


PROTOCOL

Open Access



# The burden of bacterial skin infection, scabies and atopic dermatitis among urban-living Indigenous children in high-income countries: a protocol for a systematic review

Bernadette M. Ricciardo<sup>1,2,3\*</sup> , Heather-Lynn Kessar<sup>4</sup>, Sujith Prasad Kumarasinghe<sup>1</sup>, Jonathan R. Carapetis<sup>1,2,5</sup> and Asha C. Bowen<sup>1,2,5</sup>

## Abstract

**Background:** Bacterial skin infections and scabies disproportionately affect children in resource-poor countries as well as underprivileged children in high-income countries. Atopic dermatitis is a common childhood dermatosis that predisposes to bacterial skin infection. In Australia, at any one time, almost half of all Aboriginal and Torres Strait Islander children living remotely will have impetigo, and up to one-third will also have scabies. Yet, there is a gap in knowledge of the skin infection burden for urban-living Australian Aboriginal and Torres Strait Islander children, as well as atopic dermatitis which may be a contributing factor. The objective of this study is to provide a global background on the burden of these disorders in Indigenous urban-living children in high-income countries. These countries share a similar history of colonisation, dispossession and subsequent ongoing negative impacts on Indigenous people.

**Methods:** This protocol follows the Preferred Reporting Items for Systematic Review and Meta-Analyses Protocols statement. Observational studies reporting incidence and/or prevalence data on bacterial skin infection, scabies and/or atopic dermatitis in urban-living Indigenous children in high-income countries will be included. Literature searches will be conducted in several international electronic databases (from 1990 onwards), including MEDLINE, Embase, EmCare, Web of Science and PubMed. Reference lists and citation records of all included articles will be scanned for additional relevant manuscripts. Two investigators will independently perform eligibility assessment of titles, abstract and full-text manuscripts, following which both investigators will independently extract data. Where there is disagreement, the senior author will determine eligibility. The methodological quality of selected studies will be appraised using an appropriate tool. Data will be tabulated and narratively synthesised. We expect there will be insufficient data to perform meta-analysis.

**Discussion:** This study will identify and evaluate epidemiological data on bacterial skin infection, scabies and atopic dermatitis in urban-living Indigenous children in high-income countries. Where available, the clinical features, risk

\*Correspondence: bernadette.ricciardo@health.wa.gov.au

<sup>3</sup> Fiona Stanley Hospital, Murdoch, Western Australia, Australia  
Full list of author information is available at the end of the article



factors, comorbidities and complications of these common childhood skin disorders will be described. The evidence will highlight the burden of disease in this population, to contribute to global burden of disease estimates and identify gaps in the current literature to provide direction for future research.

**Systematic review registration:** PROSPERO CRD42021277288

**Keywords:** Bacterial skin infection, Impetigo, Scabies, Atopic dermatitis, Eczema, Urban, Indigenous, Children, High-income countries, Epidemiology

## Background

Bacterial skin infections commonly present as impetigo, cellulitis or abscess. They are typically caused by infection with the bacteria *Staphylococcus aureus* (the predominant organism in temperate regions) and/or *Streptococcus pyogenes* (the predominant organism in tropical regions) [1]. They may be the result of direct inoculation of pathogenic bacteria (primary infection), or they may occur at a site of skin injury or inflammation where the skin barrier function is disrupted (secondary infection). Such skin inflammation in children is often the result of a pruritic skin disorder, commonly scabies and atopic dermatitis. Bacterial skin infections are readily visible, adversely affect wellbeing and self-image and contribute to general poor health. Without treatment, they can lead to serious and sometimes fatal sequelae, including invasive infection (i.e. sepsis, osteomyelitis) and post-infectious complications (i.e. acute rheumatic fever, acute post-streptococcal glomerulonephritis) [2–5].

Bacterial skin infections are common in childhood with the global paediatric population suffering from impetigo at any one time estimated to be > 162 million [6]. Based on this systematic review of 89 available studies, including 145,028 children assessed for impetigo between 2000 and 2015, the median childhood prevalence was estimated at 12.3% (interquartile range [IQR] 4.2–19.4%) [6]. While high, limitations to this approach include the sparse number and geographical spread of population that contributed to this review — with only 15 of 89 studies conducted in urban populations, none of whom was indigenous children in high-income countries. The highest burden of impetigo is seen in children from marginalised communities of high-income countries where the median prevalence is 19.4% (IQR 3.9–43.3%). Australian Aboriginal children in remote northern Australia have the highest documented prevalence of impetigo worldwide. In this cohort, the median prevalence is 45% (IQR 34–49%), equating to almost half of all Aboriginal children in remote Australia with impetigo at any one time [6, 7].

