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# Ethnic differences and inequities in paediatric healthcare utilisation in the UK: a scoping review

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## ABSTRACT

**Background** Despite the increased policy attention on ethnic health inequities since the COVID-19 pandemic, research on ethnicity and healthcare utilisation in children has largely been overlooked.

**Objectives** This scoping review aimed to describe and appraise the quantitative evidence on ethnic differences (unequal) and inequities (unequal, unfair and disproportionate to healthcare needs) in paediatric healthcare utilisation in the UK 2001–2021.

**Methods** We searched Embase, Medline and grey literature sources and mapped the number of studies that found differences and inequities by ethnic group and healthcare utilisation outcome. We summarised the distribution of studies across various methodological parameters.

**Results** The majority of the 61 included studies (n=54, 89%) identified ethnic differences or inequities in paediatric healthcare utilisation, though inequities were examined in fewer than half of studies (n=27, 44%). These studies mostly focused on primary and preventive care, and depending on whether ethnicity data were aggregated or disaggregated, findings were sometimes conflicting. Emergency and outpatient care were understudied, as were health conditions besides mental health and infectious disease. Studies used a range of ethnicity classification systems and lacked the use of theoretical frameworks. Children's ethnicity was often the explanatory factor of interest while parent/caregiver ethnicity was largely overlooked.

**Discussion** While the current evidence base can assist policy makers to identify inequities in paediatric healthcare utilisation among certain ethnic groups, we outline recommendations to improve the validity, generalisability and comparability of research to better understand and thereby act on ethnic inequities in paediatric healthcare.

## BACKGROUND

Ethnic diversity in the UK has grown considerably in the last few decades, with the proportion of some minority ethnic groups doubling between the 2001 and 2011 census. At the time of the 2011 census, nearly 11 million people in England and Wales identified as belonging to an ethnic group other than White British.<sup>1–3</sup> While differences in health outcomes between ethnic groups have been observed in the UK for some time, understanding and addressing ethnic inequities in health and healthcare became an enhanced policy imperative more recently following the starkly

disproportionate impact of COVID-19 on minority ethnic communities.<sup>4</sup>

However, in trying to understand the complex relationship between ethnicity and health, the majority of research has focused on health outcomes rather than healthcare access and utilisation.<sup>5 6</sup> Research concerning healthcare utilisation has centred on adults or the general population, with children largely overlooked. A recent rapid review commissioned by the National Health Service (NHS) Race and Health Observatory found that quantitative data on maternal and neonatal healthcare use in the UK are inconsistent and studies on neonates are particularly scarce.<sup>6</sup>

It is also unclear whether the evidence on ethnic inequities in paediatric healthcare utilisation in the UK is sufficient for policy making, commissioning and service planning, particularly whether findings about ethnic variation in healthcare use can be interpreted as inequitable. Throughout this paper, we use 'ethnic variation' as an umbrella term to capture both ethnic differences (unequal healthcare use) and ethnic inequities (unequal and unfair or disproportionate to health needs and health outcomes). This delineation is important from a policy perspective. While action is needed to address ethnic differences in healthcare utilisation that stem from differences in disease burden, these are distinct from actions to address inequities in healthcare utilisation that persist even after accounting for healthcare need.<sup>7</sup>

We conducted a scoping review to identify and appraise the current evidence, focusing on studies that quantified differences between ethnic groups or between observed and expected proportions of children who used healthcare within an ethnic group. We aimed to describe the quantity and quality of the evidence base, identify research gaps and develop recommendations for future research. We also aimed to summarise which studies reported ethnic variations in paediatric healthcare utilisation, for which ethnic groups and outcomes and whether they attempted to distinguish between ethnic differences and inequities.

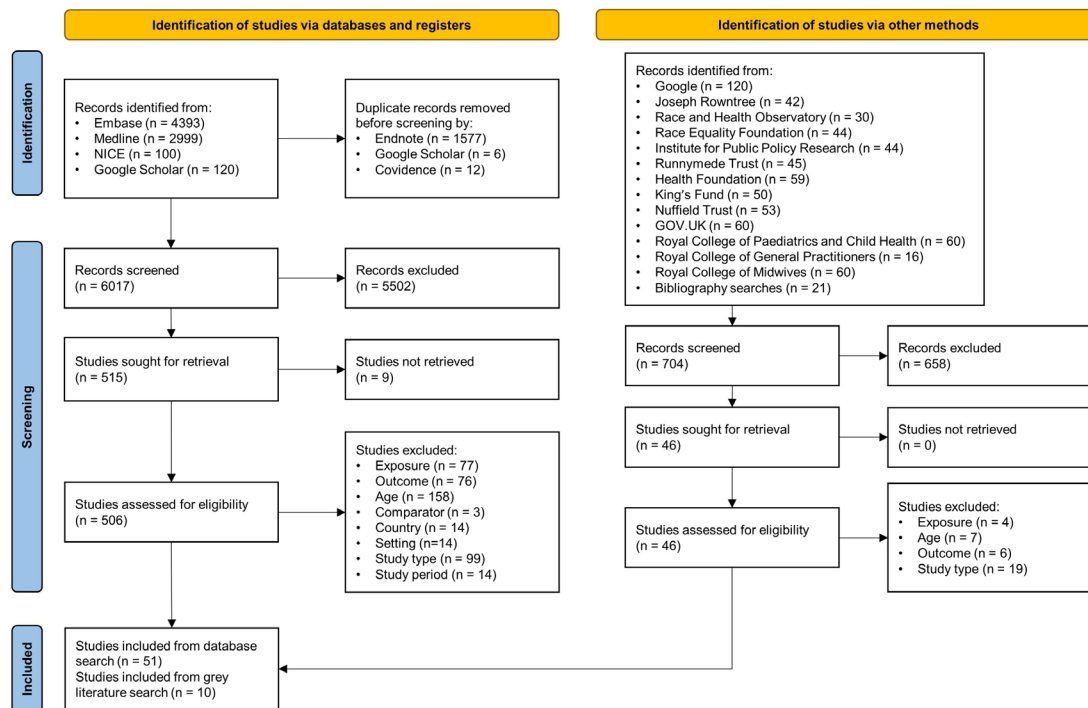
## METHODS

This review was conducted in line with the scoping review framework developed by Arksey and O'Malley<sup>8</sup> and enhanced by Levac and colleagues,<sup>9</sup> and was reported using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews checklist<sup>10</sup> (online supplemental appendix 1).



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**Figure 1** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram. NICE, National Institute for Health and Care Excellence.

We define ethnicity as a social construct, self-identified and influenced by characteristics such as one's cultural identity, nationality, language, heritage, migration history and religion, as well as the evolving cultural, political and social dynamics within societies.<sup>11</sup> For healthcare utilisation, we adopted the definition of 'realised access'<sup>12</sup> to health and medical services provided by the NHS, which was quantitatively measured through direct contacts with these services.

### Information sources

Empirical studies were sourced from Embase and Medline via Ovid. Grey literature was sourced from Google, Google Scholar, National Institute for Health and Care Excellence (NICE) and the websites of organisations known to publish on ethnicity, inequalities and health (figure 1).

### Search strategies

We developed search strategies with the assistance of a librarian. Database search strategies included text word terms and subject heading terms for a combination of the following concepts: ethnicity AND paediatric AND healthcare utilisation AND UK. Database searches were filtered by year (2001–2021) and by country using validated filters developed by NICE.<sup>13</sup> An example of a full database search strategy and additional information on grey literature searches are presented in online supplemental appendix 2.

### Outcomes

Primary outcomes included attendance at face-to-face or remote healthcare appointments at any level of the healthcare system, uptake of preventive care, hospital admissions and emergency department attendances. Secondary outcomes included additional characteristics of healthcare use, such as referrals, failure to attend appointments, length of stay, readmissions, escalation to high dependency and intensive care, discharge, timing of

healthcare (eg, wait times or delays) and costs incurred by the healthcare system.

