

A systematic review with Bayesian modelling of the prevalence of pain with neuropathic characteristics

Peter R Kamerman¹, Taskeen Hoosen¹, Nkazimulo Mnguni¹, Prince C Chikezie¹

¹Brain Function Research Group, Department of Physiology, School of Biomedical Sciences, Faculty of Health Sciences, University of the Witwatersrand, South Africa

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Corresponding author

Prof Peter R Kamerman

Brain Function Research Group, Department of Physiology, School of Biomedical Sciences, Faculty of Health Sciences, University of the Witwatersrand, 7 York Road, Parktown, 2193, South Africa

Tel: +27 (0)11 717 2363

Email: peter.kamerman@wits.ac.za

Abstract

We performed the first systematic review and meta-analysis of the prevalence of pain with neuropathic characteristics using Bayesian methods to correct prevalence estimates for the use of screening tools with imperfect sensitivity and specificity (CRD42023416845). We searched major databases for national or regional epidemiological studies that reported the prevalence of pain with neuropathic characteristics, as identified by the PainDETECT, S-LANSS, or DN4-interview. Of the 1,251 unique records retrieved, 8 were finally extracted. The uncorrected (apparent) prevalence data were pooled using a random-effects meta-analysis for proportions. The corrected (true) prevalence was estimated using Bayesian models incorporating sensitivity and specificity distributions under non-informative [beta(1,1)] and informative priors [beta(4.389, 29.522); based on apparent prevalence]. Using the mean values from Bayesian credible intervals, a pooled estimate of true prevalence was generated using a random-effects model. The pooled estimate for the apparent prevalence was 10.6% (95% CI: 8.5; 12.9). The pooled estimate for true prevalence was 4.9% (95% CI: 3.8; 6.1) using informative priors, and 2.3% (95% CI: 1.5; 3.2) using non-informative priors. The use of imperfect screening tools may have overestimated the prevalence of neuropathic pain.

Perspective

The prevalence of neuropathic pain may be lower than previously estimated. A lower prevalence should not be equated with reduced societal or clinical significance, but it may have implications for healthcare resource allocation and research funding policies for neuropathic pain.

1. Introduction

Estimates of the prevalence of neuropathic pain in the general adult population are flawed because the instruments used to screen for the presence of neuropathic pain only assess for pains with neuropathic characteristics, which does not necessarily mean the pain is indeed neuropathic, and the instruments are not perfect tools. For example, screening tools such as the self-report Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS), which was developed for epidemiological studies ⁷, and the interview-only Douleur Neuropathique en 4 questions (DN4-interview), which was suggested as being suitable for epidemiological studies ⁹, both have sensitivities and specificities greater than 0.7, but less than 0.9 in their validation populations. That is, they are imperfect diagnostic tools.

When the prevalence of a disease is low (e.g., 3 to 17% of the adult population is estimated to have neuropathic pain) ²⁵, and screening tool sensitivity and specificity are moderate to high (e.g., tools developed to screen for pain with neuropathic features), then the number of false positives is typically numerically greater than the number of false negatives, and prevalence estimates are inflated. From a frequentist statistical standpoint, prevalence estimates can be corrected for the use of imperfect screening tools using the Rogan-Gladen estimator ³⁵.

However, this estimator has significant limitations, such as it assumes fixed sensitivity and specificity values for a questionnaire across populations, and at prevalence extremes, it yields invalid results (prevalence estimates less than zero or greater than one) ^{17,37}. An alternative approach is to use Bayesian estimation, which allows the modelling of the sensitivity and specificity, and the prevalence estimate within the boundaries of zero and one. The method also allows the incorporation of prior knowledge on the prevalence in the estimate of true prevalence ^{17,37}.

Consequently, we conducted a systematic review of the literature on the prevalence of pain with neuropathic features in the general adult population (using regional or country-level studies only), and then applied Bayesian estimation methods to estimate the corrected prevalence of pain with neuropathic features in the general adult population.

2. Methods

The protocol for this review was registered on the PROSPERO database ([CRD42023416845](#)), and the results are reported according to the recommendations of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guideline ³⁴; the checklist is available in the Supplementary file: Section 1.

2.1 Eligibility criteria

Using the Population, Phenomena of Interest and Context (PICO) framework, our research question was, “*What is the prevalence of neuropathic pain in the general adult population?*”, and our selection criteria were as follows:

2.1.1 Inclusion criteria:

1. An epidemiological study investigating disease (neuropathic pain) prevalence.
2. The study was conducted at the level of a geographical region (e.g., Great Britain), country, or state/province.
3. The study was conducted in the general adult population (≥ 18 years of age).
4. Neuropathic pain was assessed as a primary or secondary outcome of the study.
5. Neuropathic pain was screened for using the full Douleur Neuropathique en 4 questions (DN4) or the shortened interview only version (DN4-interview) ⁹; the Leeds

Assessment of Neuropathic Symptoms and Signs (LANSS) ⁶ or the self-report version of the LANSS (S-LANSS) ⁷; or the painDETECT ¹⁸ screening tools.

6. The study was published in English.

2.1.2 Exclusion criteria:

1. The study focused on one type/cause of neuropathic pain only (e.g., painful diabetic neuropathy only).
2. The study was conducted on a sub-population (e.g., presence of neuropathic pain in adults with chronic pain).

2.2 Information sources and search strategy

We queried three electronic databases: PubMed, Scopus, and Web of Science (search strategies in the Supplementary file: Section 2). The initial search was conducted on 14 April 2023 and spanned the period: 1 January 2001 (the year the first screening tool—LANSS—was published) to 31 March 2023. A second search was conducted on 5 February 2025 and spanned the period: 1 April 2023 to 4 February 2025. Reference lists of papers that passed the initial author-abstract screening process (see below) were assessed to identify additional articles. Grey literature sources were not assessed.

2.3 Selection process and data collection

The results returned from each database were uploaded to Covidence (<https://www.covidence.org>), an online platform for managing systematic reviews, and duplicates were removed using the built-in automatic duplicate removal tool that uses title, year, volume number, and author similarities to detect duplicates. Once duplicate articles had been removed, articles underwent title and abstract screening, followed by article retrieval and full text screening. Finally, the included articles underwent data extraction and quality

assessment. The screening processes were performed in duplicate by four reviewers working independently of each other (PRK, TH, NM, and PCC). When there were conflicts, a third reviewer from the group made the final decision. Data extraction and quality assessment were also performed in duplicate by two independent reviewers (TH and NM), with PRK checking for consensus and resolving conflicts between the two reviewers.

A copy of the extraction template used in Covidence is available in the Supplementary file: Section 3. Key items extracted were: publication date; study location (country and region/state/province); sample frame; the criteria used to define whether pain was chronic; the neuropathic pain screening tool used and the threshold used for defining caseness; the number of people approached to take part; the number of people recruited and who completed the questionnaires; the number of people with no pain, acute pain, chronic pain, and chronic pain with neuropathic features. Where sample weights were used by the authors, the raw and weighted sample sizes were recorded.