Children with scabies are high risk for secondary bacterial infection with impetigo; as a result, areas with a high prevalence of one condition often also have a high prevalence of the other [1]. It is estimated that up to one-third of all Aboriginal children in remote Australia have

scabies at any one time [6, 8], with the reported prevalence ranging from 16.1 to 35% [7].

Atopic dermatitis (eczema) is a risk factor for recurrent and severe bacterial skin infection, most commonly due to *S. aureus* and *S. pyogenes* [9]. Approximately, 1 in 3 Australian infants will develop atopic dermatitis by 12 months, [10] and while it has long been thought that Aboriginal people had a lower prevalence of eczema than their non-Aboriginal peers, a recent study revealed comparable rates between these populations [11].

While bacterial skin infections are well documented and at the highest rate in the world in remote-living Australian Aboriginal children, research is lacking on the burden of skin disease for Aboriginal children living in urban areas. Urban-living Aboriginal children in Australia now comprise over 75% of all Aboriginal children; however, little is known about skin infections in this population [12]. Furthermore, there is a gap in knowledge of the burden of predisposing pruritic conditions, such as scabies and atopic dermatitis, in this cohort. Given this, we seek to investigate the burden of these diseases in urban-living Indigenous children, specifically those in high-income countries that share a similar history of colonisation, dispossession and subsequent ongoing negative impacts on Indigenous people. We will systematically evaluate observational epidemiological studies that present prevalence and/or incidence data for bacterial skin infection, scabies and atopic dermatitis among urban-living Indigenous children in high-income countries.

## Methods

This study protocol has been registered with PROSPERO (registration ID: CRD42021277288) and is developed and will be reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocol (PRISMA-P) statement (Additional file 1) [13–15]. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses literature search extension (PRISMA-S) checklist will be submitted with the final manuscript [16].

### Eligibility criteria

#### Study design

Primary observational studies with epidemiological data on bacterial skin infection, scabies or atopic

dermatitis in urban-living Indigenous children in high-income countries will be eligible for inclusion. These may be population-based or institutional-based studies. We will include cross-sectional studies and cohort studies (retrospective and prospective) and exclude case-control studies, case series, case studies, randomised controlled trials, reports, commentaries, letters, editorials, book chapters, conference proceedings, theses and animal studies. We will also exclude review articles and opinion papers; however, these will be used to identify any potential primary observational studies that may have been missed in our search.

### **Study population**

The review will include Indigenous children and/or adolescents ( $\leq 18$  years old) of any gender who have been diagnosed with a bacterial skin infection, scabies or atopic dermatitis. While the initial vision for this systematic review was to include *all* dermatological disorders, a preliminary search strategy revealed a paucity of published literature on other infectious (including tinea, pediculosis capitis and Buruli ulcer) and non-infectious dermatological conditions in this population and context; hence, the focus was narrowed.

The participants must be urban-living, and since there is heterogeneity in how urban is defined globally, we will use the definition of “urban” as applied by the country in which the study is set at the time the study was performed. Consistent with the degree of urbanisation classification, we will consider urban areas to include cities, towns and semi-dense areas, and where possible, we will categorise our urban studies using these sub-headings [17].

We anticipate there being studies set in major and regional cities that do not provide a breakdown for urban-living versus rural-living participants. We will contact the corresponding author of these studies to determine if they have unpublished data specific for urban-living Indigenous children, and if so, these data will be requested and included. If specific data on urban-living Indigenous children are not available, these studies will also be included but considered in a separate category of combined urban- and rural-living children treated in an urban hospital.

The study setting is high-income countries, as classified by the Organization for Economic Co-operation and Development (OECD) [18]. We are particularly interested in high-income countries that share a similar history of colonisation with the subsequent displacement of Indigenous peoples, including Australia, New Zealand, the USA, Canada, Denmark, Finland, Greenland, Norway and Sweden.

Countries of all climates will be included. Where climate data is not reported, the Koppen climate classification system will be used to code the climate by country (tropical, arid, temperate, cold and polar) [19].

