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Personal strategies to reduce the effects of landscape fire smoke on asthma-related outcomes: a protocol for systematic review and meta-analysis

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ABSTRACT

Introduction Landscape fire smoke (LFS) contains several hazardous air pollutants that are known to be detrimental to human health. People with asthma are more vulnerable to the health impact of LFS than general populations. The aim of this review is to investigate the effectiveness of personal strategies to reduce the effect of LFS on asthma-related outcomes.

Methods and analysis We will electronically search databases such as Medline, Embase, CINAHL and Cochrane Clinical Trials Register to identify eligible articles for the review. Screening of search results and data extraction from included studies will be completed by two independent reviewers. The risk of bias (RoB 2) will be assessed using the Risk of Bias Assessment Tool for Non-Randomised Studies for observational studies, the Cochrane Collaboration tool for assessing the RoB 2 for randomised controlled trials (RCTs) and the Risk Of Bias In Nonrandomized Studies of Interventions tool for non-RCTs. A random-effect meta-analysis will be performed to determine the pooled summary of findings of the included studies. If meta-analysis is not possible, we will conduct a narrative synthesis. Findings will be reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement.

Ethics and dissemination This study will synthesise the available evidence obtained from published studies and as such, no ethical approval is required. The review will be disseminated through peer-reviewed publications and conference presentations.

PROSPERO registration number CRD42022341120.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study will include observational, randomised control trials and before and after studies from a comprehensive list of bibliographic databases, to summarise personal strategies to reduce the effects of landscape fire smoke (LFS) on asthma-related outcomes.
⇒ The review will provide updated information on the effectiveness of personal strategies to reduce the effects of LFS on asthma-related outcomes.
⇒ The methods will adhere to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.
⇒ Language restriction to English may exclude additional studies published in other languages.

INTRODUCTION

In recent years, unprecedented landscape fire (including bushfires, prescribed fires and uncontrolled wildfires, tropical deforestation fires, peat fires, agricultural burning and grass fires) events have been occurring more frequently around the world and with increased intensity and duration in many fire-prone regions.[1 2] Landscape fire smoke (LFS) contains several air pollutants such as particulate matter (PM), carbon monoxide, nitrogen dioxide, nitric oxide and volatile organic compounds that are known to cause adverse health effects.[3 4] A study of global mortality attributable to smoke from landscape fires estimated that 339 000 deaths annually are attributable to LFS.[5] In addition, some people, particularly those with asthma, are at higher risk of adverse health outcomes following exposure to fire smoke.[6 7] Asthma is a common illness worldwide with a global prevalence of approximately 262 million people.[8]

Epidemiological studies have found an association between exposure to LFS and increased respiratory morbidity, mortality and healthcare utilisation.[9–11] A systematic review and meta-analysis of 20 studies that investigated the relationship between landscape fire-related $PM_{2.5}$ and asthma-related outcomes reported that fire-related $PM_{2.5}$ increases hospital admission and emergency department visits for asthma.[12] A cross-sectional survey examining the impact of the 2019/2020 catastrophic bushfires on people with asthma in Australia found that people with asthma were more likely to report respiratory symptoms and healthcare service utilisation than those without asthma.[6] Taken together, these findings show the significant health impact of LFS on people with asthma.

A study on the impact of prolonged bushfire smoke exposure in people with severe asthma reported that most people with severe asthma reported respiratory and non-respiratory symptoms during the bushfire period. This was despite most people with severe asthma implementing actions (such as staying indoors and avoiding going outdoors) to minimise or avoid exposure to bushfire smoke.[10] Similarly, a study on the impact of prolonged landscape fires on women with asthma found that even though most women with asthma took action to minimise exposure to landscape fire smoke, they experienced respiratory and non-respiratory symptoms during landscape fire period.[13] A study of the impact of bushfires on people with and without asthma revealed that those with asthma were more likely to take measures to minimise exposure to bushfire smoke than those without asthma.[6]