### Study selection

Two reviewers conducted title, abstract and full-text screening (CXZ all studies; TB and CO half each). The rest of the authorship team assisted to resolve conflicts. Full inclusion and exclusion criteria are presented in online supplemental appendix 3. We included primary research or evaluation conducted in the UK that contained data from 2001 onwards and quantified differences between ethnic groups or between observed and expected proportions of individuals who used healthcare within an ethnic group. Since transition from paediatric to adult health services in the UK is not based on a single age cut-off,<sup>14</sup> the paediatric population was defined as children and young people in the context of the type of service under investigation.

We included studies that used child and/or parent/caregiver ethnicity as a primary explanatory factor or as part of a group of multiple explanatory factors. We excluded studies that only used ethnicity as a confounder in statistical modelling because these studies often did not present results by ethnicity, thus limiting extraction and the ability to address our study's objectives. We excluded studies that used healthcare utilisation metrics as a proxy measure for other outcomes (eg, hospitalisations as a measure of disease prevalence), or described intended or anticipated uptake of service. Studies concerning healthcare experiences, attitudes, access barriers and facilitators were also outside of the scope of this review.

### Charting (extraction) and appraisal

We developed a data charting form<sup>15</sup> which two reviewers (CC and TB) piloted on five studies and iteratively refined with the authorship team.<sup>9</sup> Data items were extracted by one reviewer (CXZ) and included: citation details, study period, location, participant characteristics, ethnicity, aims, methodology, outcome

measures and key findings (online supplemental appendix 4). One reviewer (CXZ) appraised studies using the NICE quality appraisal checklist for quantitative studies reporting correlations and associations.<sup>16</sup> Only aspects of studies relevant to ethnicity and outcomes of interest were extracted and appraised.

### Collating and summarising (synthesis)

The number and proportion of studies were described by: year, location, age, ethnicity, healthcare utilisation outcome, health topic, study methods, whether the study found ethnic variations and whether they attempted to distinguish ethnic differences from inequities through their methodology (eg, adjusting for healthcare need) or by choosing outcomes that are assumed to be a normative need for all children (eg, vaccination) or no children (eg, non-attendance, avoidable care).

### Patient and public involvement

We held an online consultation workshop with a patient and public involvement (PPI) advisory group to triangulate the findings with parents' perspectives and develop recommendations for future research.<sup>9</sup> The PPI group consisted of five mothers from different ethnic backgrounds across England, recruited as part of a wider research project.

## RESULTS

Of the 8316 studies identified in database and grey literature searches, 61 were included for extraction and synthesis (figure 1).

### Year, location and age of the child

Individual study details are summarised in online supplemental appendix 5. Studies were published between 2004 and 2021 and increased in number over the years. Years in which studies were conducted were distributed relatively evenly between 2001 and 2015, with a decrease in the latter half of the 2010s, likely an artefact of a lag in data availability (online supplemental appendix 6). Only five (8%) reported findings by ethnicity over time (ie, stratified by year). Studies were largely concentrated in England (41, 67%), with 23 (56%) of English studies conducted in a specific region or city, including 13 (32%) in London. Eight (13%) were UK-wide studies (online supplemental appendix 6). Nearly a third of all studies (18, 30%) presented age-specific results (ie, stratified by age).

### Ethnicity

For most studies, ethnicity of the child was the factor of interest (49, 80%), with seven (11%) studying the ethnicity of the parent/caregiver, five (8%) not specifying which and none studying both. Ethnicity was more often included in a group of multiple explanatory factors under investigation (37, 61%) as opposed to being the primary factor of interest (24, 39%). The classification of ethnicity varied widely between studies, with the majority using custom groupings (42, 69%). Ten (16%) made a binary comparison of all minority ethnic groups and White or White British groups. Nine studies (15%) used Office for National Statistics (ONS) England and Wales census 2001 or 2011 aggregated five-level groupings, and only three (5%) used the 2001 census disaggregated 16-level groupings (online supplemental appendix 7). The most frequently used comparator ethnic group was White (28, 46%).

### Outcomes in the included studies

Utilisation of primary and preventive care and hospitalisation were most frequently studied (22, 36% each), followed closely

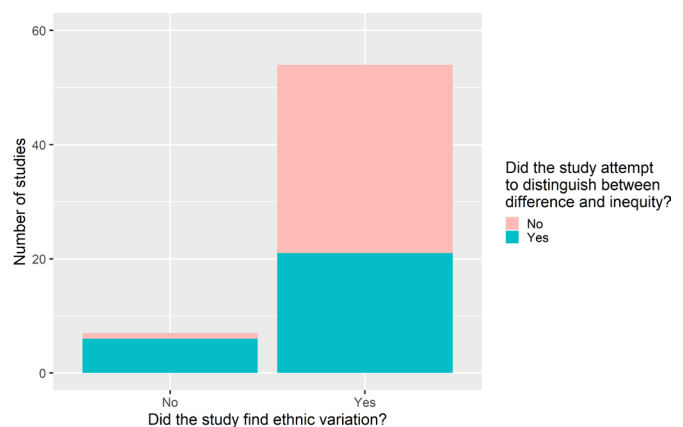
by secondary outcomes like step-up to intensive care and length of stay (21, 34%). Outpatient and community care (9, 15%) and emergency department attendance (7, 11%) were least studied. Vaccination studies comprised over half (13, 59%) of primary and preventive care studies.

### Methodology used in the included studies

The majority of studies assigned ethnicity using routine administrative health data (48, 79%), while the remainder elicited self-reported or parent-reported ethnicity via surveys, interviews and focus groups. Most presented descriptive quantitative findings such as summary statistics and proportions (53, 87%). Just over half proceeded to examine unadjusted statistical associations (35, 57%) with fewer presenting adjusted associations (27, 44%). Reporting of participant characteristics also varied widely, with child age (43, 70%), sex or gender (36, 59%), clinical conditions or comorbidities (28, 46%) and aggregated area-level socio-economic status (26, 43%) being the most frequently reported. Other factors relevant to the study of child health and ethnicity such as pregnancy and birth outcomes, migration status, religion and languages spoken were rarely reported.

### Ethnic differences and inequities

The majority of studies (54, 89%) found ethnic variation in healthcare utilisation for at least one ethnic group. Fewer than half (27, 44%) of all studies attempted to distinguish between differences and inequities. Nine (15%) attempted to identify inequities through methodological design (such as adjusting for measures of healthcare need), and the rest (18, 30%) did so because the outcomes chosen were assumed to be a normative need for all children (eg, vaccination) or no children (eg, non-attendance, avoidable care). Figure 2 shows that less than half of the studies that reported ethnic variation had attempted to look for inequities, while nearly all the studies that found no ethnic variation had tried to address this issue. Figure 3 focuses only on the studies that found ethnic variation, showing the number of studies by ethnic group, outcome and whether the finding was a difference or inequity. In primary and preventive care, inequities in utilisation were reported across all census ethnic groups, but most frequently in children of Mixed/Multiple and White ethnicities when ethnicity was aggregated,<sup>17–21</sup> and African, Caribbean, Pakistani, Bangladeshi and White Irish ethnicities when disaggregated.<sup>18–20 22–26</sup>



**Figure 2** Number of studies by whether the study found any ethnic variation, stratified by whether the study attempted to distinguish between difference and inequity.



**Figure 3** Number of studies that found ethnic variation, stratified by ethnic group, healthcare utilisation outcome and whether the study examined ethnic differences or inequities. 3A shows studies that used aggregated ethnic groups. 3B shows studies that used disaggregated ethnic groups.

### Quality of evidence

Quality ratings for individual studies are presented in online supplemental appendix 8. All had low (35, 57%) or medium (26, 43%) internal validity. The majority also had low (14, 23%) or medium (40, 66%) external validity, though some were high (7, 11%). For cohort studies, none compared follow-up time between ethnic groups to assess bias. Custom aggregations of ethnic groups were often made to achieve analytical power, which limited comparability between studies. Forty-one studies (67%) did not provide any theoretical justification for their analytical methods including variable selection and 16 (26%) provided minimal justification. Only four (7%) provided a moderate amount of information and none provided a theoretical framework.