### **Outcomes**

The primary outcome will be the prevalence and/or incidence of bacterial skin infection (including impetigo, cellulitis and abscess), scabies or atopic dermatitis (eczema) in urban-living Indigenous children of high-income countries. We will use author-reported definitions of these diseases.

The secondary outcomes will be the clinical features (phenotype), risk factors, comorbidities and complications of bacterial skin infection, scabies and atopic dermatitis in urban-living Indigenous children of high-income countries. The microbiology of the bacterial skin infections in this population will also be reported.

### **Information sources**

Literature searches will be conducted in several international electronic databases including MEDLINE (Ovid), Embase (Ovid), EmCare (Ovid), Web of Science and PubMed.

The reference lists of all included full-text articles and relevant review articles will be scanned for additional manuscripts for inclusion. Citation searching of all included full-text articles will also be performed.

### **Search strategy**

The literature searches will be designed and conducted by the review team with the help of a health information specialist. The search strategy will be conducted taking into account the “CoCoPop” (condition, context and population) framework [20]. It will use a combination of keywords and subject headings relating to the population and outcomes of interest. A sample search strategy for MEDLINE (Ovid) search strategy is included (Additional file 2). The search will be restricted to studies published since 1990. Any study published in English will be considered for inclusion in the review.

### **Study records**

#### **Data management**

The search results will be uploaded to EndNote reference management software where titles and abstracts will be screened. Full-text articles for assessment against the inclusion criteria will be collated in a Microsoft Excel spreadsheet. Extracted data from included articles will also be recorded in a Microsoft Excel spreadsheet.

**Selection process**

Two authors will independently perform the search strategy, removing duplicates and screening the titles and abstracts for relevance. Following this, the full-text articles will be retrieved and assessed against the inclusion criteria. Any disagreement between the two reviewers regarding a potential study inclusion will be resolved through discussion with the senior author as third reviewer if needed. In the case that data is duplicated in more than one study, the study with the most comprehensive data will be included. The literature selection and the reasons for study exclusion will be recorded in a Microsoft Excel spreadsheet and then documented in a PRISMA flow diagram.

For included full-text articles and relevant reviews, the reference lists and citations will be scanned to identify additional studies that may have been missed in the initial search.

The included manuscripts will be divided in to the following conditions — bacterial skin infection, scabies and atopic dermatitis.

**Data collection process**

A data extraction form will be prepared to capture information on study characteristics, participants and study outcomes. Two authors will independently extract the data. Any disagreement between the two reviewers as relates to data extraction will be resolved through discussion with a third reviewer if needed.

**Data items**

Extracted data will include the following:

- Publication details: publication year, first author, title, journal and source of funding
- Design details: type of study, aim(s) of study, inclusion criteria, exclusion criteria, diagnostic criteria (for bacterial skin infection, scabies and atopic dermatitis), qualification(s) of person conducting the screening, method of data collection, recruitment and sampling methods, number of participants and response rate
- Study setting details: study site (school, juvenile custodial centre, primary health-care service, hospital emergency department, hospital inpatient), town/city where study conducted, population of town/city where study conducted at the time the study was performed, country where study conducted, definition of “urban” in country where study conducted at the time the study was performed, degree of urbanization (city, town, semi-dense area) and climate of town/city where study conducted (tropical, arid, temperate, cold and polar)
- Study participant details: age, sex and ethnicity

- Data for primary outcome measures: all reported estimates or sufficient information to calculate an estimate of the point prevalence, period prevalence, cumulative incidence and/or incidence rates of bacterial skin infection, scabies and atopic dermatitis
- Data for secondary outcome measures: clinical features (phenotype), risk factors, comorbidities and complications of bacterial skin infection, scabies and atopic dermatitis, culture-proven aetiology of bacterial skin infection
- Limitations: selection bias, response bias, information bias, limitations of assessment tool(s) used and limitations reported by study authors.

**Risk-of-bias assessment**

Two authors will independently appraise the studies. The assessment of methodological quality will be based on the Joanna Briggs Institute (JBI) appraisal checklist for studies reporting prevalence data [21]. Risk-of-bias assessments will subsequently be rated as high, low or unclear in a “risk-of-bias” table. Any disagreements that arise will be resolved via a consensus decision of the review team members.

