other hand, there are several reasons to explain the high prevalence of chronic LBP among hemodialysis patients, including an increase in cases of chronic back pain with increasing age,[34,49,59] the presence of multiple morbidities that are often associated with persistent pain complaint,[41,52,53] poor musculoskeletal and physical/functional outcomes,[41,49,53] and co-occurrence of psychological disorders (e.g., depression and anxiety), which strongly predict the course and severity of back pain.[39,47,48]

Frequency of low back pain/total number of pain complaints

Estimates from 10 included articles revealed that LBP accounts for four out of 10 hemodialysis patients who have painful conditions. This is a difficult outcome to measure since it can result from important clinical and statistical heterogeneity present in the denominator of the pooled estimate. Nonetheless, data from two previous systematic reviews seem to corroborate the high burden of LBP among other pain sites in hemodialysis patients. Davison *et al*.[11] demonstrated that the lumbar region was the second most affected site after the lower extremities and Santos *et al*.[13] found that the back region was the most affected site after the head. Thus, it should be stressed that LBP may account for a large proportion of pain complaints in hemodialysis settings.

Practical implications

Given the high prevalence of LBP as well as its high frequency in relation to other painful conditions as observed here, clinicians must be attentive to hemodialysis patients who present with musculoskeletal complaints. Back pain symptoms must be identified and managed early to improve patient outcomes and avoid/mitigate the development of chronic pain and functional disability.[14,60] Persistent pain is a potential comorbidity in ESRD and may contribute to loss of independence, autonomy, quality of life, and social participation.[44,45,53,61] There is some evidence that a multimodal approach including pharmacological treatment (e.g., oral acetaminophen and transdermal buprenorphine), physical rehabilitation (e.g., therapeutic exercises and electrical stimulation), psychological intervention (e.g., cognitive behavioral therapy and mindfulness), and social support (e.g., education and good access to healthcare services) can benefit these patients.[14,60,62] A therapeutic strategy using an individualized, patient-centered care should be adopted, especially, for pharmacological options regarding the type, dosage, adjustment, and side effects of drugs.[14,60]

Weakness and strengths

Major limitations of the review are the following: (i) few included articles investigated LBP as a primary outcome,

which leads to some variation in case definition, clinical assessment of pain symptoms as well as prevalence measures; (ii) only two included articles provided the prevalence of acute LBP and perhaps the pooled estimate for this outcome is quite inaccurate; and (iii) most of the articles included had important methodological limitations such as small sample size, lack of a clear definition of LBP, and absence of confidence intervals for prevalence proportions, which negatively impacts the quality of the evidence and the GRADE recommendations for meta-analysis results. Strengths are the following: (i) data from hemodialysis patients collected in 12 different countries from both developed and developing regions were used in the review, which increases the generalizability of prevalence estimates; (ii) a range of outcomes were obtained including sex-, and duration-specific prevalence of LBP, and frequency of LBP over the total number of pain complaints, thus strengthening the epidemiological and clinical utility of the review findings; and (iii) providing relevant information about the burden of LBP in hemodialysis settings for health professionals/managers and patients as well as insights for future research.

CONCLUSION

This review evidences that LBP may be an important pain condition in hemodialysis patients, especially for males and those with chronic complaints. The quality of evidence for pooled estimates is low or very low, and future prevalence studies with adequate statistical power and definitions of LBP are likely to provide more accurate data. Meanwhile, nephrologists must pay attention to their patients undergoing hemodialysis who complain of back pain symptoms and thus intervene to prevent these symptoms from progressing into a disabling condition.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1. Search strategies conducted on July 17th, 2023.