Study quality and risk of bias were assessed on a Covidence template using the Joanna Briggs Institute's (JBI) Checklist for Prevalence Studies [28,33]. A copy of the quality assessment template is available in the Supplementary file: Section 4. The tool includes nine questions, each answered "yes", "no", or "unclear". The checklist does not produce a score, and hence, there is no cut-off score for deciding whether a study should be included in a review. Rather, the evidence is weighed over the questions, and a subjective decision to include a paper is made based on the balance of the evidence.

2.4 Effect measure

The effect measure of interest was the prevalence of pain with neuropathic features in the study sample.

2.5 Reporting bias and certainty assessments

No assessment of reporting bias and certainty was made.

2.6 Data analysis

All analyses and plotting were performed in the R statistical environment (v4.4.2) using functions from the following packages: dplyr^[47], epiR³⁸, forcats⁴⁵, ggdist²⁹, ggplot2⁴⁶, meta⁴, prevalence¹¹, purrr⁴⁸, and tidyr⁴⁹.

All analysis scripts and the data used in these scripts are available at:

https://github.com/kamermanpr/neuropathic-pain_prevalence/ and mirrored at [Zenodo.org](https://zenodo.org/doi/10.5281/zenodo.17510858) (<https://doi.org/10.5281/zenodo.17510858>). In addition, a Docker image has been created for the R environment used in these analyses

(https://hub.docker.com/repository/docker/kamermanpr/neuropathic-pain_prevalence/).

Instructions on how to use the Docker image to recapitulate or modify our analyses are provided in the README file on the GitHub/Zenodo repositories. Outputs from the Bayesian models were too large to upload to GitHub, so they were uploaded to a separate Zendo repository (<https://doi.org/10.5281/zenodo.15591085>).

The analysis was conducted as follows:

2.6.1 Apparent prevalence

1. Apparent prevalence (i.e., no correction for screening tool sensitivity and specificity) was calculated using the number of people detected as having pain with neuropathic features (as detected using screening tools) and the total number of people reported to have completed the questionnaires. For the two studies where population weights were applied to the data, the scaled sample sizes were used instead of the raw numbers^{12,43}. Following data extraction, the proportion (95% confidence interval; calculated using the exact binomial method) of people with pain with neuropathic features was calculated for each study.

2. A random effects model meta-analysis for proportions was used to estimate the apparent prevalence of pain with neuropathic features across the eight studies. Details of meta-analysis method: i) an arcsine transformation was applied to individual study proportions before the calculation of the overall proportion using the inverse variance method (data were back transformed for reporting), iii) a restricted maximum-likelihood estimator was used to calculate the between-study variance (tau-squared), iv) the Q-Profile method was used to calculate the confidence interval of tau-squared and its square root, tau, and v) the calculation of I-squared was based on Q.

The decision to use a random effect model was made before the analysis was undertaken, and was selected ahead of a fixed effects model because we felt that differences in the populations assessed (i.e., population structure), the methods of recruitment (postal versus telephonic solicitation), the methods of measurement (three different screening tools were used), and the methods of questionnaire delivery (e.g.,

entirely self-complete versus directed verbal instructions) meant that it was unlikely that a single true effect could be assessed.

2.6.2 True prevalence

1. Because the sensitivity and specificity values of a screening tool are not universal, and apply only for the sample of people and context in which the tool was developed^{8,27}, we generated distributions of possible sensitivity and specificity values for each questionnaire for inclusion in the Bayesian modelling of true prevalence (see below). The distributions of possible sensitivity and specificity values for each screening tool were modelled using a beta distribution, with the two shape parameters for each distribution being determined using the “beta.buster” function in the R “epiR” package. The R script to generate the distributions is located in the “03_betas.R” file at <https://doi.org/10.5281/zenodo.17510858>. In brief, for each published validation of the screening tools used in the studies included in this review, we extracted the point estimates for the sensitivity and specificity of the screening tool at the scoring threshold used in the reviewed studies. These values were specified as the most likely sensitivity and specificity values for a particular screening tool, with 90% confidence that the sensitivity/specificity value was greater than the sensitivity/specificity value - 0.1. For example, the published sensitivity for a score ≥ 19 on the PainDetect instrument is 0.84¹⁸, which was specified as the most likely value, and we were 90% confident that the sensitivity value was greater than 0.74.
2. We used the “truePrev” function from the R “prevalence” package to calculate the true prevalence for each of the reviewed studies. The values specified for the number of people with pain with neuropathic features and the total sample size were the same

as those used in the calculation of the apparent prevalences (see above). In addition, the distributions of sensitivity and specificity values for each screening tool were specified using the beta distributions that had been calculated (see above). The data were then modelled under two conditions:

- a. An uninformative prior distribution, specified as Beta(1, 1),
- b. An informative prior distribution, specified as Beta(4.389, 29.52249). The informative prior distribution was generated using the “beta.buster” function in the R “epiR” package, with distribution assumptions based on the results of the meta-analysis conducted using the apparent prevalence point estimate, namely, the most likely value = 0.1062 (10.62%), with 90% confidence that the true prevalence was less than 0.2062; see the Results section below for detailed findings of the apparent prevalence meta-analysis.

The modelling started with 5 chains using a burn-in of 10,000 iterations, and an update of 100,000 iterations. The convergence of each model was then checked using the Brooks-Gelman-Rubin statistic, with convergence accepted at values < 1.2. If convergence was not attained, the burn-in and update iterations were each increased by a factor of 10 until convergence was achieved.

The final model specifications for each study, and the model outputs, can be viewed in the R script files: i) “04_prevalence_true_bayesian_uninformative.R”, and ii) “05_prevalence_true_bayesian_informative.R” (<https://doi.org/10.5281/zenodo.17510858>)

3. The results of the Bayesian estimates of true prevalence for each study were plotted as the point estimate with 66% and 95% high-density intervals (certainty intervals). The boundaries of the high-density intervals were determined using the quantile method.
4. To perform a meta-analysis of the true prevalence data, we multiplied the total number of people reported to have completed the questionnaires in each study by the calculated point estimate of true prevalence for a study. The resulting values were then included in the meta-analysis model as the number of people with pain with neuropathic features for each study. The meta-analysis was completed using the same methods described in point 2 of the *apparent prevalence* section.

3. Results

3.1 Search results

Figure 1 provides an overview of the article selection process. After duplicate removal and title-abstract screening, 21 articles underwent full-text screening. Twelve of these 21 studies were deemed not to fit the inclusion criteria; a list of the 12 studies and the reason for their exclusion is provided in Section 5 of the Supplementary file^{1,3,13–15,20,24,32,36,39–41}. The remaining 9 studies underwent data extraction^{5,10,12,21,23,26,42,43,50}. However, during the extraction process, it became evident that sensitivity and specificity data for the screening tool used in one of the studies (Japanese version of the painDETECT) were not available²⁶. Only the specificity of the tool was forthcoming after emailing the authors, so the study was excluded at the data extraction phase.

