BMC Pulmonary Medicine

SYSTEMATIC REVIEW Open Access

# Prevalence of chronic respiratory disease using case-finding tools in adults living with noncommunicable disease in low- and middle-income countries: a systematic review

Adriano Petrolini-Mateus[1], Gustavo Henrique Guimarães Araujo[1], Nathany Souza Schafauser-Segundo[1], Naiara Tais Leonardi[1], Viviane Castello-Simões[1], John R. Hurst[2†] and Renata Gonçalves Mendes[1*†]

## Abstract

**Background** Chronic respiratory diseases (CRD) often coexist with other non-communicable diseases (NCD) and are responsible for nearly three-quarters of all deaths in low- and middle-income countries (LMIC). People living with NCD are considered at higher risk of having CRD, but the prevalence of CRD in those with other NCD in LMIC is not well described. This study aimed to identify the prevalence of CRD and/or abnormal spirometry identified through case-finding tools in adults living with NCD in LMIC.

**Methods** This systematic review followed the PRISMA guidelines and included Lilacs, PubMed, Scielo, Embase and Web of Science databases. Two reviewers independently examined the titles and abstracts of studies identified from the search to determine eligibility for inclusion. Searching was carried out until May 16, 2024, and was updated in February 2025. Cross-sectional studies that used case finding tools to identify CRD in adults living with other NCD in LMIC were eligible. The studies were exported to Rayyan software, and duplicates were manually removed. Data were extracted including study characteristics, and quality was assessed using the modified Newcastle-Ottawa Scale risk of bias tool. A descriptive analysis of the prevalence of respiratory diseases and spirometric abnormalities was reported considering 95% confidence intervals.

**Results** A total of 8,939 citations were screened based on titles and abstracts. Thirteen full-text articles were assessed for eligibility. Five studies were excluded for not providing sufficient data, two for inadequate outcome ascertainment, two for being conducted in developed countries, and one for only including patients with a previous COPD diagnosis. Three cross-sectional studies met the inclusion criteria, one conducted in India, and two in Brazil. Considering

†John R. Hurst and Renata Gonçalves Mendes have contributed equally to this work.

*Correspondence:
Renata Gonçalves Mendes
renatamendes@ufscar.br

Full list of author information is available at the end of the article

studies with a low risk of bias, the prevalence of CRD was between 1% and 5.2% in patients with hypertension. The prevalence of abnormal spirometry was between 11% and 17% in patients with coronary artery disease.

**Conclusion** The prevalence of CRD identified through case-finding tools in adults with NCD in LMIC varies according to the NCD in which it was investigated. These findings highlight the opportunity to case-find CRD by assessing people accessing care for other NCD.

**Registration** PROSPERO 2024 CRD42024534734.

**Keywords** Prevalence, Public health, Respiratory tract diseases, Noncommunicable diseases, Mass screening, Developing countries

## Introduction

Chronic respiratory diseases (CRD) are characterized by chronic inflammation and/or fibrosis of the airways and interstitium of the lungs [1], and are common and neglected in low- and middle-income countries (LMIC). Chronic obstructive pulmonary disease (COPD), asthma, bronchiectasis, and interstitial lung diseases contribute to 7% of deaths worldwide [2, 3]. Asthma and COPD represent the most prevalent CRD affecting 300 and 400 million people, respectively. CRD often occurs in combination with other noncommunicable diseases (NCD), mainly due to shared risk factors such as socioeconomic disadvantage, noxious respiratory exposures, and aging [4]. NCD, including hypertension, cardiovascular diseases, cancer, diabetes, and CRD, are collectively responsible for almost 70% of all deaths worldwide [5].

In LMIC, NCD conditions are responsible for nearly three-quarters of all deaths and for 82% of the 16 million premature deaths [6, 7]. Most of these diseases, at least in part, are preventable [3]. People living with NCD use health services more frequently with significant healthcare expenditure. There is a high demand for routine and acute consultations related to NCD [8, 9]. In fact, health service use is largely determined by users' perceived needs based on their health condition and previous knowledge of their disease [10].

NCD, including CRD, commonly develop as a consequence of repeated exposure to noxious environmental stimuli such as air pollution, cigarette smoke, and occupational hazards [11]. Possible causes of CRD include repeated severe respiratory infections during childhood, genetic factors, iatrogenic responses, and lifestyle habits [12]. As a consequence, people with CRD often experience an increased prevalence of physical and mental health problems, along with recurrent exacerbations that further limit functional capacity, reduce exercise tolerance, and result in repeated need for hospitalization and impaired health-related quality of life [13, 14].

The lack of resources and trained personnel to properly perform and interpret confirmatory tests for CRD, such as spirometry, poses barriers to diagnosis in LMIC. As a result, many patients remain undiagnosed, and, consequently, undertreated [15]. This contributes to increased healthcare use, a higher risk of disability, acute exacerbations, and premature death [16]. Case-finding tools for CRD do exist and comprise a range of instruments including spirometry, imaging tests, peak expiratory flow rate, and questionnaires. These instruments have received a conditional recommendation in the Global Initiative for Chronic Obstructive Lung Disease (GOLD) strategy [13] and there are several studies of case-finding for CRD in primary care from a variety of settings worldwide [17–19]. These show that case-finding instruments have reasonable precision in identifying symptomatic CRD, offering the advantage of facilitating timely diagnosis and treatment outside specialty settings [20, 21].

Considering that CRD often occur alongside other NCD, and that care for other NCD such as hypertension and diabetes is often better established, initiatives are needed to investigate CRD diagnosis in this population, increasing early diagnosis, and optimizing treatment. Building this knowledge may contribute to achieving the global goal of chronic disease prevention and control. It is expected that the most prevalent NCD will result in cumulative global economic losses of 47 trillion USD by 2030 [22], with disproportionate impacts on LMIC, where health systems are fragile, safety nets are lacking, and efforts to cope with multiple concurrent health issues are ongoing [23]. Therefore, there is a need to systematically review the approaches used to identify people with CRD in LMIC settings as highlighted by previous studies [1, 8, 24].