**Data synthesis**

The results for each condition (i.e. bacterial skin infection, scabies, atopic dermatitis) will be presented separately. Quantitative and qualitative findings for each condition will be described in narrative form and, where appropriate, synthesised into tables and figures to aid in data interpretation. A single, comprehensive set of synthesised quantitative findings will be presented in a “Summary of Findings” table for each condition.

If appropriate, and if such data can be retrieved from the manuscripts, subgroup analysis (with median prevalence) may be carried out using the following:

- Age groups: 0–1 years, 1–5 years, 6–10 years and > 11 years
- Sex: male and female
- Continental population groups: the Oceanic Ancestry Group, American Native Continental Ancestry Group and European Continental Ancestry Group
- Degree of urbanisation: city, town and semi-dense area
- Climate: tropical, arid, temperate, cold and polar

We expect there to be insufficient data to conduct meta-analysis.

**Meta-biases**

Studies will be included only once to reduce the risk of publication bias. Selective outcome reporting will be considered when articles describe the outcomes in “Methods” but fail to report them in “Results.”

## Discussion

This systematic review will identify and report the estimated prevalence and/or incidence of bacterial skin infections, scabies and atopic dermatitis among urban-living Indigenous children of high-income countries. This has not been previously collated in the published literature. Where possible, subgroup analysis will be performed based on age, sex, continental population group, degree of urbanisation and climate, and we will describe the clinical features, risk factors, comorbidities and complications of these common childhood skin disorders. The expected high heterogeneity between studies will likely preclude meta-analysis. Limitations of the studies will be discussed in detail.

To our knowledge, this will be the first review to systematically synthesise and collate the available epidemiological evidence on bacterial skin infections, scabies and atopic dermatitis in urban-living Indigenous children of high-income countries. The results will describe the burden of these skin conditions, highlighting the risk factors and comorbidities and identifying gaps in the literature to direct future research. In addition, this will be an important contribution to the global burden of disease estimates as these populations have not previously been included. Implications of the review and suggestions for future research will be provided. The resulting manuscript will be submitted for publication.

## Abbreviations

IQR: Interquartile range; JBI: Joanna Briggs Institute; OECD: Organization for Economic Co-operation and Development; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses; PRISMA-P: Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocol; PRISMA-S: Preferred Reporting Items for Systematic Reviews and Meta-Analyses literature search extension; *S. aureus*: *Staphylococcus aureus*; *S. pyogenes*: *Streptococcus pyogenes*.

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13643-022-02038-8>.

**Additional file 1.** PRISMA-P 2015 Checklist: recommended items to address in a systematic review.

**Additional file 2.** MEDLINE (Ovid) search strategy.

## Acknowledgements

We acknowledge the traditional owners of the urban region of Perth, Western Australia, the Noongar nation. We acknowledge the Derbarl Yerrigan Health Service Aboriginal Corporation (DYHSAC) and South West Aboriginal Health Service (SWAMS) whom we partner with in this work.

## Authors' contributions

BR wrote the protocol. AB conceived the initial idea for the review, which was refined by BR. HK, PK, JC and AB critically appraised the protocol and contributed to its design and development. All authors approve the final version and take responsibility for its content. The authors read and approved the final manuscript.

## Funding

The authors have not received any external funding in support of this protocol. BR is the recipient of an Australian Government Research Training Program Fees Offset, an Australian National Health and Medical Research Council (NHMRC) PhD scholarship (GNT2014208) and Wesfarmers Centre of Vaccines & Infectious Diseases Higher Degree by Research Scholarship. AB is the recipient of an NHMRC investigator award (GNT1175509). JC is the recipient of an NHMRC investigator award (GNT1173874).

## Availability of data and materials

Not applicable

## Declarations

### Ethics approval and consent to participate

Not applicable

### Consent for publication

Not applicable

### Competing interests

The authors declare that they have no competing interests.

## Author details

<sup>1</sup>University of Western Australia, Crawley, Western Australia, Australia. <sup>2</sup>Wesfarmers Centre for Vaccines and Infectious Diseases, Telethon Kids Institute, Nedlands, Western Australia, Australia. <sup>3</sup>Fiona Stanley Hospital, Murdoch, Western Australia, Australia. <sup>4</sup>Royal Darwin Hospital, Tiwi, Northern Territory, Australia. <sup>5</sup>Perth Children's Hospital, Nedlands, Western Australia, Australia.