3.2 Study characteristics

The characteristics of the eight studies that were included in the review are provided in Table

1. One of the studies, VanDenKerkhof et al., 2016⁴³, screened the recruited population for the presence of chronic pain with neuropathic features using the DN4-interview and the S-LANSS; we decided to treat the results from the two screening tools as two independent datasets, with both datasets being included in our analyses.

One study each was conducted in France¹⁰ and in Morocco²¹, and two studies were conducted in each of Canada^{42,43}, the United Kingdom^{5,23}, and the United States of America^{12,50}. Five studies were national studies^{5,10,12,21,43}, with the rest being regional. Six studies used the DN4-interview^{5,10,21,23,42,43}, two studies used the S-LANSS^{43,50}, and one study used the painDETECT¹². In all cases, the published recommended screening tool scores were used to define whether a participant had pain with neuropathic features (DN4-interview: ≥ 3 ^{9,22}, painDETECT: ≥ 19 ¹⁸, and S-LANSS: ≥ 12 ⁷). Similarly, all studies used pain lasting ≥ 3 months to classify whether pain was chronic. The study by VanDenKerkhof et al.⁴³ included the additional criterion that the pain was associated with a likely (e.g., accident with nerve damage, amputation, and shingles) or probable (e.g., surgery more than 3 months ago, back problem, diabetes, cancer) insult to the somatosensory nervous system that could result in neuropathic pain. The point estimates of the sensitivity and specificity of the three screening tools were extracted from their respective validation studies (i.e., DN4-interview in French⁹, DN4-interview in Arabic²², S-LANSS in English⁷). Where no validation study was available for the language version of the screening tool used in a survey, the sensitivity and specificity values were taken from the original validation study (e.g., an unvalidated English translation of the original French version of the DN4-interview was used in four of the surveys^{5,23,42,43}, so the sensitivity and specificity reported in the French validation study were used⁹).

In total, across the 8 studies, approximately 1,411,552 people were approached to participate in the surveys (largest: ~1,000,000¹², smallest: 4,167⁴²). Of those approached, 235,479 people responded (average response rate: 16.7%; lowest: 2.5%¹², highest: 81.2%¹⁰), and 214,925 people had complete data that could be analysed (average completion rate: 15.2%; lowest: 2.5%¹², highest: 78.6%¹⁰). Across the 9 datasets (VanDenKerkhof et al.⁴³ contributed 2 datasets), the raw—no correction for population structure—total number of people fitting the criteria for chronic pain with neuropathic features was 20,217, giving a raw prevalence of 9.3%.

3.3 Study quality and risk of bias

Results of the JBI Checklist for Prevalence Studies are provided in Table 2. Overall, there were limitations in several study quality metrics, particularly the reporting of standardisation methods for questionnaire administration, the appropriateness of the statistical analysis, and low response rates. However, no studies were excluded based on the overall balance of the evidence quality.

3.4 Apparent prevalence

Figure 2 shows a forest plot of apparent prevalence (i.e., no correction for screening tool sensitivity and specificity) for the eight studies included in the analysis. The highest prevalence reported was by Toth et al. [17.9% (95% confidence interval: 18.8; 20.2)]⁴², and the lowest prevalence was reported by Bouhassira et al. [6.9% (95% confidence interval: 6.6; 7.2)]¹⁰. Overall, the random effects model returned a pooled estimate for apparent prevalence of 10.6% (95% confidence interval: 8.5; 12.9).

3.5 True prevalence

Figure 3 shows the mean and credible intervals of true prevalence (i.e., after correcting for screening tool sensitivity and specificity) for the eight studies using an informative prior (top panel), and a non-informative prior (bottom panel). In both scenarios, the highest prevalence reported was by Toth et al. [informative prior: 8.7% (95% credible interval: 3.1; 15.7); non-informative prior: 6.0% (95% credible interval: 0.3; 15.5)]⁴², and the lowest prevalence was reported by Bouhassira et al. [informative prior: 3.3% (95% credible interval: 1.2; 6.0)]¹⁰, and VanDenKerkhof et al. [non-informative prior: 1.2% (95% credible interval: 0.0; 4.0)]⁴³.

Figure 4 shows a forest plot of true prevalence for the eight studies using an informative prior (top panel), and a non-informative prior (bottom panel); the number of events was based on the total sample multiplied by the mean proportion shown in Figure 3 [e.g., Toth et al.: 0.087 (mean for informative prior) x 1,207 (sample size) = 105 events]. In both scenarios, the highest prevalence reported was by Toth et al. [informative prior: 8.7% (95% confidence interval: 7.2; 10.4); non-informative prior: 6.0% (95% confidence interval: 4.8; 7.5)]⁴², and the lowest prevalence was reported by Bouhassira et al. [informative prior: 3.3% (95% confidence interval: 3.1; 3.5)]¹⁰, and VanDenKerkhof et al. [non-informative prior: 1.2% (95% confidence interval: 1.2; 1.2)]⁴³.

Overall (Figure 4), the pooled estimates from the meta-analysis was 4.9% (95% confidence interval: 3.8; 6.1) when using an informative prior, and 2.3% (95% confidence interval: 1.5; 3.2) when using a non-informative prior.

4. Discussion

We undertook to provide the first-ever estimate of the true prevalence of pain with neuropathic characteristics in the general adult population by conducting a systematic review of the field and then using Bayesian methods to provide a more accurate estimate of the true prevalence of the condition by correcting apparent prevalences generated through the use of imperfect screening tools. Using data from eight studies that met our inclusion criteria, the apparent prevalence was 10.6% (95% confidence interval: 8.5; 12.9). Correcting for screening tool sensitivity and specificity shifted the estimate of true prevalence substantially lower [informative prior: 4.9% (95% confidence interval: 3.8; 6.1); non-informative prior 2.3% (95% confidence interval: 1.5; 3.2)].

A limitation of our analytical approach when calculating the pooled estimate of true prevalence is that we only used the mean density of the credible interval for each study when back-calculating the number of cases for the meta-analysis. Thus, we did not perform meta-analyses for all possible combinations of major landmarks in the credible intervals (e.g., mean, 66% interval, 95% interval) across the studies. However, we judged that this large undertaking would only yield incremental improvements in the quality of our estimates. Instead, we present the credible intervals for each study using an informative and non-informative prior, and the pooled estimate from the meta-analysis represents the true prevalence based on the most likely estimates from the Bayesian analysis. A related limitation is our choice of an informative prior, which in this case was the apparent prevalence for each study. Doing so meant that we used prevalence estimates that we state are incorrect to inform a revised estimate, and the posterior distributions are thus informed by inappropriate priors. Nevertheless, we felt it important to include at least two Bayesian models using different prior assumptions.