Nevertheless, case-finding tools for CRD applied to the general population are influenced by variable prevalence, affecting their positive predictive value [25]. In this sense, targeting a higher-risk population might be more cost-effective, reducing the likelihood of false positives and contributing to earlier diagnosis [26]. In this context, people living with other NCD represent a high-risk population for CRD [27]. Thus, this review aims to identify the prevalence of CRD and/or abnormal spirometry results identified through case-finding tools in adults with NCD living in LMIC.

## Methods

This systematic review was written following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [28] and was prospectively registered in PROSPERO (CRD42024534734).

### Search strategy

The initial search strategy was developed in PubMed and adapted for use in the other databases using medical subject headings (MeSH terms) and text words related to COPD, lung diseases, asthma, spirometry, questionnaires, surveys, noncommunicable disease, hypertension, diabetes mellitus, primary health care, and preventive medicine. Comprehensive searches of electronic databases (PubMed, Lilacs, SciELO, Embase, and Web of Science) were conducted from database inception to May 2024, and updated in February 2025, considering publications in Portuguese, Spanish, and English. The search strategies used are presented in more detail in the supplementary material.

### Selection process

Studies that assessed the prevalence of CRD identified through case-finding tools in people with an established or suspected NCD in LMIC were included. The identified studies from each of the databases were exported into Rayyan software [29] to manually remove duplicates. The update search employed an automated tool (ChatGPT, GPT-4 version, OpenAI, 2023) to assist with the initial screening process. The search strategy included five bibliographic databases and was based on a PEO structure (P: population, E: exposure, and O: outcome). A sensitivity test was performed by checking the inclusion of the study by Martins et al., in the search results. This article was selected as a sentinel study because it met the inclusion criteria for this review but was not retrieved when the same strategy was performed including LMIC as a keyword. For this reason, the search was not limited to these countries.

Two reviewers (AP and GHGA) independently screened the titles and abstracts of all studies identified in the search to determine eligibility for inclusion (see details of the PEO strategy in the supplemental). Decisions were recorded, and in cases of disagreement, a decision was reached through discussion with a third review author (NSS). After assessing the full text of potentially eligible studies, the same reviewers independently screened them using a standardized form (see eligibility checklist in the supplemental). All processes are reported based on the PRISMA flow diagram [28]. The identification and screening process was conducted by two blinded authors, and after unblinding, eight conflicts were identified, representing a 99% agreement rate between reviewers.

### Outcome measurement

The primary outcome of this review was the prevalence of CRD. The secondary outcome was the prevalence of abnormal spirometry, such as preserved ratio impaired spirometry (PRISm). We also reported which tests were used.

### Data management and extraction

The data were extracted into an Excel sheet by two researchers to prevent errors or the loss of crucial information. Study characteristics (authors, year, country, study design, and sample characteristics) and outcome measures (name of case-finding tools, protocol, variables, and equipment) data were summarized.

### Risk of bias assessment

The modified Newcastle-Ottawa Scale (NOS) for cross-sectional studies was used to evaluate the quality of the included studies (NOS; http://www.ohri.ca/programs). The appraisal tool includes seven assessment items, across three domains: 'selection', 'comparability', and 'outcome'. The tool is valid for assessing the quality of non-randomized studies. The NOS adapted for cross-sectional studies uses a nine-star rating system, with a maximum of four stars available for selection, two for comparability and three for outcome assessment. According to NOS standards, the quality of cross-sectional studies can be classified as low (scores of 0–4), moderate (scores of 5–6) or high (scores ≥ 7). Quality appraisal was undertaken by two authors (AP and GHGA).

### Analysis

An initial descriptive analysis of the included studies was conducted. For each study, the prevalence of respiratory diseases and spirometric abnormalities was calculated, presenting the 95% confidence intervals for these estimates. Due to heterogeneity among the studies, a meta-analysis was not performed. Consequently, no formal tool was applied to assess the certainty of the evidence, given the descriptive nature of this review and the limited number of included studies. However, the methodological limitations and risk of bias of each study were considered during the interpretation of the findings, and caution was taken when drawing conclusions based on the available data. This descriptive approach provides an overview of the observed prevalences while maintaining transparency regarding the inherent limitations in comparing results across different settings and methodologies.

## Results

### Study selection

In the initial search, after removing duplicates, a total of 8,716 studies were identified. In the updated search, 223 studies were identified after employing an automated tool (ChatGPT, GPT-4 version, OpenAI, 2023) to assist with the initial screening process. In total, 8,939 studies were screened based on their titles and abstracts. Thirteen full-text articles were assessed for eligibility. Five studies that did not provide sufficient data [30–34], two with inadequate outcome ascertainment [35, 36], two conducted in developed countries [37, 38] and one that only included patients with a previous COPD diagnosis were excluded [39]. Finally, three studies were selected (Fig. 1), all of which had included a statement indicated they were conducted in accordance with all required ethics permissions.