Received: 28 October 2021 Accepted: 28 July 2022

Published online: 09 August 2022

## References

- Steer AC, Jenney AW, Kado J, et al. High burden of impetigo and scabies in a tropical country. *PLoS Neglect Trop Dis* [electronic resource]. 2009;3:e467.
- Munro APS, Blyth CC, Campbell AJ, Bowen AC. Infection characteristics and treatment of *Staphylococcus aureus* bacteraemia at a tertiary children's hospital. *BMC Infect Dis*. 2018;18:387.
- Campbell AJ, Al Yazidi LS, Phuon LK, et al. Pediatric *Staphylococcus aureus* Bacteremia: Clinical Spectrum and Predictors of Poor Outcome. *Clin Infect Dis*. 2022;74(4):604-13. <https://doi.org/10.1093/cid/ciab510>.
- Baker MG, Gurney J, Oliver J, et al. Risk factors for acute rheumatic fever: literature review and protocol for a case-control study in New Zealand. *Int J Environ Res Public Health* [Electronic Resource]. 2019;16:15.
- Hoy WE, White AV, Dowling A, et al. Post-streptococcal glomerulonephritis is a strong risk factor for chronic kidney disease in later life. *Kidney Int*. 2012;81:1026-32.
- Bowen AC, Mahé A, Hay RJ, et al. The global epidemiology of impetigo: a systematic review of the population prevalence of impetigo and pyoderma. *PLoS One*. 2015;10:e0136789.
- Davidson L, Bowen AC. Skin infections in Australian Aboriginal children: a narrative review. *Med J Australia*. 2020;213:287-e1.
- Romani L, Steer AC, Whitfeld MJ, Kaldor JM. Prevalence of scabies and impetigo worldwide: a systematic review. *Lancet Infect Dis*. 2015;15:960-7.
- Alexander H, Paller AS, Traidl-Hoffmann C, et al. The role of bacterial skin infections in atopic dermatitis: expert statement and review from the International Eczema Council Skin Infection Group. *Br J Dermatol*. 2020;182:1331-42.
- Martin PE, Koplin JJ, Eckert JK, et al. The prevalence and socio-demographic risk factors of clinical eczema in infancy: a population-based observational study. *Clin Exp Allergy*. 2013;43:642-51.
- Haggett MG, Tait CP. Five years of dermatological disease requiring specialist care in the Kimberley region of Western Australia. *Australas J Dermatol*. 2021;62:157-61.

12. Australian Bureau of Statistics. Aboriginal and Torres Strait Islander well-being: a focus on children and youth, Apr 2011 Canberra: cat. no. 4725. [Available at <http://www.abs.gov.au/ausstats/abs@nsf/Lookup/4>]
13. Moher D, Shamseer L, Clarke M, et al. Preferred Reporting Items for systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015 statement. *Syst Rev.* 2015;4:1.
14. Shamseer L, Moher D, Clarke M, et al. Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) 2015: elaboration and explanation. *Brmj.* 2015;350:g7647.
15. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: the PRISMA statement. *PLoS Med.* 2009;6:e1000097.
16. Rethlefsen ML, Kirtley S, Waffenschmidt S, et al. PRISMA-S: an extension to the PRISMA statement for reporting literature searches in systematic reviews. *Syst Rev.* 2021;10:39.
17. Dijkstra L, Florczyk A, Freire S, Kemper T, Pesaresi M. Applying the degree of urbanisation to the globe: a new harmonised definition reveals a different picture of global urbanisation. 16th Conference of International Association for Official Statistics (IAOS). Paris: Organization for Economic Co-operation and Development (OECD) Headquarters; 2018.
18. Woodward R. The Organisation for Economic Co-operation and Development (OECD): Routledge; 2009.
19. Peel MC, Finlayson BL, McMahon TA. Updated world map of the Köppen-Geiger climate classification. *Hydrol Earth Syst Sci.* 2007;11:1633–44.
20. Munn Z, Stern C, Aromataris E, Lockwood C, Jordan Z. What kind of systematic review should I conduct? A proposed typology and guidance for systematic reviewers in the medical and health sciences. *BMC Med Res Methodol.* 2018;5.
21. 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

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more [biomedcentral.com/submissions](https://biomedcentral.com/submissions)