While we believe our Bayesian approach provides better estimates of the prevalence of pain with neuropathic characteristics in the adult population, we still believe that our values may overestimate the true prevalence of pain with neuropathic characteristics. We reason that while our analysis approach corrects for the use of imperfect screening tools, inherent deficiencies across all of the included studies could lead to a positive reporting bias (Table 2). That is, there was a high prevalence of unclear or deficient sampling frames, unclear or absent controls for coverage bias and adjustment to reference populations, and response rates were generally low to very low. For example, the UK Biobank is not a representative sample of the UK population¹⁹, and the respondents to the pain rephenotyping sub-study differed from the parent sample⁵. Yet, no adjustments were made to the sample in the rephenotyping study, which would have improved the generalisability of the findings^{2,30,44}. Another shortcoming of the data is that it is heavily biased to high-income, western countries (Europe and North America), with only a single study coming from a low- or middle-income country (Morocco²¹). The data are therefore representative of a Western, high-income country context and may not be globally representative.

We also draw attention to the fact that our true prevalence estimates of pain with neuropathic characteristics probably overestimate the true prevalence of neuropathic pain in the adult population. The co-occurrence of certain pain symptoms can be suggestive that a pain is neuropathic in origin; however, these symptom clusters are not pathognomic. Indeed, in the clinical context (as opposed to the epidemiological context)³¹, a combination of particular co-occurring symptoms, a relevant medical history, and a plausible neuroanatomical distribution are all required for the grading of a pain as being possible neuropathic pain; the lowest level of diagnostic certainty¹⁶. One study in our sample factored causes of neuropathic pain into

their case definition⁴³, but that still means that none of the studies met the minimum level of evidence to define the presence of possible neuropathic pain instead of pain with neuropathic characteristics. We propose that any epidemiological studies to estimate the prevalence of neuropathic pain as such, and not pain with neuropathic features, must include not only symptom screens, but also solicit information on medical history (e.g., the presence of a preceding injury or disease of the somatosensory nervous system that could explain the pain) and site of pain (e.g., body charts)³¹.

In conclusion, we used a Bayesian methodology to estimate the true prevalence of pain with neuropathic characteristics. Using this method, we show that our pooled estimates of true prevalence are about 75% (non-informative prior) and 50% (informative prior) lower than the pooled estimate of apparent (uncorrected) prevalence. The substantial downward revision of prevalence estimates presented here compels a reassessment of how the burden of neuropathic pain is conceptualised in population health. However, a lower prevalence should not be equated with reduced societal or clinical significance. Neuropathic pain remains a debilitating condition that impacts quality of life, functional capacity and mental health. Its effects influence caregiver responsibilities, workforce participation, and healthcare resource use. As such, these revised estimates argue not for the reprioritisation of neuropathic pain in research and policy agendas, but for more precise, evidence-informed strategies to identify, manage and mitigate its impact.

CONTRIBUTIONS

PRK: Conceptualisation, data curation, formal analysis (including directly accessing and verifying the data), investigation, supervision, visualisation, and writing – original draft. TH: Formal analysis (including directly accessing and verifying the data), investigation,

visualisation, and writing – review & editing. NM: Investigation, and writing – review & editing. PCC: Investigation, and writing – review & editing. All authors had full access to all the data in the study and had final responsibility for the decision to submit for publication.

CONFLICTS OF INTEREST

P.R.K. is the sole proprietor of Blueprint Analytics and is a consultant for Partners in Research. The remaining authors have no conflicts of interest to declare.

DATA SHARING

All data, analysis scripts, and the analysis environment are available at:

https://github.com/kamermanpr/neuropathic-pain_prevalence (mirrored at

<https://doi.org/10.5281/zenodo.17510858>),

https://hub.docker.com/repository/docker/kamermanpr/neuropathic-pain_prevalence, and

<https://doi.org/10.5281/zenodo.15591085>.

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Figure 1. PRISMA flow diagram for the study selection process.

Figure 2. Forest plot of the apparent prevalence (not corrected for screening tool sensitivity and specificity) of pain with neuropathic characteristics. The sample sizes for DiBonaventura et al., 2017, and VanDenKerkhof et al., 2016 are the scaled values for the adult population of the respective countries. The study by VanDenKerkhof et al., 2016 made use of two screening tools, the Douleur Neuropathique en 4 - interview only (DN4-i) and the Self-complete Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS).

Figure 3. Posterior distributions of pain with neuropathic characteristics. The blue squares show the means of the posterior distributions, while the thickened bars show the 66% credible interval, and the thin bars show the 95% credible interval for the distributions. The vertical dashed line shows the estimated apparent prevalence (not corrected for screening tool sensitivity and specificity) of pain with neuropathic characteristics (estimate = 10.6%), and the vertical orange bar shows the 95% confidence interval for the estimated apparent prevalence of pain with neuropathic characteristics (estimate = 8.5 to 12.9). The top panel (A) used the beta distribution of the apparent prevalence as an informative prior (likely value = 10.6%, with 90% confidence that the value was below 20.62%), while the bottom panel (B) used a non-informative beta distribution as a prior. The study by VanDenKerkhof et al., 2016 made use of two screening tools, the Douleur Neuropathique en 4 - interview only (DN4-i) and the Self-complete Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS).

Figure 4. Forest plots of the true prevalence (Bayesian correction for screening tool sensitivity and specificity) of pain with neuropathic characteristics. For each study, the number of cases was back-calculated from the mean value for the Bayesian posterior

distribution. The top panel (A) used the beta distribution of the apparent prevalence as an informative prior (likely value = 10.6%, with 90% confidence that the value was below 20.62%), while the bottom panel (B) used a non-informative beta distribution as a prior. The sample sizes for DiBonaventura et al., 2017, and VanDenKerkhof et al., 2016 are the scaled values for the adult population of the respective countries. The study by VanDenKerkhof et al., 2016 made use of two screening tools, the Douleur Neuropathique en 4 - interview only (DN4-i) and the Self-complete Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS).

Table 1. Description of the studies included in the systematic review and meta-analysis (eight studies, with one study having two datasets)

Article	Country (region)	Screening tool	Sensitivity of the screening tool at the threshold score	Specificity of the screening tool at the threshold score	Screening tool threshold score for defining the presence of pain with neuropathic features	Additional requirements for the case definition of chronic pain with neuropathic features	Number of individuals contacted	Number of individuals recruited [response rate] ⁸ (%)	Analytical set: Number of individuals completing the screening tool assessment (scaled N) [completion rate] ⁹ (%)	Number of individuals in the analytical set with chronic pain with neuropathic features (scaled N)
Baskozos et al., 2023	UK (regions: England, Scotland, Wales)	DN4 (interview) ⁵	0.78	0.812	≥ 3	Pain duration ≥ 3 months	335,587	167,203 [49.8]	148,828 [44.3]	13,744
Bouhassira et al., 2008 ¹	France (national)	DN4 (interview) ⁵	0.78	0.812	≥ 3	Pain duration ≥ 3 months	30,155	24,497 [81.2]	23,712 [78.6]	1,631
DiBonaventura et al., 2017	USA (national)	PainDETECT	0.84	0.84	≥ 19	Pain duration ≥ 3 months	~1,000,000 ⁷	24,925 [2.5]	24,925 (241,829,594) [2.5]	2,548 (24,206,788)
Harifi et al., 2013 ²	Morocco (national)	DN4 (interview) ⁵ [Arabic version]	0.894	0.724	≥ 3	Pain duration ≥ 3 months	8,382	5,328 [63.6]	5,116 [61.0]	542
Hebert et al., 2021 ³	UK (region: Scotland)	DN4 (interview) ⁵	0.78	0.812	≥ 3	Pain duration ≥ 3 months	20,221	7,240 [35.8]	6,058 [30.0]	932
Toth et al., 2009	Canada (region: Alberta)	DN4 (interview) ⁵	0.78	0.812	≥ 3	Pain duration ≥ 3 months	4,167	1,207 [29.0]	1,207 [29.0]	216