### Overall study characteristics

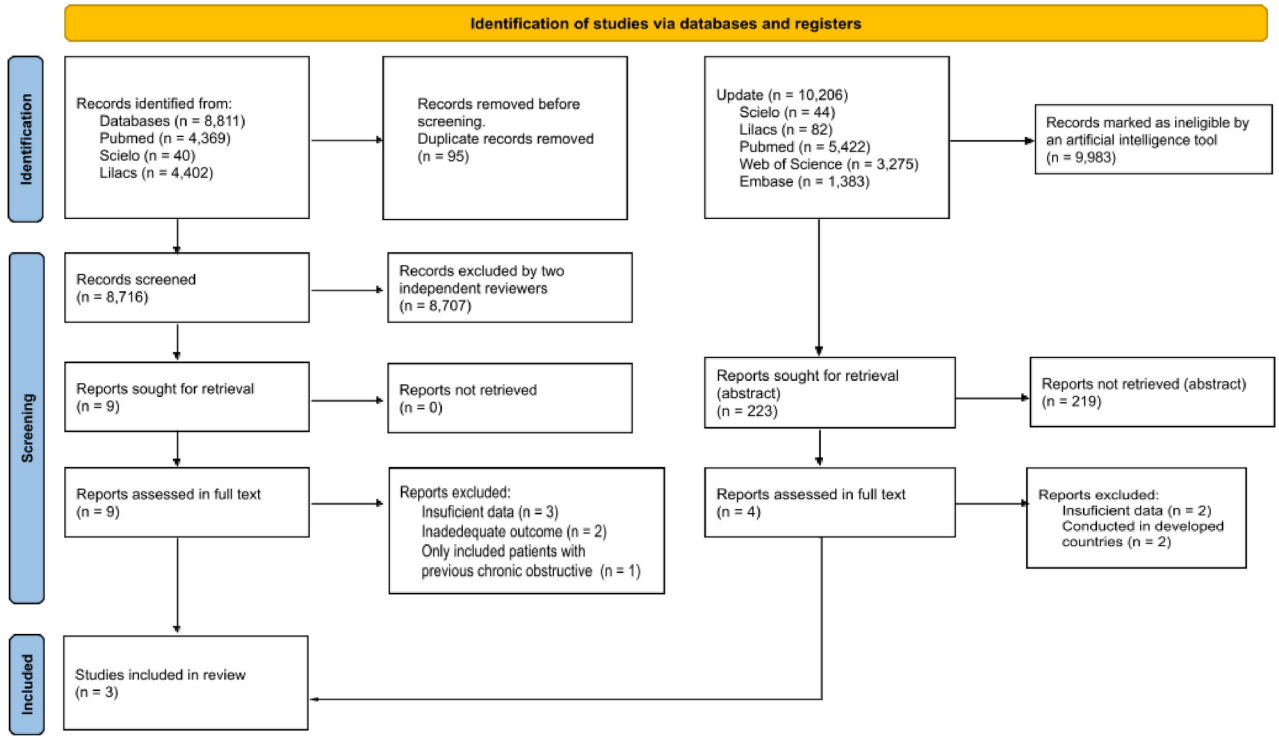
The characteristics of the included studies are summarized in Tables 1 and 2. One study was conducted in India [40], and the other two in Brazil [27, 41]. All studies were cross-sectional. Two studies used convenience sampling ($n = 255$) while one study recruited participants from the general population who attended Basic Health Units (primary care centres in Brazil, $n = 1{,}162$). Two studies [27, 40] used spirometry, and one study [41] applied multiple case-finding tools: spirometry, peak flow, microspirometry, the COPD Diagnostic Questionnaire (CDQ) [42], the COPD Assessment in Primary Care to Identify Undiagnosed Respiratory Disease and Exacerbation Risk (CAPTURE) [20], the COPD Screening Questionnaire (COPD-SQ) [43] and the Symptom-Based Questionnaire (SBQ) [44]. CDQ, CAPTURE, SBQ and COPD-SQ were used individually and associated with peak flow and microspirometry for assessing the diagnostic accuracy of these tools.

### Primary outcome and sample characteristics

The study by Martins et al. [41], investigated undiagnosed COPD in 1,162 patients with hypertension attending Basic Health Units in Brazil. The sample had a mean age of 62.3 ± 10.1 years and 378 participants were male (32.5%). This study found 12 individuals with asthma [prevalence of 1.0% (95% CI 0.59–1.9)], 19 individuals with asthma-COPD overlap [prevalence of 1.6% (95% CI 1.0-2.5)] and 60 individuals with COPD [prevalence of 5.2% (95% CI 4.0-6.6)] (Table 2).

### Secondary outcomes and sample characteristics

Sharma et al. [40], performed spirometry in 50 patients with end-stage kidney disease in a tertiary hospital. The sample had a mean age of 45.8 ± 10 years and 32 patients were male (64%). This study found 41 individuals with




**1.** Adapted from PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources (source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71). This work is licensed under CC BY 4.0. To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

**Fig. 1** Flow diagram of literature search and study selection

**Table 1** Included studies

| Author, year | Design and setting | Eligibility criteria | Case-finding tool used | Comorbidities | CRD identified | Limitations |
|---|---|---|---|---|---|---|
| *Sharma, 2017* | Cross-sectional study: conducted in a tertiary-level care center. | Inclusion Criteria: clinically stable patients in the age group of 18–60 years, who had been undergoing hemodialysis for more than three months. | Spirometry | CKD in end stage ($n=50$) | Post-dialysis:<br>82% - restrictive pulmonary disorder.[1]<br>6% - obstructive respiratory disorder.[1]<br>12% - pulmonary function within the normal range | Demographics of the study population are not mentioned, which may limit the generalizability of the findings. |
| *Fernandes, 2018* | Cross-sectional study conducted in a tertiary cardiac hospital. | Inclusion Criteria:<br>Patients over 40 years of age referred for cardiac CT were screened. | Spirometry | Cardiovascular disease in investigation ($n=205$) | Obstructive lung disease ($n=23$).[1]<br>PRISm ($n=35$). | The sample of 205 included patients under investigation of cardiovascular disease, not necessarily confirmed. |
| *Martins, 2022* | Cross-sectional study was conducted in nine Basic Health Units (primary care centres). | Inclusion Criteria:<br>Patients aged ≥ 40 years with clinician-diagnosed hypertension who attended routine consultations at their registered Basic Health Unit. | Peak flow<br>Pre-bronchodilator<br>Microspirometry<br>Questionnaires:<br>CDQ<br>CAPTURE<br>COPD-SQ<br>SBQ | Hypertension ($n=1,162$) | Asthma ($n=12$)<br>COPD/asthma ($n=19$)<br>COPD ($n=60$) | Unclear whether outcome assessors were blinded.<br>Included patients with previously diagnosed CRD. |

CRD, chronic respiratory disease; CKD, chronic kidney disease; n, number of individuals; CT, computed tomography; PRISm, preserved ratio but impaired spirometry, CDQ, COPD Diagnostic Questionnaire; CAPTURE, COPD Assessment in Primary Care To Identify Undiagnosed Respiratory Disease and Exacerbation Risk; COPD-SQ, COPD Screening Questionnaire; SBQ, Symptom-Based Questionnaire; COPD, chronic obstructive pulmonary disease. [1]: terminology in relation to spirometry is as used in the original paper

restrictive spirometry [prevalence of 82% (95% CI 69.2–90.2)] and three individuals with obstructive or mixed spirometry [prevalence of 6% (95% CI 2.0-16.2)] (Table 2).