Results for Mixed/Multiple ethnic groups were presented in studies' tables and figures but received less mention in the body of text than Black and Asian ethnic groups, or were combined with Other ethnic groups and therefore not able to be interpreted meaningfully. It was sometimes unclear why higher or lower utilisation was interpreted as inappropriate for the health service of interest. Studies that did not distinguish between difference and inequity also often conflated these concepts. Altogether, this made it difficult to determine whether some studies' analytical methods were appropriate for their aims.

## DISCUSSION

This scoping review aimed to describe and appraise the quantitative evidence on ethnic differences and inequities in paediatric healthcare utilisation in the UK. It found that in the last two decades, the majority of studies in this field reported ethnic variations in utilisation across a range of healthcare services. However, there was a lack of theory underpinning methodological decisions, limiting the quality of the overall body of evidence and resulting in substantial heterogeneity in the way that studies classified ethnicity. When ethnic variation was found, less than half of these studies attempted to distinguish between difference and inequity; those that did were mainly situated in primary and preventive care.

### Implications for policy

In keeping with previous reviews of ethnicity and healthcare in the UK, there is a reasonably sized body of quantitative evidence on ethnic variation in paediatric healthcare utilisation across the NHS.<sup>6</sup> However, within the small number of studies that found no ethnic variation, a much greater proportion attempted to identify inequities, suggesting challenges with defining research questions and methods that identify meaningful inequities, or possible publication bias in favour of studies that found ethnic variation despite not distinguishing between difference and inequity.<sup>27</sup> Furthermore, despite the long-standing and ongoing theoretical research on ethnicity and health,<sup>7,28</sup> theory was rarely adopted in paediatric healthcare utilisation studies, thereby limiting the quality of studies and making it difficult to interpret and synthesise findings for policy making.

Where inequity was studied, it was most consistently done in primary and preventive care in England, owing to the large proportion of vaccination studies that could assume normative need for all children. Different underlying factors affecting vaccination access and attendance have been proposed for different ethnic groups: deprivation and parity for White ethnic groups,<sup>21,29</sup> compared with barriers to accessing healthcare, timely and accessible information about preventive care and perceptions about vaccination importance for minority ethnic groups, particularly those of Black and Asian ethnic backgrounds.<sup>18,30,31</sup> However, research about these underlying factors is sparse, especially for Mixed/Multiple and Other ethnic groups in the UK,<sup>31</sup> likely in part due to a lack of clear definitions and inconsistencies in elicitation and reporting for these two groups.<sup>32</sup> It highlights the need for concerted efforts to better understand how ethnic categories are conceptualised and reported in different healthcare contexts, identify why inequities occur for specific ethnic groups, and co-produce place-based actions to address them. The emergence of conflicting findings from the included studies depending on whether ethnicity was studied at an aggregate or disaggregated level also suggests that Simpson's paradox may be at play,<sup>33</sup> and reinforces the need to understand underlying pathways to ethnic inequities at a more granular level.

### Implications for research

There are research gaps in utilisation of emergency department and outpatient services, likely due to the poorer quality and less timely release of routine health data for these outcomes compared with primary care and hospitalisation.<sup>34</sup> While improvements to emergency department and outpatient data sets could help fill these research gaps, the completeness and representativeness of ethnicity data is an ongoing concern in these two types of data sources in England as well as in other routine sources of

**Table 1** Recommendations to improve the quality of research on ethnicity and paediatric healthcare utilisation

Methodological consideration	Recommendation
Theoretical frameworks	<ul style="list-style-type: none"> <li>▶ Avoid conflating the concepts of ethnic difference and inequity.</li> <li>▶ Use theoretical frameworks to guide analysis and avoid overadjustment or unnecessary adjustment in statistical modelling.<sup>45</sup></li> <li>▶ Studies interested in quantifying inequities in healthcare utilisation should ensure that choice of outcomes or analytical methods account for variation in healthcare need and health outcomes between ethnic groups.<sup>7</sup></li> <li>▶ Clearly define the range of normal/expected limits for healthcare use for the specific health service examined.</li> </ul>
Ethnicity	<ul style="list-style-type: none"> <li>▶ Explain why ethnicity is an explanatory factor of interest and how the research will impact on the ethnic groups of interest.</li> <li>▶ In the absence of universally agreed 'best' classification system for ethnicity in the UK, provide sufficient detail about the context and justification for choice of classification systems.<sup>41</sup></li> <li>▶ Where statistical power allows, avoid aggregation of ethnic groups because the meaningfulness of interpretation of findings for policy and practice decreases with increasing aggregation,<sup>41</sup> and aggregated estimates can mask variation between ethnic groups.</li> <li>▶ When aiming to improve comparability of studies or to validate existing findings, consider using standard groupings like census groupings.</li> <li>▶ Examine parent/primary caregiver ethnicity where data are available, and compare the effect of parent/caregiver ethnicity with child ethnicity in influencing paediatric healthcare utilisation.</li> <li>▶ Consider the likelihood of children's recorded ethnicity changing over time in routine data sets.<sup>37</sup></li> <li>▶ Examine the potential for misclassification bias and report on the completeness and representativeness of the ethnic breakdown of study cohorts/samples.<sup>35</sup></li> <li>▶ Examine the potential for selection bias and report follow-up time by ethnic group in cohort studies.</li> <li>▶ Avoid selective reporting of findings about larger ethnic groups like White, Black and South Asian when ethnic variation in healthcare use is also identified in smaller groups like Mixed and Other ethnicities.</li> </ul>
Patterns by age, time and location	<p>Wherever statistical power allows, produce:</p> <ul style="list-style-type: none"> <li>▶ Age-specific estimates, particularly given the age-specific changes in healthcare utilisation rates across the life course.<sup>42</sup></li> <li>▶ Year-specific estimates, or use other methods to take into account changes over time.</li> <li>▶ Region-specific estimates in UK-wide or country-wide studies.</li> </ul>

health data,<sup>35</sup> and could potentially be improved through linkages to better sources of ethnicity data (eg, census and ONS birth notification).

Though high-level data governance through NHS Digital and the ONS might allow for greater availability of routine administrative data than other countries, at the local health service level there is still much variation in the way that ethnicity and healthcare data are collected.<sup>36</sup> In the individual studies included in our review, it was not possible to ascertain how ethnicity data were elicited since almost 80% of studies used routine administrative data. Assigning ethnicity using routine administrative data poses risk of misclassification, and methods for eliciting patient ethnicity data are rarely documented; it is often a mix of self-report (gold standard), third-party report particularly in the case of children, or assumptions made by healthcare staff on the basis of sociodemographic or physical characteristics.<sup>36 37</sup> Furthermore, despite the NHS's universal healthcare system with free primary care for all, access to both primary care and secondary care is an ongoing challenge for migrants in the UK,<sup>38 39</sup> so routine health data and findings from subsequent studies may be less representative of individuals from minority ethnic groups who are not UK born.

Even in light of these challenges, the quality of evidence can and should be improved. We synthesised the methodological limitations of the current evidence base into recommendations in [table 1](#) to improve the validity and generalisability of future research in ethnicity and paediatric healthcare utilisation. Recommendations build on the existing work of Salway and colleagues<sup>40</sup> and the NHS Race and Health Observatory in the broader field of ethnicity and health research, and include further considerations for defining and classifying ethnic groups,<sup>41</sup> using theory to guide methodological decisions,<sup>7</sup> and ensuring that trends over time, by age and by location are considered. These recommendations were developed with the input of the PPI advisory group.