Article	Country (region)	Screening tool	Sensitivity of the screening tool at the threshold score	Specificity of the screening tool at the threshold score	Screening tool threshold score for defining the presence of pain with neuropathic features	Additional requirements for the case definition of chronic pain with neuropathic features	Number of individuals contacted	Number of individuals recruited [response rate] ⁸ (%)	Analytical set: Number of individuals completing the screening tool assessment (scaled N) [completion rate] ⁹ (%)	Number of individuals in the analytical set with chronic pain with neuropathic features (scaled N)
VanDenKerkhof et al., 2016 ⁴ Dataset 1	Canada (national)	DN4 (interview) ⁵	0.78	0.812	≥ 3	Pain duration ≥ 3 months + likely or possible cause of neuropathic pain	7,134	1,504 [21.1]	1,504 (26,423,076) [21.1]	166 (3,027,521)
VanDenKerkhof et al., 2016 ⁴ Dataset 2	Canada (national)	S-LANSS (self-complete) ⁶	0.74	0.76	≥ 12	Pain duration ≥ 3 months + likely or possible cause of neuropathic pain	7,134	1,504 [21.1]	1,504 (26,423,076) [21.1]	123 (2,030,351)
Yawn et al., 2009	USA (region: Olmsted County, Minnesota)	S-LANSS (self-complete) ⁶	0.74	0.76	≥ 12	Pain duration ≥ 3 months	5,897	3,575 [60.6]	3,575 [60.6]	315

1. Population weights were used for the analysis of demographic data, but their use for pain prevalence calculations was unclear, so raw data were used to calculate prevalence
2. The number of cases back-calculated from the reported prevalence
3. The number of individuals in the analytical set and the number of individuals with pain with neuropathic features were extracted from Table 7
4. Raw numbers were extracted from Figure 1. Weighted numbers were extracted from Table 1
5. DN4: Douleur Neuropathique en 4 Questions (interview only)
6. S-LANSS: Self-completed Leeds Assessment of Neuropathic Symptoms and Signs
7. The exact number was not reported

8. Response rate: Number of individuals recruited / number of individuals approached to take part in the study
9. Completion rate: Number of respondents included in the analysis/number of individuals approached to take part in the study

Table 2. Quality assessment of the studies included in the systematic review and meta-analysis (eight studies).

Article	Was the sample frame appropriate to address the target population? ¹	Were study participants sampled in an appropriate way? ²	Was the sample size adequate? ³	Were the study subjects and the setting described in detail? ⁴	Was the data analysis conducted with sufficient coverage of the identified sample? ⁵	Were valid methods used for the identification of the condition? ⁶	Was the condition measured in a standard, reliable way for all participants? ⁷	Was there appropriate statistical analysis? ⁸	Was the response rate adequate, and if not, was the low response rate managed appropriately? ⁹
Baskozos et al., 2023	Unclear Used an existing cohort (UK Biobank), and the sample frame for that cohort was not clear.	Yes	Yes	Yes	No There was an over representation of participants who were: female, of younger age, lower BMI, and who were less socially deprived compared with the rest of the UK Biobank cohort	Yes	Unclear Self-administered questionnaire with no stated quality assurance mechanism.	No - Prevalence was reported without confidence intervals - Sample weights were not applied.	No Response rate: 49.8%
Bouhassira et al., 2008	Yes	Yes	Yes	Yes	Yes	Yes	Unclear Self-administered questionnaire with no stated quality assurance mechanism.	Yes	Yes

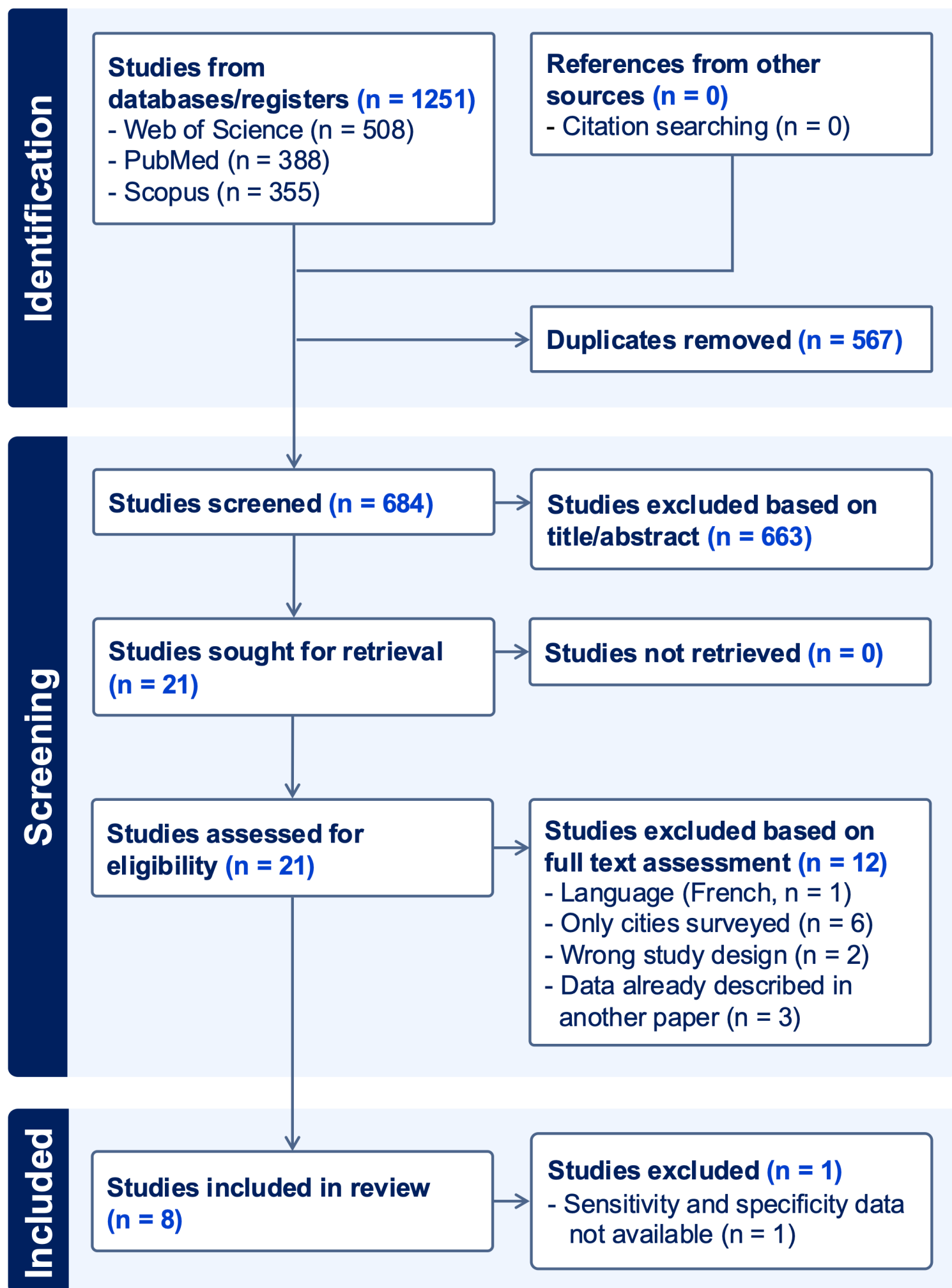
Article	Was the sample frame appropriate to address the target population? ¹	Were study participants sampled in an appropriate way? ²	Was the sample size adequate? ³	Were the study subjects and the setting described in detail? ⁴	Was the data analysis conducted with sufficient coverage of the identified sample? ⁵	Were valid methods used for the identification of the condition? ⁶	Was the condition measured in a standard, reliable way for all participants? ⁷	Was there appropriate statistical analysis? ⁸	Was the response rate adequate, and if not, was the low response rate managed appropriately? ⁹
DiBonaventura et al., 2017	Unclear The representativeness of population databases was not stated.	Unclear The balance between random sampling and convenience sampling was not stated	Yes	Yes	Yes	Yes	Unclear The majority of the sample was assessed using a self-administered questionnaire with no stated quality assurance mechanism.	Yes	No Response rate: 2.5%
Harifi et al., 2013	No The sample frame only included households with landlines.	Yes	Yes	Yes	No Incomplete sampling frame (landline household only), and over representation of female respondents.	Yes	Unclear Telephone interview with no information provided on the training of interviewers.	No - The number of respondents with neuropathic pain was not stated. - Sample weights were not applied.	No Response rate: 63.6%