CINAHL S1 (MH "Low Back Pain") OR "low back pain" OR (MH "Back Injuries+") OR (MH "Back Pain+") OR (MH "Chronic Pain") S2 (MH "Dialysis+") OR (MH "Dialysis Patients") OR (MH "Hemodialysis+") OR "hemodialysis" OR (MH "Renal Replacement Therapy+") S3 S1 AND S2
Embase ('low back pain' AND 'chronic kidney disease')/br OR (('low back pain' AND hemodialysis)/br) OR (('lower back pain' AND 'chronic kidney disease')/br) OR (('lower back pain' AND hemodialysis)/br) OR (('lumbar pain' AND 'chronic kidney disease')/br) OR (('lumbar pain' AND hemodialysis)/br)
LILACS ("low back pain") OR ("lower back pain") OR ("lumbar pain") OR ("chronic kidney disease") AND (hemodialysis)
MEDLINE/PubMed "low back pain" OR "lower back pain" OR lumbar AND hemodialysis
SciELO (("low back pain") OR ("lower back pain") OR ("lumbar pain") OR ("chronic kidney disease") AND (hemodialysis))

Supplementary Table 2. Risk of bias assessment of the included articles (*k*=19).

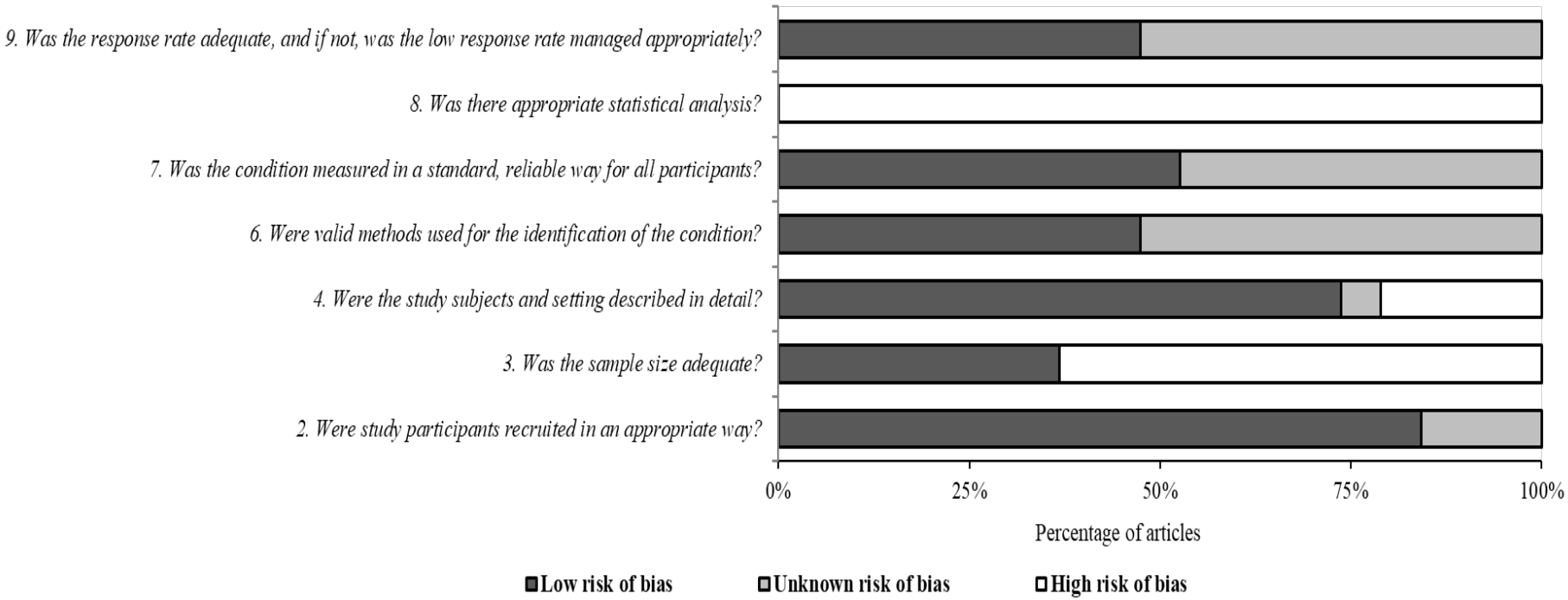
	Item							
	2	**3**	**4**	**6**	**7**	**8**	**9**	**Total**
Study	*Participants' recruitment*	*Sample size*	*Setting/ subjects*	*Condition's identification*	*Data collection*	*Statistical procedure*	*Response rate*	0–7 (yes)
Afifi et al[37]	Y	N	Y	U	U	N	U	2
Alca-Clares et al[38]	Y	N	Y	Y	Y	N	U	4
Boukhira et al[39]	Y	Y	Y	Y	U	N	Y	5
Cordeiro et al[40]	Y	Y	N	U	U	N	Y	3
Cristofolini et al[41]	Y	Y	Y	Y	Y	N	Y	6
Dalle et al[42]	Y	N	N	Y	Y	N	Y	4
Evaristo et al[43]	Y	N	Y	U	U	N	Y	3
Ezzat et al[44]	Y	Y	Y	Y	Y	N	Y	6
Fleishman et al[45]	Y	Y	Y	U	Y	N	Y	5
Gnionsahe et al[46]	U	N	N	U	U	N	U	0
Hishii et al[47]	Y	N	Y	Y	U	N	U	3
Hishii et al[48]	Y	N	Y	Y	Y	N	U	4
Kesikburun et al[49]	Y	N	Y	Y	Y	N	U	4
Koga et al[50]	U	N	U	U	U	N	U	0
Kurer et al[51]	Y	N	N	U	Y	N	U	2
Mizher et al[52]	Y	Y	Y	U	U	N	Y	4
Rao et al[53]	Y	Y	Y	Y	Y	N	Y	6
Rosique et al[54]	U	N	Y	U	U	N	U	1