### Strengths and limitations

To our knowledge, this is the first review to describe and appraise quantitative research on ethnicity and paediatric healthcare

utilisation in the UK, and also the first review within the field of ethnicity and healthcare more broadly in the UK to distinguish between ethnic differences and inequities. While studies of paediatric healthcare have at times excluded preventive care outcomes, we included specific search terms for preventive and avoidable care. This is because the majority of children are healthy and use healthcare services much less than older age groups with the exception of the early years,<sup>42</sup> where direct healthcare contacts are likely to be for routine preventive reasons (eg, vaccinations, development checks, screening) or acute unplanned reasons.<sup>43</sup>

We made a pragmatic decision to use search terms related to general healthcare utilisation of core health and medical services, rather than an exhaustive list of all healthcare and health-related services. As such, the review may not comprehensively capture services like allied health, therapies, dental, optical and pharmacy. Additionally, medication prescription was not an outcome of interest as this review focused on direct contacts with the healthcare system. Prescribing is a secondary event after contact with the healthcare system and can occur without ongoing direct contact with the system. However, prescribing is sometimes used as a measure of health resource utilisation,<sup>44</sup> which may limit the comparability of our review.

### CONCLUSION

The majority of quantitative studies concerning ethnicity and paediatric healthcare utilisation in the UK found ethnic variations. However, ethnic inequities in healthcare utilisation that are unequal, unfair and disproportionate to healthcare needs were examined in less than half of the identified studies. While these studies provide a good starting point for policy makers, commissioners and service planners to identify services where healthcare use among certain ethnic groups is disproportionate to need, methodological challenges and research gaps still prevail. In particular, future studies on ethnicity and paediatric healthcare utilisation in the UK should provide clear parameters for classification of ethnicity and use robust theoretical frameworks to improve the validity, generalisability and comparability of research in this field.

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## Appendices

### Appendix 1. Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED IN SECTION
<b>TITLE</b>			
Title	1	Identify the report as a scoping review.	Title
<b>ABSTRACT</b>			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Abstract
<b>INTRODUCTION</b>			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Background
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Background
<b>METHODS</b>			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Methods: Study selection Appendix 3
Information sources	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Methods: Information sources
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Methods: Search strategies Appendix 2
Selection of sources of evidence	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Methods: Study selection
Data charting process	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Methods: Charting (extraction) and appraisal Appendix 4
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Methods: Charting (extraction) and appraisal Appendix 4
Critical appraisal of individual sources of evidence	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Methods: Charting (extraction) and appraisal
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Methods: Collating and summarising (synthesis)
<b>RESULTS</b>			



SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED IN SECTION
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Figure 1
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Results Appendix 5
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Results: Quality of evidence Appendix 8
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Results
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Results Appendix 6-7
<b>DISCUSSION</b>			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Discussion
Limitations	20	Discuss the limitations of the scoping review process.	Discussion: Strengths and limitations
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Conclusions
<b>FUNDING</b>			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Methods: Role of the funding source Funding

## Appendix 2. Search strategies

## 2.1. Embase search strategy

Embase 1974 to present

- 1 exp United Kingdom/
- 2 (national health service\* or nhs\*).ti,ab,in.
- 3 (english not ((published or publication\* or translat\* or written or language\* or speak\* or literature or citation\*) adj5 english)).ti,ab.
- 4 (gb or "g.b." or britain\* or (british\* not "british columbia") or uk or "u.k." or united kingdom\* or (england\* not "new england") or northern ireland\* or northern irish\* or scotland\* or scottish\* or ((wales or "south wales") not "new south wales") or welsh\*).ti,ab,jw,in.
- 5 (bangor or "bangor's" or cardiff or "cardiff's" or newport or "newport's " or st asaph or "st asaph's" or st davids or swansea or "swansea's").ti,ab,in.
- 6 (aberdeen or "aberdeen's" or dundee or "dundee's" or edinburgh or "edinburgh's" or glasgow or "glasgow's" or inverness or (perth not australia\*) or ("perth's" not australia\*) or stirling or "stirling's").ti,ab,in.
- 7 (armagh or "armagh's" or belfast or "belfast's" or lisburn or "lisburn's" or londonderry or "londonderry's" or derry or "derry's" or newry or "newry's").ti,ab,in.
- 8 (bath or "bath's" or ((Birmingham not alabama\*) or ("birmingham's" not alabama\*) or bradford or "bradford's" or brighton or "brighton's" or bristol or "bristol's" or Carlisle\* or "Carlisle's" or (Cambridge not (massachusetts\* or boston\* or harvard\*)) or ("Cambridge's" not (massachusetts\* or boston\* or harvard\*)) or (canterbury not zealand\*) or ("canterbury's" not zealand\*) or chelmsford or "chelmsford's" or chester or "chester's" or chichester or "chichester's" or coventry or "coventry's" or derby or "derby's" or (durham not (carolina\* or nc)) or ("durham's" not (carolina\* or nc)) or ely or "ely's" or Exeter or "Exeter's" or Gloucester or "Gloucester's" or Hereford or "Hereford's" or Hull or "Hull's" or Lancaster or "Lancaster's" or Leeds\* or Leicester or "Leicester's" or (Lincoln not nebraska\*) or ("Lincoln's" not nebraska\*) or (Liverpool not (new south wales\* or nsw)) or ("Liverpool's" not (new south wales\* or nsw)) or ((London not (ontario\* or ont or toronto\*)) or ("London's" not (ontario\* or ont or toronto\*)) or Manchester or "Manchester's" or (Newcastle not (new south wales\* or nsw)) or ("Newcastle's" not (new south wales\* or nsw)) or Norwich or "Norwich's" or Nottingham or "Nottingham's" or Oxford or "Oxford's" or Peterborough or "Peterborough's" or Plymouth or "Plymouth's" or Portsmouth or "Portsmouth's" or Preston or "Preston's" or Ripon or "Ripon's" or Salford or "Salford's" or Salisbury or "Salisbury's" or Sheffield or "Sheffield's" or Southampton or "Southampton's" or St Albans or Stoke or "Stoke's" or Sunderland or "Sunderland's" or Truro or "Truro's" or Wakefield or "Wakefield's" or Wells or Westminster or "Westminster's" or Winchester or "Winchester's" or Wolverhampton or "Wolverhampton's" or (Worcester not (massachusetts\* or boston\* or harvard\*)) or ("Worcester's" not (massachusetts\* or boston\* or harvard\*)) or (York not ("New York\*" or ny or ontario\* or ont or toronto\*)) or ("York's" not ("New York\*" or ny or ontario\* or ont or toronto\*)))).ti,ab,in.
- 9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8
- 10 (exp africa/ or exp asia/ or exp Pacific Islands/ or "Australia and New Zealand"/ or "arctic and antarctic"/ or exp north america/ or exp "south and central america"/) not (exp United Kingdom/ or Europe/)
- 11 9 not 10
- 12 (ethnic\* or race\* or racial\* or BAME or BME).ti.
- 13 ethnic group/ or exp afro-asiatic people/ or exp caucasian speaking people/ or minority group/
- 14 ((ethnic\* or race\* or racial\*) adj5 (inequalit\* or inequit\* or equit\* or equalit\* or disparit\* or difference\*)).tw.
- 15 ethnic or racial aspects/ or ethnic difference/ or ethnicity/ or race/ or race difference/
- 16 (White\* or Black\* or Asian\* or Bangladeshi\* or Pakistani\* or Indian\* or Chinese or African\* or Caribbean\* or European\* or Irish\* or Gyps\* or Roma\* or Traveller\* or Boater\* or Arab\* or Scottish or British or Welsh).ti.