Governmental organisations have developed guidance about smoke mitigation strategies for the public to improve health outcomes.[14] However, there is a dearth of data regarding the effectiveness of personal strategies to reduce the effect of LFS on health outcomes, particularly for vulnerable populations.[15 16] A workshop convened by the Centre for Air pollution, energy and health Research underscored the need for assessing the efficacy of smoke mitigation strategies such as the use of air cleaners and making houses more airtight to reduce the adverse health outcomes.[17] Furthermore, a report by the European Respiratory Society highlighted the need for healthcare professionals to have information to advise patients about air pollution including fire smoke since they are facing daily concerns from patients, particularly vulnerable populations, about the effect that air pollution can have on their health.[18] Given that landscape fires are increasing in frequency and duration, it is imperative to examine personal strategies for people with asthma that are designed to reduce the effect of LFS on asthma-related outcomes. Furthermore, Vardoulakis *et al* suggested further research to understand if health advice during bushfire smoke can effectively lower the risk of adverse health outcomes.[19] A position statement about asthma and LFS highlighted the importance of improving health communication during fire period to lower health risks and preparation for future events.[20] To the best of our knowledge, no published systematic review has investigated the effectiveness of personal smoke mitigation strategies in reducing asthma related outcomes. Thus, the aim of this systematic review and meta-analysis is to synthesise evidence on personal strategies for people with asthma who were exposed to LFS to reduce the negative effect of LFS on asthma-related outcomes.

Study question

We aim to answer the following question: for people with asthma exposed to LFS do personal smoke mitigation strategies improve asthma-related outcomes?

METHODS AND ANALYSIS

Reporting of the review findings

The protocol was developed in accordance with the Preferred Reporting Items for Systematic review and Meta-analysis Protocols (PRISMA-P) statement.[21] The protocol for this review has been registered with PROSPERO (CRD42022341120). The PRISMA (2020) statement will be used to report the findings.[22] This review will commence on the 15 October 2023 and end on the 25 January 2024.

Data sources and search strategy

We developed the search strategy with the support of a librarian and other researchers and pilot tested it before the final search. A search will be conducted of the electronic Medline, Embase, CINAHL and Cochrane Clinical Trials Register databases to identify eligible articles for the review. We will use Medical Subject Headings (Mesh), keywords and free text search terms. The keywords include: ("Asthma" or "wheez*") and ("bushfire" or "wildfire" or "wildland fire" or "landscape fire") and ("mitigat*" or "reduc*" or "interven*" or "avoid*" or "personal protect*") and ("hospital*" or "admission*", "emergenc*", "physicia*", "doctor", "dispensatio*", "visit*", "medication", "attendanc*") which will be used to identify all potential studies. The complete list of keywords is included in online supplemental table S1). The search strategy for Medline is supplemented with this protocol (online supplemental table S2). Reference lists of selected articles will be assessed to identify other possible studies of interest.

Inclusion criteria

1. Studies involving people 7 years old or above with diagnosis of asthma or self-reported asthma.
2. People who were exposed to LFS.
3. Cross-sectional, cohort, case-control, randomised controlled trials (RCTs), before and after studies in which landscape fire, asthma-related outcomes and personal strategies to reduce LFS exposure were studied. For this review, landscape fires include vegetation fires (bushfires/wildfire, prescribed and cultural burns, forest, savanna, grassland and shrubland fires and agricultural burning), open coal mine and peat fires. To determine the reliability of LFS exposure assessment in each study, we will review the methodologies, measurement techniques and definitions employed.

Exclusion criteria

1. Studies that recruited participants based on other respiratory conditions.
2. Studies published in languages other than English.

3. Other articles such as case reports, case series, letters, conference abstracts, letters and thesis.
4. Studies that examined other type of air pollution and asthma related outcomes.

POPULATION, INTERVENTION, COMPARATOR AND OUTCOMES

Population

People with asthma who were exposed to LFS. Asthma will be defined as doctor-diagnosed asthma fulfilling American Thoracic Society criteria or self-reported asthma.

Interventions

Individual strategies aimed at minimising or avoiding personal exposure to LFS. The strategies could be physical (eg, wearing face masks), behavioural (eg, staying at home or avoiding outdoor physical activity, temporary relocation and nutrition), pharmacological (eg, use of medications and appropriate inhaler) and technological (eg, use of mobile technology, use of air conditioning or air purifiers). The intervention could involve a single strategy or multiple strategies.

Comparator

People with asthma who were exposed to LFS and did not implement strategies to avoid/minimise personal exposure to LFS.

Outcomes

Asthma-related outcomes include asthma symptoms, exacerbation (including hospitalisation, emergency department visits, unscheduled doctor visits and oral corticosteroid use), quality of life, asthma control, lung function (forced vital capacity and forced expiratory volume) and asthma medication use.