Silva et al[55]	Y	N	Y	U	Y	N	U	3

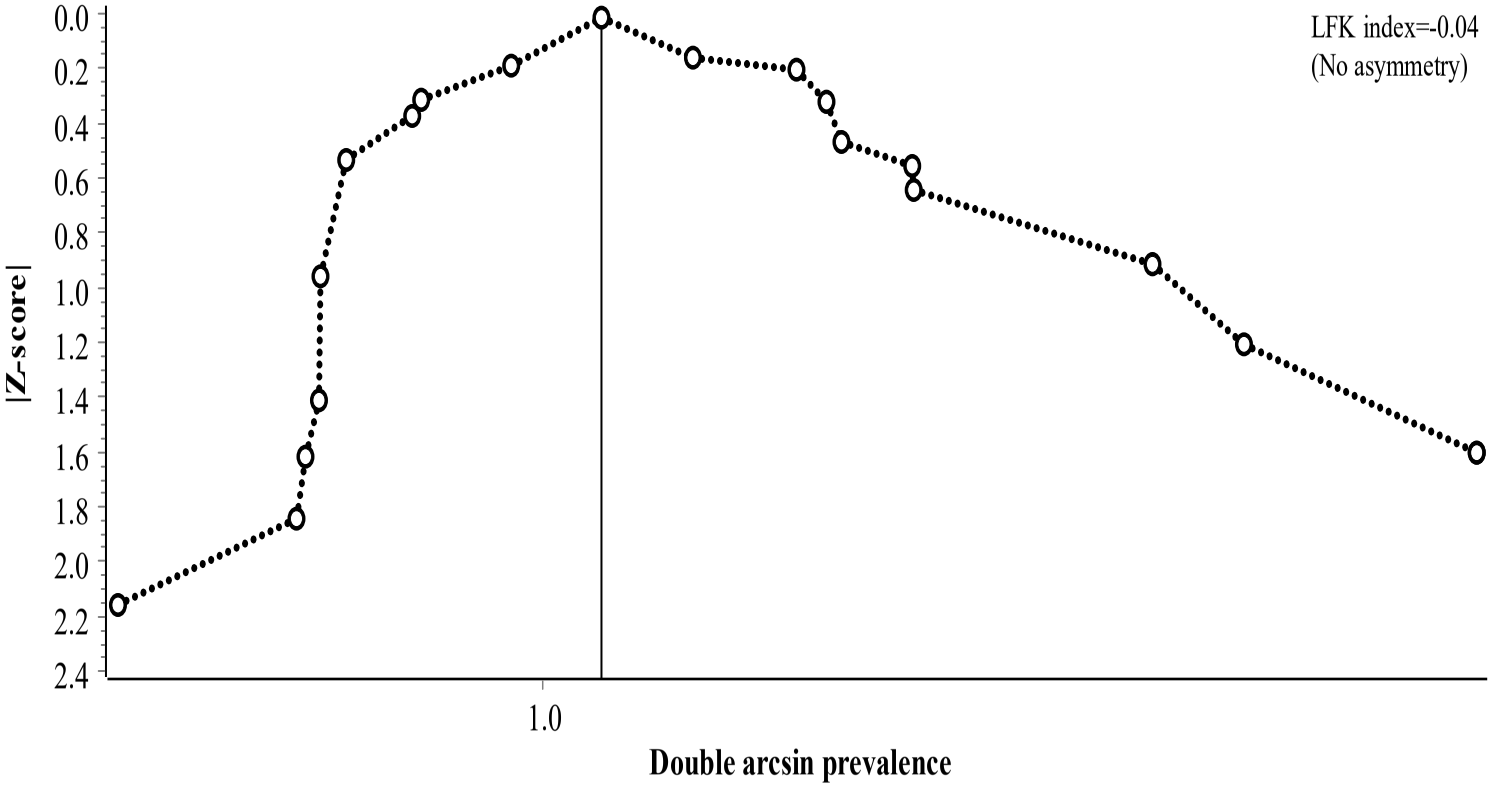
Risk of bias tool developed by Munn et al[21]
2. *Were study participants recruited in an appropriate way?*
3. *Was the sample size adequate?*
4. *Were the study subjects and setting described in detail?*
6. *Were valid methods used for the identification of the condition?*
7. *Was the condition measured in a standard, reliable way for all participants?*
8. Was there appropriate statistical analysis?
9. *Was the response rate adequate, and if not, was the low response rate managed appropriately?*
Y=yes; N=no; U=unclear