- 17 ((White\* or Black\* or Asian\* or Bangladeshi\* or Pakistani\* or Indian\* or Chinese or African\* or Caribbean\* or European\* or Irish\* or Gyps\* or Roma\* or Traveller\* or Boater\* or Arab\* or Scottish or British or Welsh) adj5 (ethnic\* or race or racial)).tw.
- 18 ((White\* or Black\* or Asian\* or Bangladeshi\* or Pakistani\* or Indian\* or Chinese or African\* or Caribbean\* or European\* or Irish\* or Gyps\* or Roma\* or Traveller\* or Boater\* or Arab\* or Scottish or British or Welsh) adj5 (cultur\* or heritage\* or ancestry or descent or minorit\*)).tw.
- 19 (multi-ethnic\* or multiethnic\*).tw.
- 20 (bi-ethnic\* or biethnic\*).tw.
- 21 (immigrant\* or migrant\* or refugee\* or asylum seeker\*).tw.
- 22 migrant/ or immigrant/ or migrant worker/ or exp forced migrant/
- 23 ((social or socioeconomic or socio-economic or sociodemographic or socio-demographic) adj3 (characteristic\* or factor or inequ\* or equity or equality or disparit\*)).tw.
- 24 social determinants of health/
- 25 or/12-24
- 26 Pediatrics/
- 27 exp adolescent/ or exp child/
- 28 (pediatric\* or paediatric\* or peadiatric\* or child\* or kid or kids or youth).tw.
- 29 (infant\* or neonat\* or newborn\* or baby or babies or preterm\* or prematur\* or postmatur\*).tw.
- 30 (early year\* or toddler\*).tw.
- 31 (boy\* or girl\*).tw.
- 32 (pubert\* or pubescen\* or adolecen\* or teen\*).tw.
- 33 (school adj age\*).tw.
- 34 or/26-33
- 35 exp health care access/ or health care availability/ or health care disparity/
- 36 health disparity/
- 37 ((healthcare or health care or medical care or health service\*) adj5 (utilis\* or utiliz\* or "use" or usage or consumption or cost\* or refer? or referral\*)).tw.
- 38 ((inpatient care or specialist care or secondary care or tertiary care or emergency or (emergency adj2 (care or department)) or A&E or "accident and emergency" or "accident & emergency" or intensive care) adj5 (utili?\* or utiliz\* or "use" or usage or consumption or cost\* or refer? or referral\*)).tw.
- 39 ((primary care or community health\* or community care or outpatient care or preventive care) adj5 (utilis\* or utiliz\* or "use" or usage or consumption or cost\* or refer? or referral\*)).tw.
- 40 ((primary care or community health\* or community care or outpatient care or preventive care) adj5 (attendanc\* or appointment\* or consult\* or present\*)).tw.
- 41 ((general practi\* or GP or gps) adj5 (utilis\* or utiliz\* or "use" or usage or consumption or cost\* or refer? or referral\*)).tw.
- 42 ((general practi\* or GP or gps) adj5 (attendanc\* or appointment\* or consult\* or present\*)).tw.
- 43 child hospitalization/ or hospital admission/ or hospital discharge/ or hospital readmission/ or hospital utilization/ or hospitalization/

- 44 (((inpatient\* or patient or hospital\* or intensive care or nicu or picu or A&E or emergency or (emergency adj2 (care or department)) or "accident and emergency" or "accident & emergency") adj3 (admission? or admit\* or discharg\* or refer? or referral\*)) or hospitali?ation?).tw.
- 45 (((patient or hospital\* or intensive care or nicu or picu) adj3 (readmission? or re-admission? or readmit\* or re-admit\*)) or (rehospitali?ation? or re-hospitali?ation?)).tw.
- 46 ((patient or hospital\* or intensive care or nicu or picu) adj3 (transfer\* or escalat\* or ste up or step-up or step down or step-down or refer? or referral\*).tw.
- 47 ((length or duration) adj2 stay).tw.
- 48 patient attendance/ or patient participation/ or refusal to participate/
- 49 patient compliance/
- 50 ("fail to attend" or FTA or "did not attend" or reschedul\* or rebook\*).tw.
- 51 (general practi\* or gp or gps).ti.
- 52 ((length or duration) adj2 stay).tw.
- 53 or/35-52
- 54 mass immunization/ or vaccination coverage/
- 55 vaccination refusal/
- 56 ((vaccin\* or immuni?\* or inoculat\*) adj5 (uptake or utilis\* or utiliz\* or hesitancy or confidence or accept\* or coverage or rate\* or dose\* or attendance or timing or delay\* or refus\* or complet\*).tw.
- 57 (booster\* adj2 (shot\* or dose\* or vaccin\* or immuni?\* or inoculat\*) adj5 (uptake or utilis\* or utiliz\* or hesitancy or confidence or accept\* or coverage or rate\* or dose\* or attendance or timing or delay\* or refus\* or complet\*).tw.
- 58 or/54-57
- 59 (((("6" or six) adj2 week baby check\*) or (("6" or six) adj2 week infant check\*) or (("6" or six) adj2 week check\*) or ((6-week or six-week) adj2 (baby check or infant check or check))).tw.
- 60 ((health or midwif\* or nurse) adj2 visit\*).tw.
- 61 (((development\* or medical or health) adj2 (check\* or exam\* or assess\*)) or (screen or screening)).tw.
- 62 59 or 60 or 61
- 63 ((avoidable or preventable or unplan\* or (vaccine adj2 preventable)) adj2 (care or admission? or hospitali?ation? readmission? or re-admission? or readmit\* or re-admit\* or rehospitali?ation? or re-hospitali?ation?)).tw.
- 64 ((ambulatory care sensitive or ambulatory care sensitive condition? or ACSC) adj2 (admission? or hospitali?ation? readmission? or re-admission? or readmit\* or re-admit\* or rehospitali?ation? or re-hospitali?ation?)).tw.
- 65 63 or 64
- 66 53 or 58 or 62 or 65
- 67 11 and 25 and 34 and 66
- 68 limit 67 to yr="2001 - 2021"

## 2.2. Grey literature

Given the large number of irrelevant results returned by grey literature search engines, we limited the number of items screened. For databases such as NICE where search functionality allowed some search operators, only one search was run and the first 100 results were screened. Due to the limited structured search functionality of other grey literature websites, we ran multiple simplified searches and screened the first 20 results for each combination of search terms.

## 2.3. Evidence reviews

We excluded evidence reviews but used their bibliographies to hand-search for additional studies.

## Appendix 3. Selection criteria

	<b>Include</b>	<b>Exclude</b>
<b>Time</b>	Published 2001-2021 with any part of the study period within 2001-2021	Published 2001-2021 but all of the study period pre-dating 2001
<b>Location</b>	Anywhere in the UK	Studies comparing multiple countries with no UK-specific findings by ethnicity
<b>Setting</b>	Any level of the healthcare system (National Health Service)	Healthcare related services delivered in other settings (e.g. vaccinations or health checks delivered in schools)
<b>Study type</b>	Primary research or evaluation, including grey literature	Intervention studies, evidence reviews, conference or meeting abstracts, commentaries, opinion pieces, study protocols, guidelines and standards, book chapters, patient case studies
<b>Population</b>	Individuals defined as neonates, infants, children and young people by the healthcare service  Parents, primary caregivers or other stakeholders recruited to provide healthcare utilisation information on behalf of individual children	Studies involving adults and children where findings were not presented separately for each
<b>Explanatory factor</b>	Any ethnic group in the UK (ethno-religious or cultural background)  Ethnicity studied as a main explanatory factor or as part of a group of multiple factors	Indicators of migration, country of birth/origin, religion and language where ethnic group is not clearly defined as a separate variable  Are-level measures of ethnicity (e.g. % minority ethnic individuals in a given geographic area)  Ethnicity used only as a confounder in statistical modelling
<b>Outcomes</b>	Quantitative findings for of the following: <ul style="list-style-type: none"> <li>• attendance at face-to-face or remote healthcare appointment at any level of the healthcare system</li> <li>• uptake of preventive care</li> <li>• hospital admissions</li> <li>• emergency department attendances</li> <li>• referrals</li> <li>• failure to attend appointments</li> <li>• length of stay</li> <li>• re-admissions</li> <li>• escalation to high-dependency and intensive care</li> <li>• discharge</li> <li>• timing of healthcare (e.g. wait times or delays)</li> <li>• costs incurred by the healthcare system</li> </ul>	Healthcare utilisation metrics used as a proxy for measuring other outcomes (e.g. morbidity, disease prevalence) or to achieve other aims (e.g. validating an algorithm)  Healthcare utilisation described for an ethnic group but not compared with another ethnic group or with the expected rate of utilisation for that group (e.g. population denominator)  Intended or anticipated uptake of services  Qualitative evidence of healthcare access barriers, facilitators and experiences  Medication prescription  Specific treatments where it is unclear whether the study is measuring healthcare utilisation or treatment allocation/preferences  Use of complementary medicine and traditional healing

Appendix 4. Data charting form, adapted from an electronic form that the authors developed for use in Covidence software

**Study details**

Title \_\_\_\_\_

Year of publication \_\_\_\_\_

Journal \_\_\_\_\_

**Study period**

Study start year \_\_\_\_\_

Study end year \_\_\_\_\_

Did the study report trends over time by ethnic group (i.e. stratify by year)?