The study by Fernandes et al. [27], investigated abnormal spirometry in 205 patients being investigated for possible coronary artery disease (CAD) in a tertiary hospital. The authors did not report the mean age of the entire sample but described a mean age of 64.5 ± 9.8 years for the subgroup with abnormal spirometry. The majority of the sample were male (55%). This study found 23 individuals meeting the spirometric criteria for COPD [prevalence of 11% (95% CI 7.5–16.2)] and 35 individuals with PRISm [prevalence of 17% (95% CI 12.5–22.8)] (Table 2).

### Quality assessment

The quality assessment of the included studies is shown in Fig. 2. One study [40] was rated as moderate quality due to concerns related to the selection process and high risk bias associated with the sample size characteristics. Two studies [27, 41] were considered to have a low risk of bias. For a detailed assessment, see quality assessment in the supplemental.

## Discussion

This is the first review of the prevalence of CRD and abnormal spirometry identified through case-finding tools in adults living with NCD in LMIC. Three studies investigating new diagnoses of CRD in three different NCD [chronic kidney disease, (suspected) coronary artery disease, and hypertension] were found. These studies used different screening tools, with spirometry being the most widely used, and were conducted in primary and tertiary care settings. They identified patterns of lung function abnormalities compatible with restrictive, obstructive, or overlapping conditions.

Considering studies with a low risk of bias, the prevalence of CRD was between 1% and 5.2% in patients with hypertension [41]. The prevalence of abnormal spirometry was between 11% and 17% in patients with suspected coronary artery disease [27]. Regarding sex, prevalence varied according to the comorbidity investigated, with a higher prevalence in men among patients with CAD and a slightly higher prevalence in women among those with hypertension. In terms of age, patients with spirometric abnormalities had an mean age of over 64 years. However, one of the studies with low risk of bias excluded individuals diagnosed with asthma from the calculation of mean age [41].

Asthma and COPD are among the most common CRD in adults. Both conditions have high prevalence in LMIC

**Table 2** Main results

| Author (year) | Country | Population characteristics | | | | Case-finding tool used | Individuals identified with CRD | Confirmed CRD | Prevalence (95% CI) |
|---|---|---|---|---|---|---|---|---|---|
| | | NCD included | Individuals screened | Mean age ± SD | Sex male (%) | | | | |
| Sharma et al. (2017) | India | End-stage CKD | *n* = 50 | 45.8 ± 10.0 | *n* = 32 (64) | Spirometry | *n* = 44 | Post-dialysis: Restrictive disorder (*n* = 41)[1] Obstructive or mixed disorder (*n* = 3)[1] | 82% (69.2–90.2) 6% (2-16.2) |
| Fernandes et al. (2018) | Brazil | CAD (presence of risk-factor/ investigation) | *n* = 205 | 64.5 ± 9.8[2] | *n* = 113 (55)[2] | Spirometry | *n* = 58 | Persistent obstructive disorder (*n* = 23)[1] PRISm (*n* = 35) | 11% (7.5–16.2) 17%(12.5–22.8) |
| Martins et al. (2022) | Brazil | Hypertension | *n* = 1.162 | 62.3 ± 10.1 | *n* = 378 (32,5) | Spirometry<br>Other tool used<br>CAPTURE<br>CDQ<br>SBQ<br>COPD-SQ<br>Peak flow<br>Microspirometry<br>CAPTURE + Peak flow<br>CDQ + Peak flow<br>SBQ + Peak flow<br>COPD-SQ + Peak flow<br>CAPTURE + Microspirometry<br>CDQ + Microspirometry<br>SBQ + Microspirometry<br>COPD-SQ + Microspirometry | *n* = 91<br>*n* = 48<br>*n* = 40<br>*n* = 60<br>*n* = 62<br>*n* = 35<br>*n* = 40<br>*n* = 25<br>*n* = 20<br>*n* = 31<br>*n* = 31<br>*n* = 24<br>*n* = 23<br>*n* = 32<br>*n* = 33 | Asthma (*n* = 12) Asthma/COPD overlap (*n* = 19) COPD (*n* = 60) | 1% (0.59–1.8) 1.6% (1- 2.5) 5.2% (4-6.6) |

NCD, noncommunicable disease; SD, standard deviation; CRD, chronic respiratory disease; CI, confidence interval; CKD, chronic kidney disease; n, number of individuals; CAD, coronary artery disease; PRISm: preserved ratio but impaired spirometry; CAPTURE, COPD Assessment in Primary Care To Identify Undiagnosed Respiratory Disease and Exacerbation Risk; CDQ, COPD Diagnostic Questionnaire; SBQ, Symptom-based questionnaire; COPD-SQ, COPD Screening Questionnaire; COPD, chronic obstructive pulmonary disease; 1 - terminology in relation to spirometry is as used in the original paper. 2 - only presented data on the mean age and sex in relation to the total sample included

[45, 46]. The findings of this review are comparable to other prevalence studies that estimate the prevalence of COPD at 9.4% in LMIC [47] and 10.3% globally [46]. Furthermore, a systematic review showed that the prevalence of PRISm ranged from 2,5 to 16% with different risk factors identified in different settings [34], and present in 17% of patients when screened in the context of CAD risk factors [27]. While obesity and tobacco use were pointed out as risk factors associated with PRISm in High Income Countries (HICs), in LMIC PRISm may be associated with younger age, female sex, and exposure to biomass fuel [48].

These variations in risk factors and prevalence highlight the complexity of diagnosing and managing CRD across different socioeconomic contexts. Martins et al. [41] investigated the diagnostic accuracy of screening tools combined with spirometry in hypertensive patients. This study presented the most representative sample in our review, with a total prevalence of 7.8% for undiagnosed asthma, asthma-COPD overlap, and COPD in primary care. Considering the other two studies and ignoring patients with restrictive disorders commonly observed in patients with chronic renal failure [40, 49, 50], the prevalence of spirometric abnormalities in this review ranged from 6 to 17%. These estimates are close to those reported by the Global Excellence in COPD Outcomes (GECo) Study Investigators screening study (2.7–18.2%) [26], and also fall within the range observed in HICs (3–24%) [51, 52].