Selection of studies

Studies obtained from databases will be exported to EndNote V.X9.1 citation manager and will then be exported to Covidence,[23] a software designed for conducting systematic reviews. Two independent reviewers (TB and PGG) will assess the studies, based on inclusion criteria. The title of the studies and abstracts will be screened to identify for full-text review. Then, full texts of potentially eligible studies will be assessed against eligibility criteria. Only studies that are approved by both reviewers will be included in the review. Any disagreements will be resolved by discussion or by consultation with a third reviewer (VMcD). Studies excluded from the review will be recorded along with the reason for their exclusion at the full-text screening stage. A final list of studies will be prepared for data extraction.

Data extraction

Two independent reviewers (TB) will complete the data extraction form, using Covidence data extraction template with clear inclusion and exclusion criteria. Periodic meetings will be held to ensure consistency in data extraction. A third reviewer (VMcD) will act as mediator in the event of disagreement. For each study, data recorded will include the first author's last name, year of publication, study setting (including country), study design, study period, sample size, response rate, population, personal smoke mitigation strategies, comparison groups, exposure and outcome definitions, and effect estimates. The corresponding authors of the studies included will be contacted to obtain missing information.

Risk of bias assessment

Two review authors (TB) will assess the risk of bias independently for each study using the Risk of Bias Assessment Tool for Non-Randomized Studies (RoBANS)[24] for observational studies, Cochrane Collaboration tool for assessing the risk of bias[25] for RCTs and the Risk Of Bias In Nonrandomized Studies of Interventions tool for non-RCTs.[26] RoBANS consists of six domains: selection bias, confounding bias, performance bias, detection bias, attrition bias and reporting bias. Each domain will be allocated one of three possible categories for each study: 'low risk', 'high risk' and 'unclear'. The ROB classes for the RCTs were 'low risk of bias,' 'some concerns,' or 'high risk of bias'. Any discrepancies arising during assessment will be resolved through discussion. Certainty of evidence will be assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework adapted to the environment and occupational health.[27] The GRADE framework uses a four-level scale (ie, high, moderate, low and very low certainty) to illustrate the strength of the evidence for each outcome.

Data synthesis and analysis

We will perform a narrative description of the studies included, including the study population, the personal strategies and the outcomes. We will use tables and figures to summarise the selected studies and results. R V.4.0.3 (Vienna, Austria) will be used for data entry and statistical analysis.[28] A random-effect meta-analysis will be performed to determine the pooled summary of findings of the included studies, where possible. The impact of individual strategies on the outcome of interest will be evaluated to compare the various personal strategies. This includes analysing data to assess how each strategy influences the outcomes' occurrence, allowing for a direct comparison of their effectiveness. To assess heterogeneity among studies, we will calculate the I^2 and τ^2 statistic,[29] which describes the percentage of total variation among studies due to heterogeneity rather than chance. Sensitivity analysis will be conducted to assess the stability of the results and to test whether any individual study influences the meta-analysis. Where possible, subgroup analysis will be conducted based on severity of asthma, type and duration of strategies (long-term vs short-term strategies), duration of exposures to LFS, country and study design. Potential publication bias will be examined by visual inspection of funnel plot asymmetry and Egger's test. If meta-analysis is not possible, we will conduct a narrative synthesis.

Patient and public involvement

A consumer reference group was conducted and people with asthma identified the need to effective stategies to reduce the effects of LFS.

DISCUSSION

To our knowledge, this systematic review and meta-analysis will be the first to synthesise literature on personal strategies for people with asthma to reduce the effects of LFS on asthma-related outcomes. This review will provide strong evidence on the effectiveness of personal strategies for people with asthma to minimise asthma-related outcomes. Furthermore, the findings will also provide information for healthcare providers to advise people with asthma on personal strategies, which have potential to improve asthma-related outcomes.

ETHICS AND DISSEMINATION PLAN

Ethical approval is not required for the proposed review. Findings of this systematic review and meta-analysis will be published in a peer-reviewed journal and presented at conferences.

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Contributors All authors were involved in the conception of the study question. TB developed the search strategy, wrote and prepared the protocol. PGG, VMur, MEJ and VMcD revised the protocol. All authors read and revised the protocol and consented to the publication of the article.

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Competing interests None declared.

Patient and public involvement A consumer reference group was conducted and people with asthma identified the need to effective stategies to reduce the effects of LFS.

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