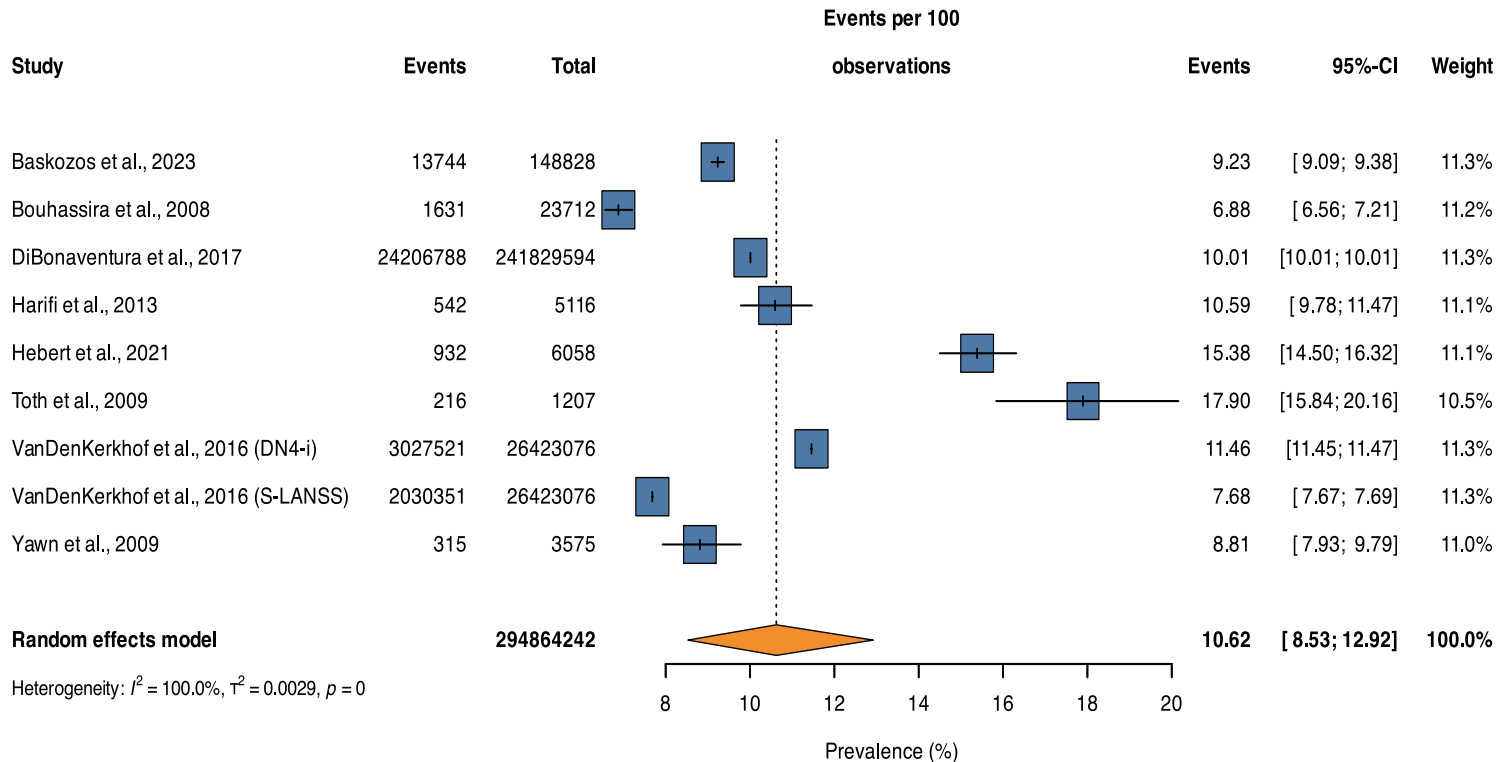
Article	Was the sample frame appropriate to address the target population? ¹	Were study participants sampled in an appropriate way? ²	Was the sample size adequate? ³	Were the study subjects and the setting described in detail? ⁴	Was the data analysis conducted with sufficient coverage of the identified sample? ⁵	Were valid methods used for the identification of the condition? ⁶	Was the condition measured in a standard, reliable way for all participants? ⁷	Was there appropriate statistical analysis? ⁸	Was the response rate adequate, and if not, was the low response rate managed appropriately? ⁹
Hebert et al., 2021	Unclear Used a pre-existing cohort (GS:SFHS), and the sample frame for that cohort was not clear.	Yes	Yes	Yes	Unclear Table 2 suggests differences between survey respondents and nonrespondents in the GS:SFHS cohort.	Yes	Unclear Self-administered questionnaire with no stated quality assurance mechanism.	No - Unclear numerator and denominator, and no confidence intervals reported for prevalence result. - Sample weights were not applied.	No Response rate: 35.8%
Toth et al., 2009	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No Unclear whether stated design components (clusters and stratification) were factored into prevalence estimate calculation. Sample weights were not applied.	Unclear Response rate: 29.0%, but, but the index of dissimilarity indicated no major deviations from the parent population from which the sample was drawn.