Supplementary Table 3. Frequency of low back pain over the total number of pain complaints reported in the included articles (*k*=10).

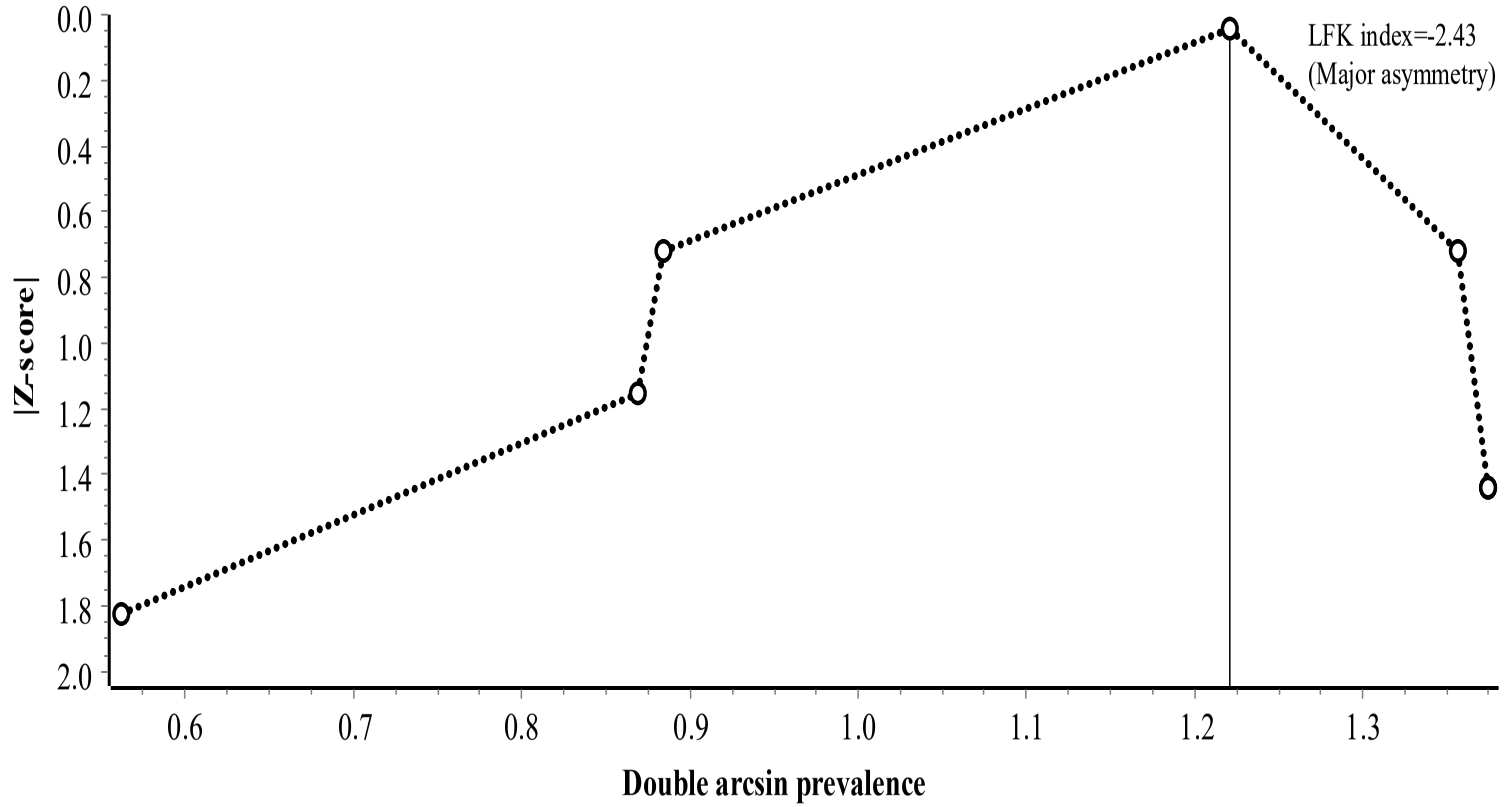
Study	**Low back pain** n	**Total of pain complaints** n	**Frequency** %
Afifi et al[37] 2019	9	44 (shoulder, hip, knee, and ankle arthralgia)	20.5
Alcas-Clares et al[38] 2013	20	66 (arthrosis, carpal tunnel syndrome, sacroiliitis, bicipital tendonitis, olecranon bursitis, fibromyalgia, hand and foot arthritis, neck and upper back pain)	30.3
Boukhira et al[39] 2021	62	321 (head, shoulder, abdomen, and multifocal pain)	19.3
Cordeiro et al[40] 2016	61	230 (head, abdomen, and lower limb pain)	26.5
Ezzat et al[44] 2020	51	180 (neck, shoulder, elbow, wrist, hand, upper back, tight, knee, and ankle pain)	28.3
Fleishman et al[45] 2018	177	276 (head, knee, shin, and foot pain, among others)	64.1
Kurer et al[51] 1991	6	34 (neck, shoulder, elbow, wrist, hip, knee, and ankle pain)	17.6
Mizher et al[52] 2023	39	123 (neck, upper back, upper arm, chest, abdomen, tight, knee, and foot pain)	31.7
Rao et al[53] 2022	204	296 (head, shoulder, lower limb, foot, and multisite pain)	68.9
Silva et al[55] 2014	12	27 (neck, shoulder, elbow, forearm, wrist, hand, abdomen, pelvic, buttock, leg, and foot pain)	44.4