- Yes
- No

**Location**

Select all countries that the study was conducted in:

- England
- Scotland
- Wales
- Northern Ireland
- UK
- Not specified

If the study was only conducted in specific regions, list them \_\_\_\_\_

If the study was only conducted in specific cities, list them \_\_\_\_\_

If the study was only conducted in specific localities within cities (e.g. boroughs, wards), list them \_\_\_\_\_

**Study aim**

Study aims and objectives/research questions \_\_\_\_\_

**Participants**

Population of interest \_\_\_\_\_

Who were the study participants?

- Parents
- Children
- Other \_\_\_\_\_

Total cohort/sample size \_\_\_\_\_

**Ethnicity**

Ethnicity data was available for the:

- Child
- Parent
- Both
- Unspecified

How was ethnicity used as an explanatory factor?

- Main explanatory factor
- Part of a group of multiple explanatory factors

Classification of ethnic groups (select all that apply)

- ONS 1991: 9 category
- ONS 1991: modified
- ONS 2001: 5 category
- ONS 2001: 16 category
- ONS 2001: modified
- ONS 2011: 5 category
- ONS 2011: 18 category
- ONS 2011: modified
- Binary: White / White British compared to minority ethnic
- Area-level
- Custom grouping

Ethnic groups used in the study (aggregated)

- Non White
- Non White British
- Non South Asian
- White (Census 2001)
- White (Census 2011)
- Black or Black British / Black, African, Caribbean or Black British (Census 2001 and 2011)
- Asian or Asian British (Census 2001)
- Asian or Asian British (Census 2011)
- South Asian
- Mixed / Mixed or Multiple ethnic groups (Census 2001 and 2011)
- Chinese or other ethnic group (Census 2001)
- Other ethnic group (Census 2011)
- Unknown ethnicity
- Other \_\_\_\_\_

Ethnic groups used in the study (disaggregated)

- White British (including English, Welsh, Scottish, Northern Irish)
- White Irish
- Gypsy or Irish Traveller
- Any other White background
- Black Caribbean
- Black African
- Any other Black, African or Caribbean background
- Indian
- Pakistani
- Bangladeshi
- Chinese
- Any other Asian background
- White and Black Caribbean



- White and Black African
- White and Asian
- Any other mixed or multiple ethnic background
- Arab
- Any other ethnic group
- Other \_\_\_\_\_

If the study compared different ethnic groups, was there a group that they used as the main comparator/reference group?

- White
- White British
- Population-based denominator
- Other \_\_\_\_\_

### Age

Youngest participant's age \_\_\_\_\_

Oldest participant's age \_\_\_\_\_

Did the study present age specific results (i.e. stratify results by age) or only study a specific age?

- Yes
- No

### Participant characteristics and/or covariates

- Child's age
- Sex/gender
- Socioeconomic status (disaggregated area-level e.g. Index of Multiple Deprivation by domains)
- Socioeconomic status (aggregated area-level, e.g. Index of Multiple Deprivation quintiles or deciles, or any other SES derived from LSOA)
- Socioeconomic status (disaggregated individual-level, e.g. housing, parental education, profession, income)
- Socioeconomic status (aggregated individual-level, e.g. aggregated measure of the individual measures above)
- Household composition (e.g. single parent, number of children)
- Location (i.e. further breakdown of participants by borough, ward, city, region, rurality, distance from healthcare service)
- Migration/country of birth/country of origin
- Languages (e.g. languages other than English)
- Religion
- Pregnancy and birth (e.g. preterm/gestational age, birth weight, mode of delivery, parity, mother's age)
- Clinical conditions of interest or co-morbidities
- Health behaviours (e.g. parental smoking status)
- Healthcare utilisation (adjusted for other metrics aside from outcome of interest)
- Other \_\_\_\_\_

### Methods

Study design

- Ecological
- Cohort
- Cross-sectional

- Case-control
- Case series or case report
- Service/programme audit or evaluation
- Economic evaluation
- Other \_\_\_\_\_

#### Data sources

- Routine administrative data (e.g. electronic health records, Office for National Statistics IMD, disease registers)
- Longitudinal cohort survey
- Interview/focus group
- Questionnaires or diagnostic surveys
- Clinical test (e.g. serology, x-ray)
- Other \_\_\_\_\_

#### Type of analyses

- Adjusted association
- Crude/unadjusted association
- Descriptive statistics

#### Outcome

##### Health system level

- Primary care
- Secondary care
- Tertiary care

##### Health topic (ICD-10)

- I Certain infectious and parasitic diseases
- II Neoplasms
- III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
- IV Endocrine, nutritional and metabolic diseases
- V Mental and behavioural disorders
- VI Diseases of the nervous system
- VII Diseases of the eye and adnexa
- VIII Diseases of the ear and mastoid process
- IX Diseases of the circulatory system
- X Diseases of the respiratory system
- XI Diseases of the digestive system
- XII Diseases of the skin and subcutaneous tissue
- XIII Diseases of the musculoskeletal system and connective tissue
- XIV Diseases of the genitourinary system
- XV Pregnancy, childbirth and the puerperium
- XVI Certain conditions originating in the perinatal period
- XVII Congenital malformations, deformations and chromosomal abnormalities
- XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
- XIX Injury, poisoning and certain other consequences of external causes
- XX External causes of morbidity and mortality
- XXI Factors influencing health status and contact with health services
- XXII Codes for special purposes

More details about the specific healthcare service studied \_\_\_\_\_

#### Outcome measures

- Attendance at any face-to-face or remote healthcare appointment at GP clinic
- Attendance at any face-to-face or remote healthcare appointment in outpatient, community, specialist clinic/service
- Uptake of any preventive care appointments delivered in primary care or by community health services (e.g. vaccinations, health visitor developmental checks, outreach, health screening)
- Admission to hospital for any reason (e.g. elective or emergency admissions)
- Emergency department attendances
- Referrals and transfers to any healthcare service at any level of the healthcare system
- Failure to attend booked appointments
- Length of stay, re-admissions and escalation to high-dependency and intensive care (hospitalisation)
- Discharge from any health service
- Timing of healthcare (e.g. wait times or delays to receiving healthcare)
- Cost of healthcare utilisation to the system
- Other

For vaccination studies, which vaccinations were examined?

- DTP & polio
- Hep B
- Rotavirus
- MMR
- Men B
- Men C
- HiB
- Human papillomavirus (HPV)
- Influenza
- Pneumococcal (PCV)
- Other \_\_\_\_\_

#### **Difference vs. inequity**

Did the study find a difference or inequity?

- Yes (minority ethnic)
- Yes (White/White British)
- No

Differences or inequities found for (aggregate ethnic groups)

- Non White
- Non White British
- Non South Asian
- White (Census 2001)
- White (Census 2011)
- Black or Black British / Black, African, Caribbean or Black British (Census 2001 and 2011)
- Asian or Asian British (Census 2001)
- Asian or Asian British (Census 2011)
- South Asian
- Mixed / Mixed or Multiple ethnic groups (Census 2001 and 2011)
- Chinese or other ethnic group (Census 2001)
- Other ethnic group (Census 2011)
- Unknown ethnicity

- Other \_\_\_\_\_

Differences or inequities found for (disaggregated ethnic groups)

- White British (including English, Welsh, Scottish, Northern Irish)  
 White Irish  
 Gypsy or Irish Traveller  
 Any other White background  
 Black Caribbean  
 Black African  
 Any other Black, African or Caribbean background  
 Indian  
 Pakistani  
 Bangladeshi  
 Chinese  
 Any other Asian background  
 White and Black Caribbean  
 White and Black African  
 White and Asian  
 Any other mixed or multiple ethnic background  
 Arab  
 Any other ethnic group  
 Other \_\_\_\_\_

Did the study attempt to distinguish between differences and inequities?