Article	Was the sample frame appropriate to address the target population? ¹	Were study participants sampled in an appropriate way? ²	Was the sample size adequate? ³	Were the study subjects and the setting described in detail? ⁴	Was the data analysis conducted with sufficient coverage of the identified sample? ⁵	Were valid methods used for the identification of the condition? ⁶	Was the condition measured in a standard, reliable way for all participants? ⁷	Was there appropriate statistical analysis? ⁸	Was the response rate adequate, and if not, was the low response rate managed appropriately? ⁹
VanDenKerkhof et al., 2016	Yes	Yes	Yes	Yes	Yes	Yes	Unclear The majority of the sample was assessed using a self-administered questionnaire with no stated quality assurance mechanism.	Yes	Unclear The estimated sample size was 4000 respondents, but only received 1504 completed responses. However, sample weights were used.
Yawn et al., 2009	Unclear • The sample frame would have excluded people not attending healthcare facilities in the past 3 years.	Yes	Yes	No No demographic data for the full sample.	Unclear No demographic data for the cohort to judge age, sex, etc distributions.	Yes	Unclear Self-administered questionnaire with no stated quality assurance mechanism.	No Sample weights were not applied.	No Response rate: 60.6%.

1. Was the sample frame appropriate to capture the target population (e.g., the general adult population of a country)?
2. Was random probabilistic sampling or a census used within the sample frame?
3. Using Cochrane's Formula and an estimated prevalence of pain with neuropathic features of 8.5% (the mid-point estimated by van Hecke et al., 2014, doi: j.pain.2013.11.013), the sample size should have been ≥ 1034 .
4. Was the study sample described in sufficient detail so that other researchers could determine if it is comparable to the population of interest to them?
5. Was there coverage bias (i.e., did all subgroups of the identified sample respond at the same rate)?
6. Was the outcome assessed based on existing definitions or diagnostic criteria?
7. Were those involved in collecting data trained or educated in the use of the instrument?

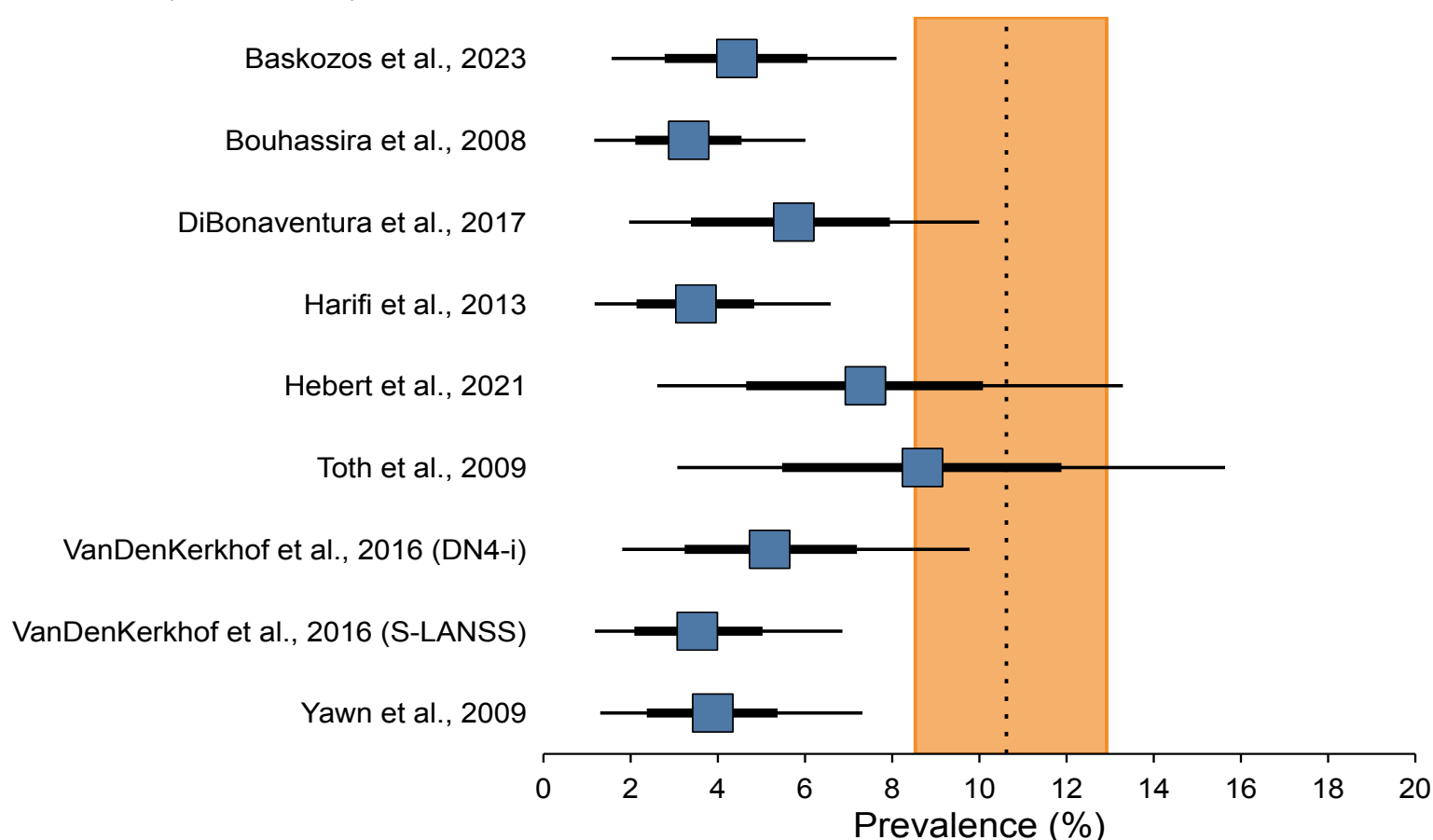
8. Was the analytical approach adequate in terms of the assumptions associated with the approach (differing methods of analysis are based on differing assumptions about the data)? Was the statistical reporting robust (clear denominator and numerator, and the prevalence reported with a confidence interval)?
9. Was there a low response rate, which may diminish a study's validity? Response rates less than 70% were considered inadequate.