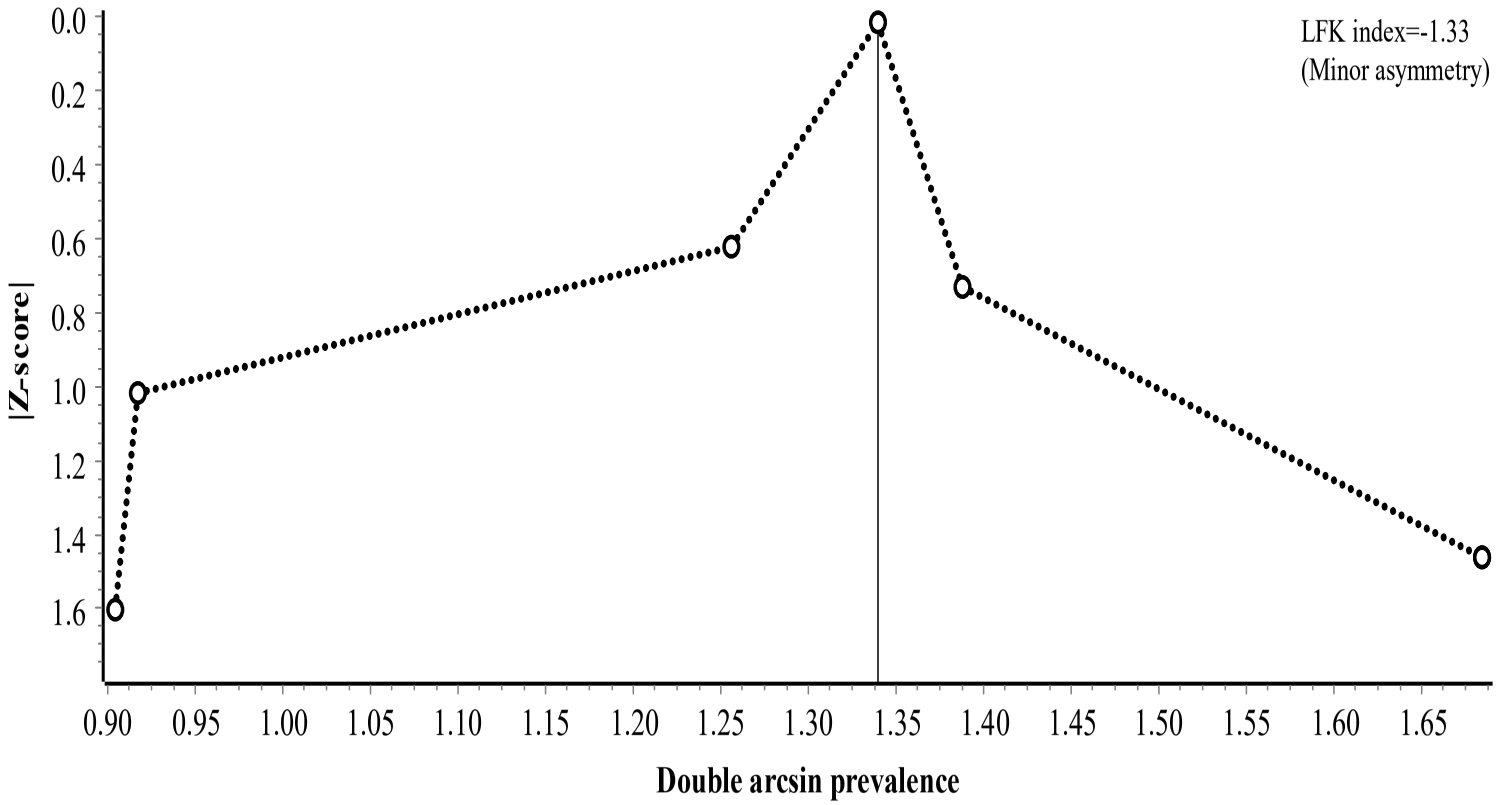
Supplementary Figure 1. Risk of bias summary of the included articles (k=19).