Haroon et al. found a prevalence range from 4.1 to 40.2% for new cases of COPD assessed via spirometry in a systematic review that aimed to summarize the effectiveness of different case-finding approaches for undiagnosed COPD in primary care, including studies from developing and middle-income countries [53]. One of the studies included in that review reported a prevalence of 71.4% of undiagnosed COPD among individuals with risk factors treated at primary health care clinics in the city of Aparecida de Goiânia, Brazil [54]. Considering these findings, the smaller variation in the prevalence of respiratory abnormalities observed in the present review may be explained by the inclusion criteria, which restricted the sample to patients with NCD living in LMIC.

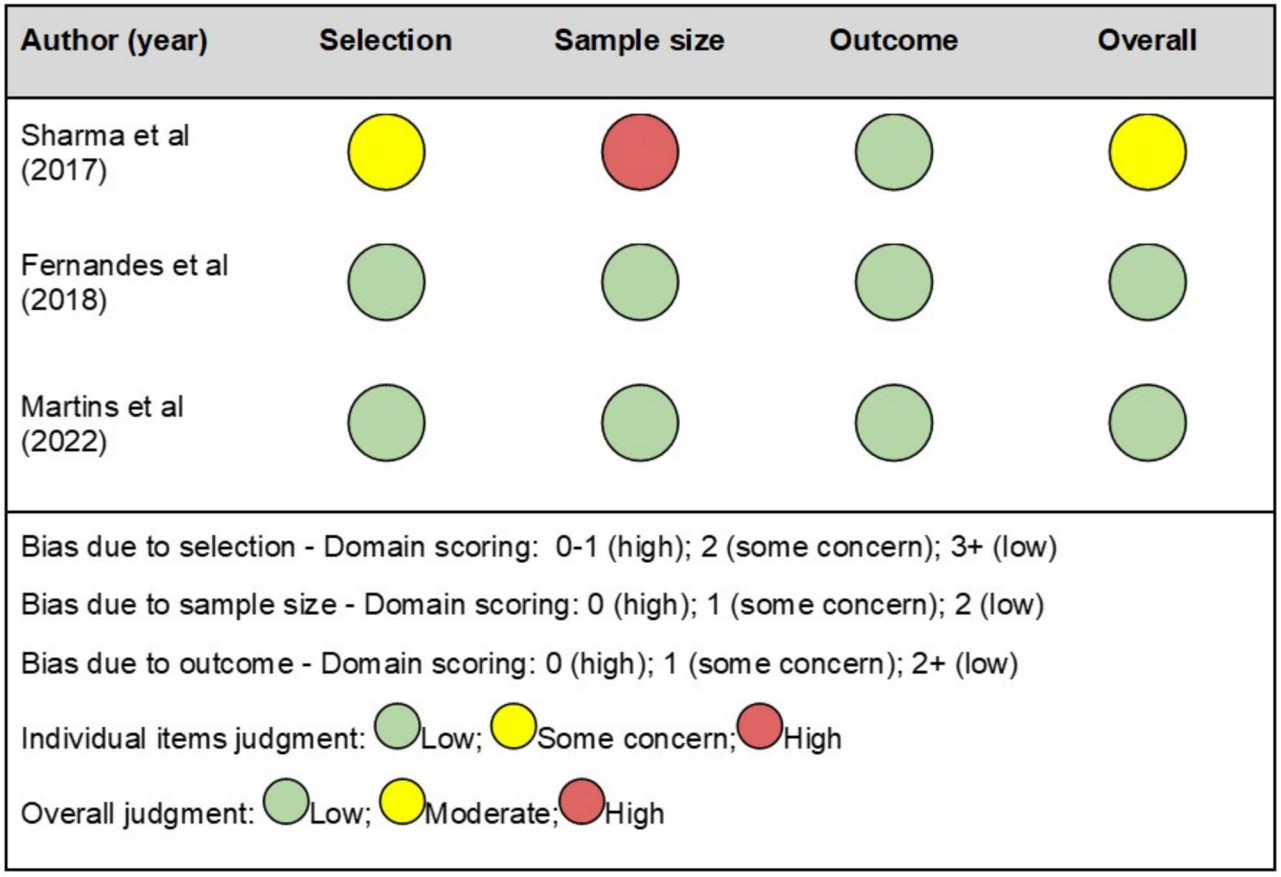



**Fig. 2** Quality assessment of the included studies

In this context, the NCD investigated for the presence of CRD and spirometric abnormalities are widely recognized in the literature as common extrapulmonary comorbidities in patients with COPD. In the review by Xiang & Luo [55], the authors point out that COPD and cardiovascular diseases share risk factors, such as smoking and lifestyle habits. A meta-analysis by Chen et al. [12] showed that the incidence of ischemic heart disease, cardiac dysrhythmias, heart failure, and arterial circulation diseases is two to five times higher in patients with COPD compared to the population without the disease. In addition, the authors highlight the presence of other frequent extrapulmonary comorbidities, such as diabetes, anxiety, and depression [55].

All too often, the primary diagnosis of CRD is identified after hospitalization events. However, a recent observational study [56] that investigated clusters of multimorbidity and CRD found multimorbidity in more than 75% of the 127,530 medical records analyzed retrospectively in a primary care setting. Hence, it could be valuable opportunistically screen for CRD by considering the presence of other NCD with well-established indicators in health records, such as cardiovascular and metabolic problems. This practice might represent a good opportunity to reduce the burden of underdiagnosis of CRD.

Regarding study quality, a systematic review of tools to assess the quality of observational studies on incidence or prevalence [57] concluded that there is no consensus on the criteria required to establish methodological quality. The Cochrane Collaboration [58] advises assessing risk of bias using domain-based evaluation, which is also relevant for cross-sectional studies. Therefore, a tool based on a subjective assessment of risk of bias in separate domains [59] was adapted to assess systematic reviews of cross-sectional studies [60, 61]. However, it is important to emphasize that even when guided by a tool, methodological appraisal remains subjective. For this reason, to minimize bias in the review process, two reviewers assessed the risk of bias independently, with minimal disagreement, and a final consensus was reached with the wider research group. In addition, a reliability exercise was undertaken with a third author. Hence, it seems reasonable to conclude that the included studies correspond to the prevalence of CRD identified using case-finding tools in a population with NCD living in LMIC available in current literature.

Systematic review of prevalence identify temporal trends and geographic distributions of diseases, offering valuable information for guiding healthcare strategies [62]. The present findings contribute to understanding the distribution of CRD among individuals with coexisting NCD, particularly in LMIC. These insights may support evidence-based decisions by clinicians and policy makers, enabling more effective allocation of resources and targeted interventions in resource-limited settings.