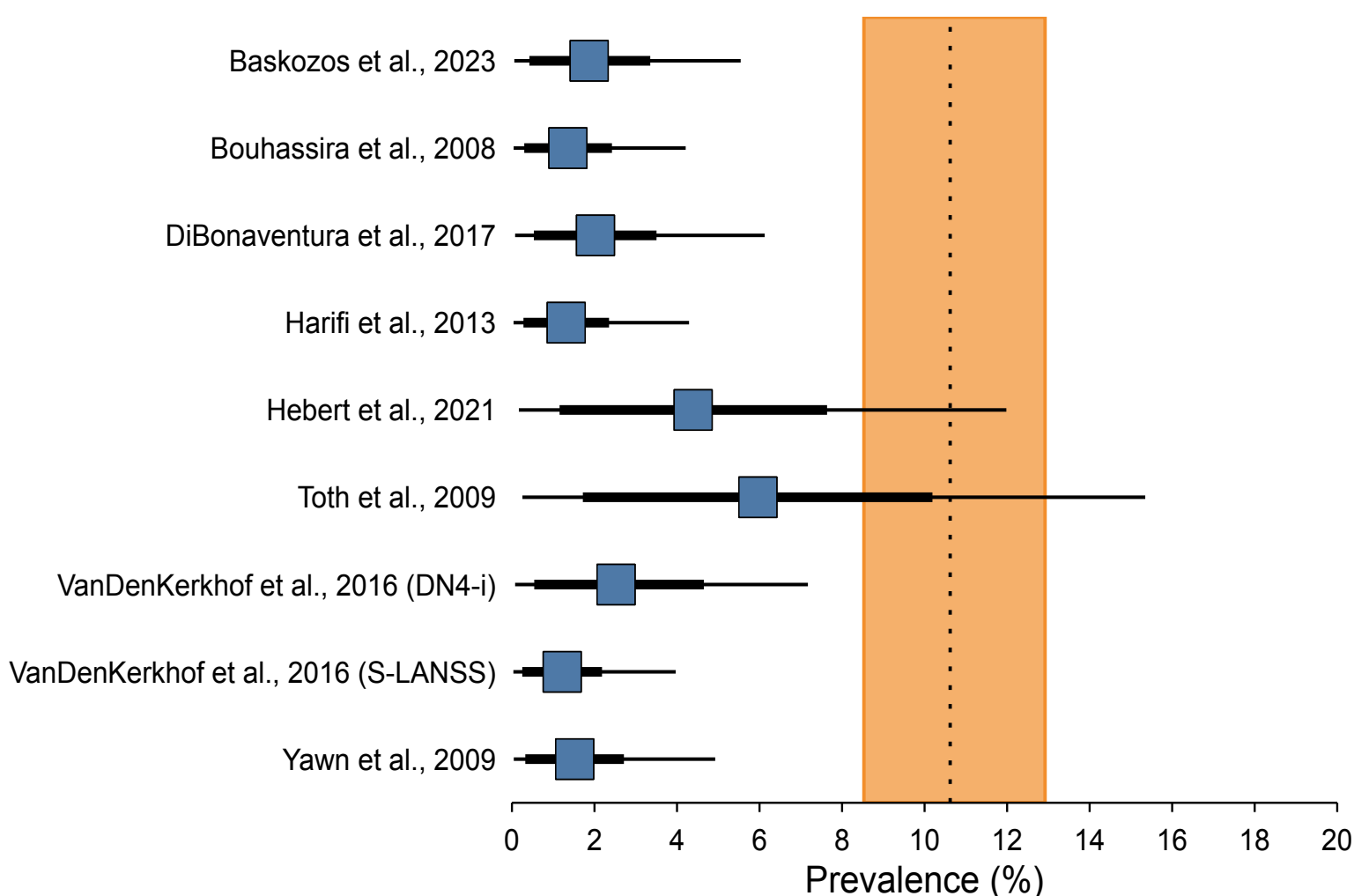
A: Informative prior

Prior = Beta(4.389, 29.522)

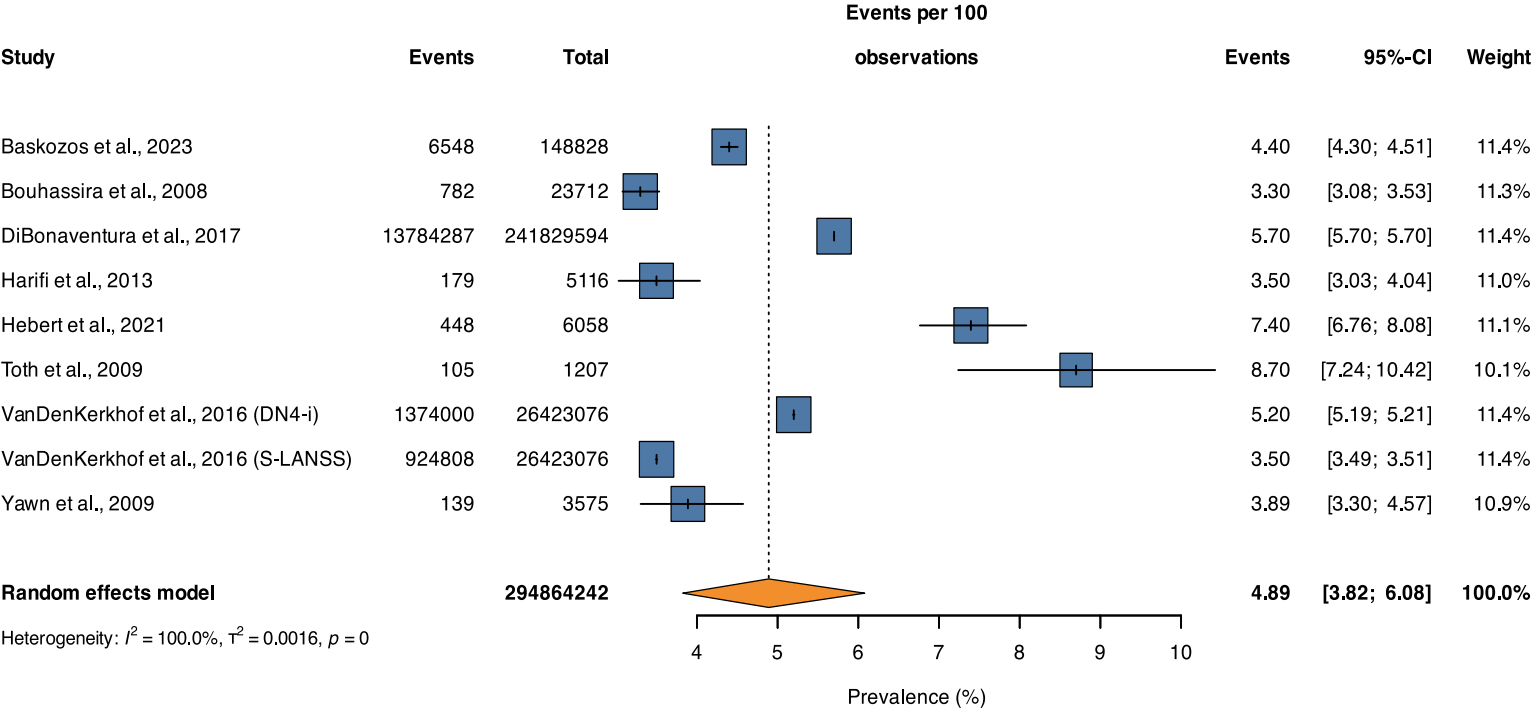


B: Non-informative prior

Prior = Beta(1, 1)



A: Informative prior
Prior = Beta(4.389, 29.522)



B: Non-informative prior
Prior = Beta(1, 1)