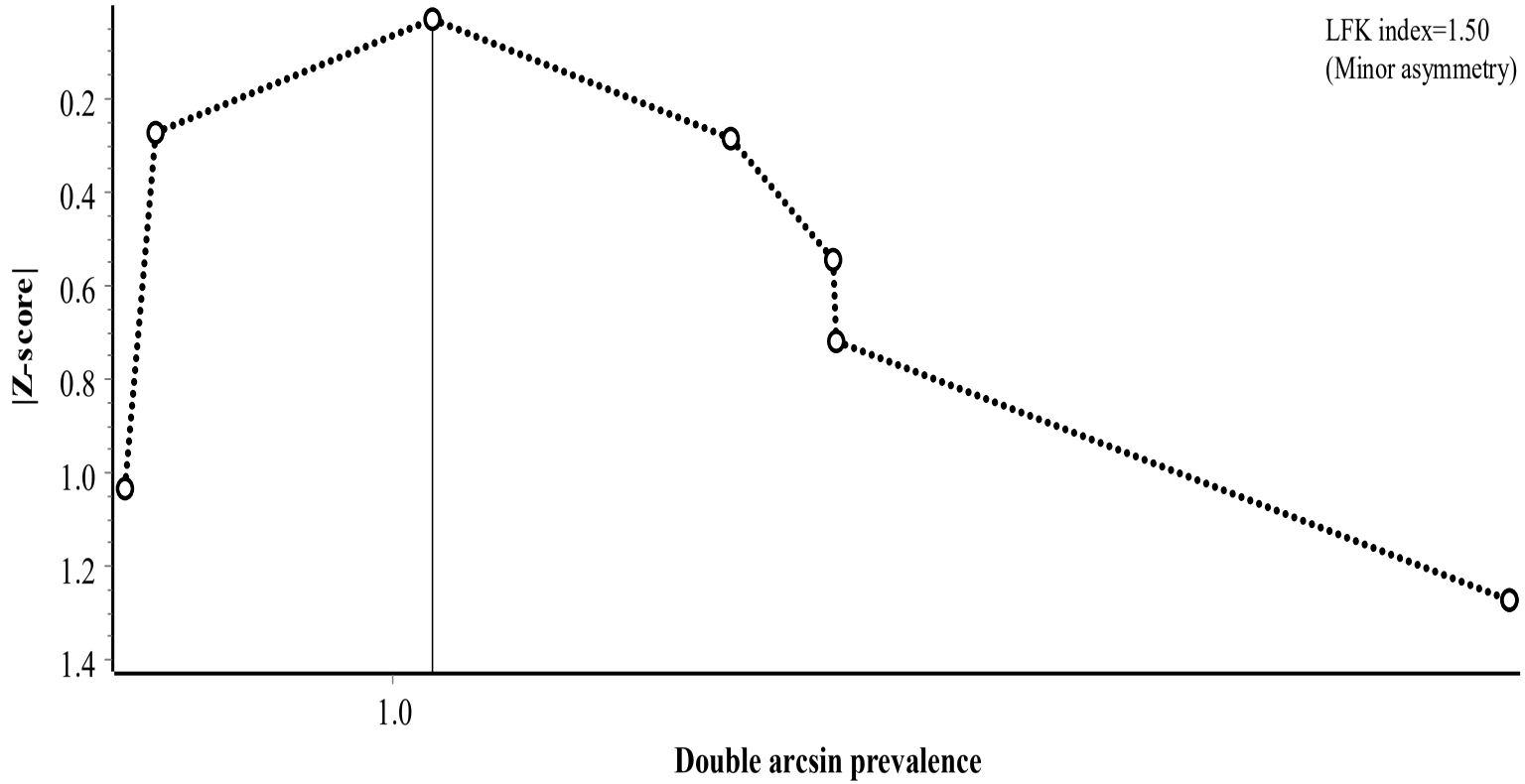
Supplementary Figure 2. Doi plot of Z-score by double arcsin prevalence (*k*=19). Data are from the meta-analysis of Figure 2.