### Limitations

The limitations of this review include finding only three studies, which provided data about diagnoses of CRD, limited to COPD, asthma, and COPD/asthma overlap. Despite the limited number of studies available, these findings align with existing literature, indicating that prevalence rates are variable across different settings. However, the geographical coverage of the included studies was limited, which restricts the generalizability of the findings to other LMIC. The results of this review emphasize the urgent need for longitudinal studies, particularly those exploring the evolution of CRD and other NCD. There was no standardization of diagnostic criteria for CRD. Two studies reported the use of the forced expiratory volume in the first second/ forced vital capacity ratio below the lower limit of normal, and of these, only one reported diagnostic confirmation taking into account the evaluation of a pulmonologist.

Furthermore, the 95% confidence intervals (CIs) for prevalence estimates were not included in the articles and had to be calculated based on the information provided. Additionally, grey literature was not included, and we excluded studies that were not available in full text which may have led to the exclusion of unpublished or inaccessible studies. Although the review was prospectively registered in PROSPERO, the update included two additional databases (Embase and Web of Science) and due to the low specificity of the search strategy, the authors used an artificial intelligence tool to support the initial screening process due to the amount of the studies retrieved. These features were not anticipated in the original PROSPERO registration. These limitations compromise, to some extent, the external validity of our findings and highlight the need for further research to expand knowledge on this topic.

## Conclusion

In conclusion, there is limited evidence on the prevalence of CRD when using case-finding approaches in adults with NCD in LMIC. The literature reviewed shows that the prevalence of CRD identified through screening tools in adults with NCD in LMIC varies according to the NCD being investigated, but appears comparable to prevalence rates observed in HICs. These findings highlight the importance of investigating CRD among individuals living with NCD as a strategy to reduce the burden of underdiagnosis. Future research should aim to expand geographical coverage and methodological quality, while further exploring the interplay between NCDs and CRDs to inform targeted screening and early intervention strategies in LMIC.

#### Abbreviations

| | |
|---|---|
| CRD | Chronic respiratory diseases |
| LMIC | Low- and middle-income countries |
| COPD | Chronic obstructive pulmonary disease |
| NCD | Noncommunicable diseases |
| GOLD | Global initiative for chronic obstructive lung disease |
| PRISMA | Preferred reporting items for systematic reviews and meta-analyses |
| PEO | Population, exposure, and outcome |
| PRISm | Preserved ratio, impaired spirometry |
| NOS | Newcastle-Ottawa Scale |
| CDQ | COPD Diagnostic Questionnaire |
| CAPTURE | COPD Assessment in Primary Care To Identify Undiagnosed Respiratory Disease and Exacerbation Risk questionnaire |
| COPD-SQ | COPD Screening Questionnaire |
| SBQ | Symptom-based questionnaire |

## Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12890-025-03697-8.

Supplementary Material 1

#### Acknowledgements

To the Coordination for the Improvement of Higher Education Personnel (CAPES), National Council for Scientific and Technological Development (CNPq), and UK NIHR.

#### Author contributions

A.P, G.H.G.A., N.T.L, J.H, and R.G.M. contributed to the conception and design of the work. A.P., and G.H.G.A prepared search strategy supplementary material, figures and tables, data extraction strategy and wrote the first draft. N.S.S, N.T.L, and V.C assisted with the data analysis, reviewing and editing. A.P, G.H.G.A., N.S.S, N.T.L, V.C., J.H, and R.G.M interpreted the findings. J.H and R.G.M substantively revised the work. AP, G.H.G.A. J.H., and R.G.M. acquired the data and wrote the main manuscript text. All authors reviewed the manuscript and approved the submitted version.

#### Funding

Professor Hurst was funded by the NIHR (project reference 303125) using UK international development funding from the UK Government to support global health research. The views expressed in this publication are those of the authors and not necessarily those of the NIHR or the UK government.

#### Data availability

The datasets used or analysed during the current study are available from the corresponding author on reasonable request.

### Declarations

#### Ethics approval and consent to participate

Not applicable, but the original studies included in the review did have ethics permissions and consent.

#### Consent for publication

Not applicable.

**Competing interests**
The authors declare no competing interests.

**Author details**
[1]Department of Physical Therapy, Federal University of São Carlos, São Paulo, Brazil
[2]UCL Respiratory, University College London, London, UK

Received: 1 November 2024 / Accepted: 29 April 2025
Published online: 10 May 2025