- Yes (assumed)  
 Yes (methodology)  
 No

If the study distinguished between differences and inequities using methodology, how did they do this?

\_\_\_\_\_

## Appendix 5. Summary of details for included studies

Author (year)	Study period	Age range (in years)	Did the study find any ethnic variations?	Comparison group	If so, for which ethnic groups?*	Did the study attempt to distinguish between difference and inequity?***	Outcomes
Baker et al (2011) (21)	2002-2007	0-2	Yes (minority ethnic & White/White British)	White	White (Census 2001); Mixed / Mixed or Multiple ethnic groups (Census 2001 and 2011)	Yes (assumed)	Primary & preventive
Battersby (2017) (46)	2011-2013	0-0	Yes (minority ethnic)	Population-based denominator	Asian (custom grouping)	No	Hospitalisation
Blair et al (2018) (47)	2013-2014	0-4	Yes (minority ethnic)	White	Asian or Asian British (Census 2001); Unknown ethnicity	No	Emergency department; Secondary outcomes
Byrne et al (2018) (26)	2014-2016	0-0	Yes (minority ethnic)	White	White Irish; Any other White background; Black African; Black Caribbean; Any other Black, African or Caribbean background; Indian; Pakistani; Bangladeshi; Any other Asian background; White and Black Caribbean; White and Black African; White and Asian; Any other mixed or multiple ethnic background; Any other ethnic group	Yes (assumed)	Primary & preventive
Chowdhury et al (2005) (48)	1995-2002	12-19	Yes (minority ethnic & White/White British)	White British	Non White; White British; Black African; Black Caribbean; Chinese; All other ethnic groups (custom grouping)	No	Hospitalisation
Chui et al (2021) (49)	2008-2016	12-17	Yes (minority ethnic)	Population-based denominator	Asian or Asian British (Census 2011); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Other ethnic group (Census 2011); White Other (custom grouping); Black African; Black Caribbean; Any other Black, African or Caribbean background	Yes (methodology)	Hospitalisation; Emergency department
Cook et al (2014) (50)	2010-2011	0-19	Yes (minority ethnic & White/White British)	White British	White British; White Irish; Any other White background; Black African; Black Caribbean; Any other Black, African or Caribbean background; Indian; Pakistani; Bangladeshi; Chinese; Any other Asian background; White and Black Caribbean; White and Black African; White and Asian; Any other mixed or multiple ethnic background; Any other ethnic group	No	Outpatient & community
Cook et al (2015) (51)	2010-2011	0-19	Yes (minority ethnic & White/White British)	Population-based denominator	White British; Any other White background; Indian; Bangladeshi	No	Outpatient & community; Secondary outcomes
Corrigall et al (2010) (52)	2001-2010	12-17	Yes (minority ethnic)	Population-based denominator	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2001); Other and Mixed (custom grouping: combined)	No	Hospitalisation
Coughlan et al (2021) (53)	2007-2017	0-14	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2011); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011)	No	Primary & preventive; Outpatient & community

Author (year)	Study period	Age range (in years)	Did the study find any ethnic variations?	Comparison group	If so, for which ethnic groups?*	Did the study attempt to distinguish between difference and inequity?***	Outcomes
Dar et al (2013) (54)	2010-2010	Not specified	Yes (minority ethnic)	White	Gypsy or Irish Traveller	Yes (assumed)	Primary & preventive
Davies et al (2020) (55)	2020-2020	0-17	Yes (minority ethnic)	Population-based denominator	Afro-Caribbean (custom grouping), Asian (custom grouping)	No	Secondary outcomes
Davis et al (2018) (56)	2004-2013	0-15	Yes (minority ethnic)	Population-based denominator	South Asian	No	Secondary outcomes
de Graaf et al (2019) (57)	2012-2015	0-17	Yes (minority ethnic & White/White British)	Non South Asian; ethnic distribution of individuals referred to Child and Adolescent Mental Health Services	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2001); Chinese or other ethnic group (Census 2001)	No	Secondary outcomes
Deshpande (2004) (23)	1999-2002	0-0	Yes (minority ethnic)	Population-based denominator	Other ethnic groups/mixed (custom grouping), Non Indian subcontinent (custom grouping: all groups other than Indian subcontinent); Black African; Black Caribbean; Any other Black, African or Caribbean background; Chinese	Yes (assumed)	Primary & preventive
Dixon et al (2016) (58)	2000-2015	0-17	Yes (minority ethnic)	White	Gypsy or Irish Traveller	Yes (assumed)	Primary & preventive
Edbrooke-Childs et al (2016) (59)	2007-2013	0-25	Yes (minority ethnic); Yes (White/White British)	Non Indian subcontinent	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2001); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Chinese or other ethnic group (Census 2001); White Other (custom grouping: White Irish and Other White background); White British	No	Secondary outcomes
Edbrooke-Childs et al (2020) (60)	2011-2015	0-25	Yes (White/White British)	Non-Traveller	Unknown ethnicity; White British	Yes (methodology)	Secondary outcomes
Fernandez de la Cruz et al (2015) (61)	1999-2013	Not specified	Yes (minority ethnic)	White British	Non White; Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2011); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011)	No	Outpatient & community; Hospitalisation
Forbes et al (2008) (62)	2007-2007	13-25	Yes (minority ethnic)	White British	Bangladeshi/Pakistani (custom grouping)	No	Primary & preventive
Fraser et al (2010) (63)	2004-2008	0-16	Yes (minority ethnic)	Population-based denominator	South Asian	No	Secondary outcomes
French et al (2017) (64)	2012-2013	0-17	Yes (minority ethnic)	Non South Asian	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011)	Yes (assumed)	Secondary outcomes
Goldacre et al (2014) (65)	1968-2011	0-14	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); South Asian	No	Hospitalisation
Greenfield et al (2021) (66)	2014-2017	0-15	Yes (minority ethnic)	Population-based denominator	Asian or Asian British (Census 2001); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011)	No	Emergency department

Author (year)	Study period	Age range (in years)	Did the study find any ethnic variations?	Comparison group	If so, for which ethnic groups?*	Did the study attempt to distinguish between difference and inequity?***	Outcomes
Gronholm et al (2015) (67)	2011-2011	9-18	No	White		Yes (methodology)	Outpatient & community; Hospitalisation
Hawley et al (2013) (68)	2011-2011	0-16	No	White		No	Emergency department
Hegazi et al (2014) (69)	2005-2012	13-18	Yes (minority ethnic & White/White British)	Population-based denominator	White (Census 2001); Any other Black, African or Caribbean background	No	Primary & preventive; Outpatient & community
Herbert et al (2015) (70)	1997-2012	10-19	Yes (minority ethnic)	Population-based denominator	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Chinese or other ethnic group (Census 2001); Unknown ethnicity	No	Hospitalisation; Secondary outcomes
Heys et al (2017) (71)	2009-2010	0-16	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2001)	No	Hospitalisation
Hull et al (2016) (72)	2015-2015	5-17	No	White		Yes (methodology)	Hospitalisation
Hull et al (2018) (73)	2014-2015	0-17	Yes (minority ethnic)	White	Black (custom grouping: Black African, Black Caribbean, Black British, Other black, and Mixed black), South Asian (custom grouping: Bangladeshi, Pakistani, Indian, Sri Lankan, British Asian, other South Asian, or Mixed Asian)	Yes (methodology)	Emergency department
Jarvis et al (2018) (74)	2003-2015	0-19	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Indian; Pakistani; Any other ethnic group	No	Hospitalisation; Secondary outcomes
Jones et al (2018) (75)	2008-2014	0-0	Yes (minority ethnic)	White; Population-based denominator	Asian or Asian British (Census 2001); Custom grouping; Other (2001 Other and Mixed groups)	Yes (assumed)	Hospitalisation
Kanthimathinathan et al (2021) (76)	2020-2020	0-18	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2001)	No	Hospitalisation
Knapp et al (2015) (77)	1999-2002	5-15	No	Ethnic distribution of PICU patients with influenza		Yes (methodology)	Primary & preventive; Outpatient & community
Marshman et al (2017) (78)	2003-2013	0-18	Yes (minority ethnic & White/White British)	White	Non White; White (Census 2001)	No	Emergency department
Mixer et al (2006) (19)	2003-2003	1-3	Yes (minority ethnic & White/White British)	White	White (Census 2001); White Irish; Any other Black, African or Caribbean background; Chinese; White and Black Caribbean; Black British (custom grouping)	Yes (assumed)	Primary & preventive