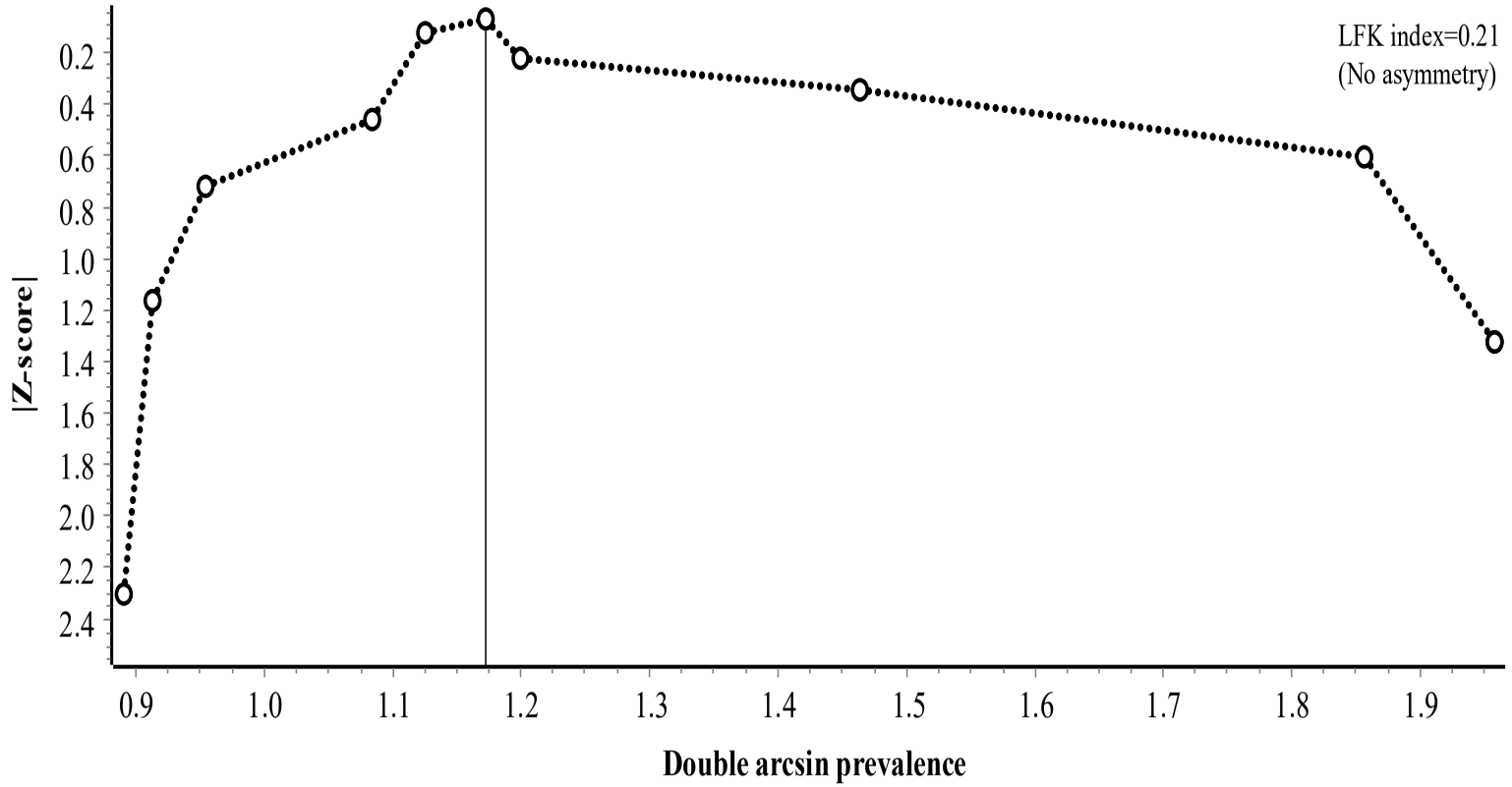
Supplementary Figure 3. Doi plot of Z-score by double arcsin prevalence (*k*=6). Data are from the meta-analysis of Figure 3a.



Supplementary Figure 4. Doi plot of Z-score by double arcsin prevalence (*k*=6). Data are from the meta-analysis of Figure 3b.



Supplementary Figure 5. Doi plot of Z-score by double arcsin prevalence (*k*=7). Data are from the meta-analysis of Figure 4b.



Supplementary Figure 6. Doi plot of Z-score by double arcsin prevalence (*k*=6). Data are from the meta-analysis of Figure 5.