**References**

1. Bousquet J, Dahl R, Khaltaev N. Global alliance against chronic respiratory diseases. Allergy. 2007;62(3):216–23. https://doi.org/10.1111/j.1398-9995.2007.01307.x.
2. Soriano JB, Kendrick PJ, Paulson KR, Gupta V, Abrams EM, Adedoyin RA, et al. Prevalence and attributable health burden of chronic respiratory diseases, 1990–2017: a systematic analysis for the global burden of disease study 2017. Lancet Respiratory Med. 2020;8:585–96.
3. Florman KEH, Siddharthan T, Pollard SL, Alupo P, Barber JA, Chandyo RK, et al. Unmet diagnostic and therapeutic opportunities for chronic obstructive pulmonary disease in Low- and Middle-Income countries. Am J Respir Crit Care Med. 2023;208:442–50.
4. Vos T, Lim SS, Abbafati C, Abbas KM, Abbasi M, Abbasifard M, et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the global burden of disease study 2019. Lancet. 2020;396:1204–22.
5. Non communicable diseases. https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. Accessed 23 Sep 2024.
6. World Health Organization. Noncommunicable diseases. https://www.who.int/health-topics/noncommunicable-diseases. Accessed 23 Sep 2024.
7. Dahal S, Sah RB, Niraula SR, Karkee R, Chakravartty A. Prevalence and determinants of non-communicable disease risk factors among adult population of Kathmandu. PLoS ONE. 2021;16:e0257037.
8. Abegunde DO, Mathers CD, Adam T, Ortegon M, Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. Lancet. 2007;370:1929–38.
9. Szwarcwald CL, Malta DC, Pereira CA, Vieira MLFP, Conde WL, de Souza Júnior PRB, et al. Pesquisa Nacional de Saúde no Brasil: Concepção e metodologia de aplicação. Ciênc Saúde Coletiva. 2014;19:333–42.
10. Stopa SR, Malta DC, Monteiro CN, Szwarcwald CL, Goldbaum M, Cesar CLG. Use of and access to health services in Brazil, 2013 National health survey. Rev Saúde Pública. 2017;51:1.
11. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. 2023 Report. Fontana, WI: GOLD. 2023. Available from: https://goldcopd.org/2023-gold-report-2/
12. Chen W, Thomas J, Sadatsafavi M, FitzGerald JM. Risk of cardiovascular comorbidity in patients with chronic obstructive pulmonary disease: a systematic review and meta-analysis. Lancet Respir Med. 2015;3:631–9.
13. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. 2021 Report. Fontana, WI: GOLD. 2021. Available from: https://goldcopd.org/2021-gold-reports/
14. Celli BR, MacNee W, Agusti A, Anzueto A, Berg B, Buist AS, et al. Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. Eur Respir J. 2004;23:932–46.
15. Siddharthan T, Wosu AC, Pollard SL, Hossen S, Alupo P, Shade T, et al. A novel Case-Finding instrument for chronic obstructive pulmonary disease in Low- and Middle-Income country settings. Int J Chron Obstruct Pulmon Dis. 2020;15:2769–77.
16. Alhabeeb FF, Whitmore GA, Vandemheen KL, FitzGerald JM, Bergeron C, Lemière C, et al. Disease burden in individuals with symptomatic undiagnosed asthma or COPD. Respir Med. 2022;200:106917.
17. Mintz ML, Yawn BP, Mannino DM, Donohue JF, Hanania NA, Grellet CA et al. Prevalence of airway obstruction assessed by lung function questionnaire. Mayo Clin Proc. 2011;86:375–81.
18. Al Ghobain M, Al-Hajjaj MS, Wali SO. Prevalence of chronic obstructive pulmonary disease among smokers attending primary healthcare clinics in Saudi Arabia. Ann Saudi Med. 2011;31:129–33.
19. Konstantikaki V, Kostikas K, Minas M, Batavanis G, Daniil Z, Gourgoulianis KI, et al. Comparison of a network of primary care physicians and an open spirometry programme for COPD diagnosis. Respir Med. 2011;105:274–81.
20. Martinez FJ, Mannino D, Leidy NK, Malley KG, Bacci ED, Barr RG, et al. A new approach for identifying patients with undiagnosed chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2017;195:748–56.
21. Yawn BP, Mapel DW, Mannino DM, Martinez FJ, Donohue JF, Hanania NA, et al. Development of the lung function questionnaire (LFQ) to identify airflow obstruction. Int J Chron Obstruct Pulmon Dis. 2010;5:1–10.
22. Financing NCDs, Alliance NCD. 2015. https://ncdalliance.org/why-ncds/financing-ncds. Accessed 25 Sep 2024.
23. Kazibwe J, Tran PB, Annerstedt KS. The household financial burden of non-communicable diseases in low- and middle-income countries: a systematic review. Health Res Policy Syst. 2021;19:96.
24. Ciarli T, Ràfols I. The relation between research priorities and societal demands: the case of rice. Res Policy. 2019;48:949–67.
25. Lin C-H, Cheng S-L, Chen C-Z, Chen C-H, Lin S-H, Wang H-C. Current progress of COPD early detection: key points and novel strategies. COPD. 2023;18:1511–24.
26. Siddharthan T, Pollard SL, Quaderi SA, Rykiel NA, Wosu AC, Alupo P, et al. Discriminative accuracy of chronic obstructive pulmonary disease screening instruments in 3 Low- and Middle-Income country settings. JAMA. 2022;327:151–60.
27. Fernandes FLA, Carvalho-Pinto RM, Stelmach R, Salge JM, Rochitte CE, Souza EC dos. Spirometry in patients screened for coronary artery disease: is it useful? J Bras Pneumol. 2018;44:299–306.
28. Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. BMJ. 2015;350:g7647.
29. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan—a web and mobile app for systematic reviews. Syst Reviews. 2016;5:210.
30. Garcia-Ortiz JD, Cardona-Jiménez JL, Quijano-Almeida YM. La evaluación con el cuestionario COPD-PS y el dispositivo portátil Vitalograph COPD–6 como estrategia para el diagnóstico temprano de la EPOC en la atención primaria. Iatreia. 2020;33(3):229–238. https://doi.org/10.17533/udea.iatreia.44
31. Orena CHV, Valdivia CG, Ferreccio RC, Orena CHV, Valdivia CG, Ferreccio RC. Asociación Entre deterioro Del Flujo espiratorio Máximo y prevalencia de Enfermedades cardiovasculares y metabólicas En Población adulta Chilena: Hallazgos preliminares de La cohorte Del Maule (MAUCO). Revista Chil De Enfermedades Respiratorias. 2019;35:33–42.
32. Fernandez-Plata R, Thirion-Romero I, Martinez-Briseño D, Franco-Marina F, Perez-Padilla R. Screening tool for restrictive and obstructive ventilatory abnormalities in a Population-Based survey. Revista De Investigación Clínica. 2020;72:386–93.
33. Maldonado-Franco A, Giraldo-Cadavid LF, Tuta-Quintero E, Bastidas AR, Moreno-Giraldo A, Botero-Rosas DA. Development of a web application to evaluate spirometric curve and clinical variables to support COPD diagnosis in primary care. Biomedica. 2024;44 Sp. 1:160–70.
34. Siddharthan T, Grealis K, Robertson NM, Lu M, Liu S, Pollard SL, et al. Assessing the prevalence and impact of preserved ratio impaired spirometry in low-income and middle-income countries: a post-hoc cross-sectional analysis. Lancet Global Health. 2024;12:e1498–505.
35. Mulyanto J, Kringos DS, Kunst AE. The accuracy of self-report versus objective assessment for estimating socioeconomic inequalities in disease prevalence in Indonesia. Int J Public Health. 2019;64:1233–41.
36. Kovelis D, Pitta F, Probst VS, Peres CPA, Delfino VDA, Mocelin AJ, et al. Função pulmonar e Força muscular respiratória Em Pacientes com Doença renal crônica submetidos à hemodiálise. J Bras Pneumol. 2008;34:907–12.
37. Klockmann LL, Tøttenborg EMK, Backe MB, Jørgensen ME, Pedersen ML. Prevalence of cardiovascular and other selected diseases among Greenlanders with and without type 2 diabetes. Int J Circumpolar Health. 2024;83:2421052.
38. Campo G, Pavasini R, Barbetta C, Maietti E, Mascetti S, Biscaglia S, et al. Predischarge screening for chronic obstructive pulmonary disease in patients with acute coronary syndrome and smoking history. Int J Cardiol. 2016;222:806–12.
39. Queiroz APA, Fonseca FR, de Rê A. Clinical, laboratory, and functional characteristics of asthma-COPD overlap in patients with a primary diagnosis of COPD. J Bras Pneumol. 2020;47:e20200033.
40. Sharma A, Sharma A, Gahlot S, Prasher PK. A study of pulmonary function in end-stage renal disease patients on hemodialysis: a cross-sectional study. Sao Paulo Med J. 2017;135:568–72.

41. Martins SM, Dickens AP, Salibe-Filho W, Albuquerque Neto AA, Adab P, Enocson A, et al. Accuracy and economic evaluation of screening tests for undiagnosed COPD among hypertensive individuals in Brazil. NPJ Prim Care Respir Med. 2022;32(1):55. https://doi.org/10.1038/s41533-022-00303-w.
42. Price DB, Tinkelman DG, Halbert RJ, Nordyke RJ, Isonaka S, Nonikov D, et al. Symptom-based questionnaire for identifying COPD in smokers. Respiration. 2006;73:285–95.
43. Zhou Y-M, Chen S-Y, Tian J, Cui J-Y, Li X-C, Hong W, et al. Development and validation of a chronic obstructive pulmonary disease screening questionnaire in China. Int J Tuberc Lung Dis. 2013;17:1645–51.
44. Zhang Q, Wang M, Li X, Wang H, Wang J. Do symptom-based questions help screen COPD among Chinese populations? Sci Rep. 2016;6:30419.
45. Mortimer K, Reddel HK, Pitrez PM, Bateman ED. Asthma management in low and middle income countries: case for change. Eur Respir J. 2022;60:2103179.
46. Adeloye D, Song P, Zhu Y, Campbell H, Sheikh A, Rudan I. Global, regional, and National prevalence of, and risk factors for, chronic obstructive pulmonary disease (COPD) in 2019: a systematic review and modelling analysis. Lancet Respir Med. 2022;10:447–58.
47. Mohan S, Cárdenas MK, Ricciardi F, Siddharthan T, Pollard SL, Rykiel NA, et al. Cost-Accuracy analysis of chronic obstructive pulmonary disease screening in Low- and Middle-Income countries. Am J Respir Crit Care Med. 2022;206:353–6.
48. Obaseki D, Bime C, Awopeju O. A look at spirometric PRISm in low-income and middle-income countries. Lancet Global Health. 2024;12:e1379–80.
49. Mahmoud BL, Abdulkader A, El-Sharkawy MMS, Khalil HH. Assessment of pulmonary functions in chronic renal failure patients with different haemodialysis regimens. J Egypt Soc Parasitol. 2004;34:1025–40.
50. Nascimento MM, Qureshi AR, Stenvinkel P, Pecoits-Filho R, Heimbürger O, Cederholm T, et al. Malnutrition and inflammation are associated with impaired pulmonary function in patients with chronic kidney disease. Nephrol Dial Transpl. 2004;19:1823–8.
51. Wan ES, Balte P, Schwartz JE, Bhatt SP, Cassano PA, Couper D, et al. Association between preserved ratio impaired spirometry and clinical outcomes in US adults. JAMA. 2021;326:2287–98.
52. Schwartz A, Arnold N, Skinner B, Simmering J, Eberlein M, Comellas AP, et al. Preserved ratio impaired spirometry in a spirometry database. Respir Care. 2021;66:58–65.
53. Haroon SM, Jordan RE, O'Beirne-Elliman J, Adab P. Effectiveness of case finding strategies for COPD in primary care: a systematic review and meta-analysis. NPJ Prim Care Respir Med. 2015;25:15056.
54. Queiroz MC, de CAM MAC, Rabahi MF. Underdiagnosis of COPD at primary health care clinics in the City of aparecida de Goiânia, Brazil. J Bras Pneumol. 2012;38:692–9.
55. Xiang Y, Luo X. Extrapulmonary comorbidities associated with chronic obstructive pulmonary disease: A review. Int J Chron Obstruct Pulmon Dis. 2024;19:567–78.
56. Carmona-Pírez J, Poblador-Plou B, Ioakeim-Skoufa I, González-Rubio F, Gimeno-Feliú LA, Díez-Manglano J, et al. Multimorbidity clusters in patients with chronic obstructive airway diseases in the epichron cohort. Sci Rep. 2021;11:4784.
57. Shamliyan T, Kane RL, Dickinson S. A systematic review of tools used to assess the quality of observational studies that examine incidence or prevalence and risk factors for diseases. J Clin Epidemiol. 2010;63:1061–70.
58. Cochrane Handbook for Systematic Reviews of Interventions. https://training.cochrane.org/handbook. Accessed 17 Sep 2024.
59. Ottawa Hospital Research Institute. https://www.ohri.ca/programs/clinical_epidemiology/oxford.asp. Accessed 17 Sep 2024.
60. Lin C-Y, Lin Y-L. Anxiety and depression of general population in the early phase of COVID-19 pandemic: A systematic review of cross-sectional studies. Arch Clin Psychiatry (São Paulo). 2021;47:199–208.
61. Herzog R, Álvarez-Pasquin MJ, Díaz C, Del Barrio JL, Estrada JM, Gil Á. Are healthcare workers' intentions to vaccinate related to their knowledge, beliefs and attitudes? A systematic review. BMC Public Health. 2013;13:154.
62. Munn Z, Moola S, Lisy K, Riitano D, Tufanaru C. Methodological guidance for systematic reviews of observational epidemiological studies reporting prevalence and cumulative incidence data. Int J Evid Based Healthc. 2015;13:147–53.

## Publisher's note