Author (year)	Study period	Age range (in years)	Did the study find any ethnic variations?	Comparison group	If so, for which ethnic groups?*	Did the study attempt to distinguish between difference and inequity?***	Outcomes
Morris et al (2021) (79)	2014-2020	Not specified	Yes (minority ethnic)	White British	Non White British	Yes (methodology)	Hospitalisation
O'Donnell et al (2010) (80)	2004-2007	0-0	Yes (minority ethnic)	Non South Asian	South Asian	No	Secondary outcomes
Parslow et al (2009) (81)	2004-2007	0-15	Yes (minority ethnic)	Non South Asian	South Asian	No	Secondary outcomes
Pearce et al (2008) (17)	2000-2005	3-3	Yes (minority ethnic & White/White British)	White	White (Census 2001); Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Chinese or other ethnic group (Census 2001); Other	Yes (assumed)	Primary & preventive
Powell et al (2013) (24)	2008-2009	0-0	Yes (minority ethnic)	White British and Irish	Black African; Black Caribbean; Indian; Pakistani; Bangladeshi	Yes (assumed)	Primary & preventive
Pruthi et al (2014) (82)	2006-2009	0-17	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); South Asian	No	Secondary outcomes
Ring et al (2004) (83)	2002-2002	0-5	Yes (minority ethnic)	White	Non White	No	Outpatient & community
Rowe et al (2021) (84)	2017-2018	0-0	Yes (minority ethnic)	White (UK and Ireland)	Any other White background	Yes (methodology)	Hospitalisation
Saatci et al (2021) (85)	2020-2020	0-18	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011); Asian or Asian British (Census 2011); Mixed and Other (custom grouping, combined)	No	Hospitalisation; Secondary outcomes
Samad et al (2006) (25)	2000-2002	0-0	Yes (minority ethnic)	White	Black Caribbean	Yes (assumed)	Primary & preventive
Santorelli et al (2020) (29)	2007-2016	1-5	Yes (White/White British)	White British	White British	Yes (assumed)	Primary & preventive
Srinivasan et al (2006) (86)	2003-2003	0-0	Yes (White/White British)	White British	White British	Yes (assumed)	Primary & preventive
Streetly et al (2010) (22)	2005-2007	0-0	Yes (minority ethnic)	White British	Unknown ethnicity; Any other White background; Black Caribbean	Yes (assumed)	Primary & preventive
Swann et al (2020) (87)	2020-2020	0-19	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011)	No	Hospitalisation; Secondary outcomes
Tiley et al (2018) (18)	2001-2010	0-5	Yes (minority ethnic)	White British (not including Northern Ireland)	Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Unknown ethnicity; Other (custom grouping: all other ethnic groups); White Irish; Black African; Black Caribbean; Indian; Pakistani; Bangladeshi; Black Somali (custom grouping), Polish (custom grouping), Black Other/Mixed/Unspecified (custom grouping)	Yes (assumed)	Primary & preventive
Tolmac et al (2004) (88)	2001-2001	13-17	Yes (minority ethnic)	Population-based denominator	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011)	No	Hospitalisation; Secondary outcomes
Venkatesan et al (2018) (89)	2005-2006	10-19	Yes (minority ethnic)	White British	Non White British	No	Hospitalisation



Author (year)	Study period	Age range (in years)	Did the study find any ethnic variations?	Comparison group	If so, for which ethnic groups?*	Did the study attempt to distinguish between difference and inequity?***	Outcomes
Wagner et al (2014) (20)	2001-2010	1-5	Yes (minority ethnic)	None	Mixed / Mixed or Multiple ethnic groups (Census 2001 or 2011); Unknown ethnicity; Other (custom grouping: all other ethnic groups); White Irish; Black African; Black Caribbean; Pakistani; Bangladeshi; White British (custom grouping: not including Northern Irish), White Polish (custom grouping), White Other/Mixed/Unspecified (custom grouping: including Gypsy, Roma and Irish Traveller), Chinese/Vietnamese (custom grouping), Asian Other/Mixed/Unspecified (custom grouping), Black Other/Mixed/Unspecified (custom grouping), Black Nigerian (custom grouping), Black Somalian (custom grouping)	Yes (assumed)	Primary & preventive
Wald et al (2019) (90)	2012-2015	1-2	No	Population-based denominator		Yes (assumed)	Primary & preventive
Walker et al (2017) (91)	2005-2014	0-20	Yes (minority ethnic)	White	South Asian; Other Asian (custom grouping); Black African; Black Caribbean	No	Primary & preventive
Wang et al (2019) (92)	2003-2016	1-1	Yes (minority ethnic)	White	Black or Black British / Black, African, Caribbean or Black British (Census 2001 or 2011)	No	Hospitalisation; Secondary outcomes
Weston et al (2017) (93)	2010-2010	0-15	No	White		Yes (assumed)	Primary & preventive
Wilson et al (2013) (94)	2005-2005	0-3	No	White		Yes (methodology)	Primary & preventive
Yoong et al (2005) (95)	2000-2003	0-19	Yes (White/White British)	White	White (Census 2001)	No	Outpatient & community

\* Excluding 'unknown' or 'missing' ethnic groups. Custom grouping = different from standard Census groupings or binary groupings of ethnicity. While the names of these custom groups are sometimes similar to/the same as Census ethnic group names, the ethnicities that constituted these groups were either different from Census groupings or not clearly described; we therefore labelled these as a custom group.

\*\* Methodology = attempted to distinguish between differences and inequities through methodology (e.g. adjusting for healthcare need). Assumed = attempted to identify inequities by choosing outcomes that are assumed to be a normative need for all children (e.g. vaccination) or no children (e.g. non-attendance, avoidable care).

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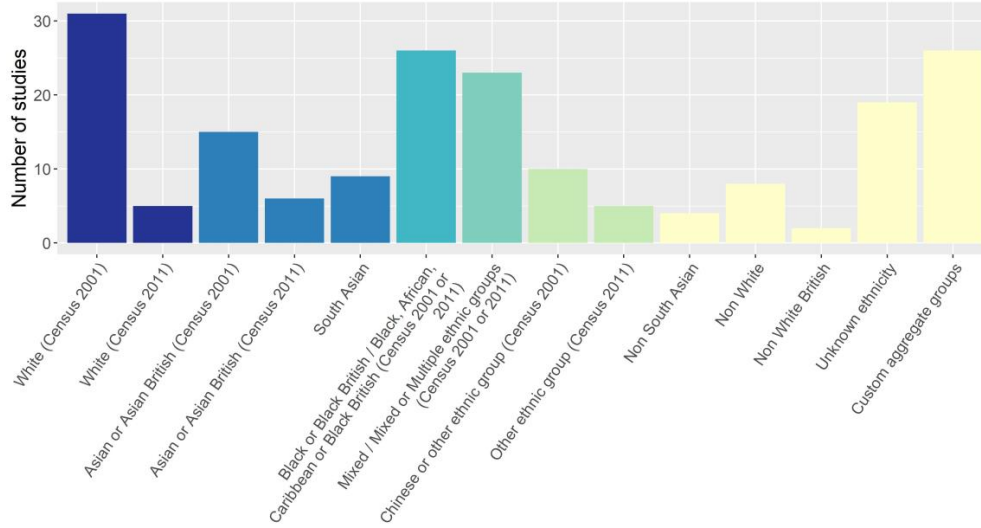
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## Appendix 6. Years and countries in which studies were conducted

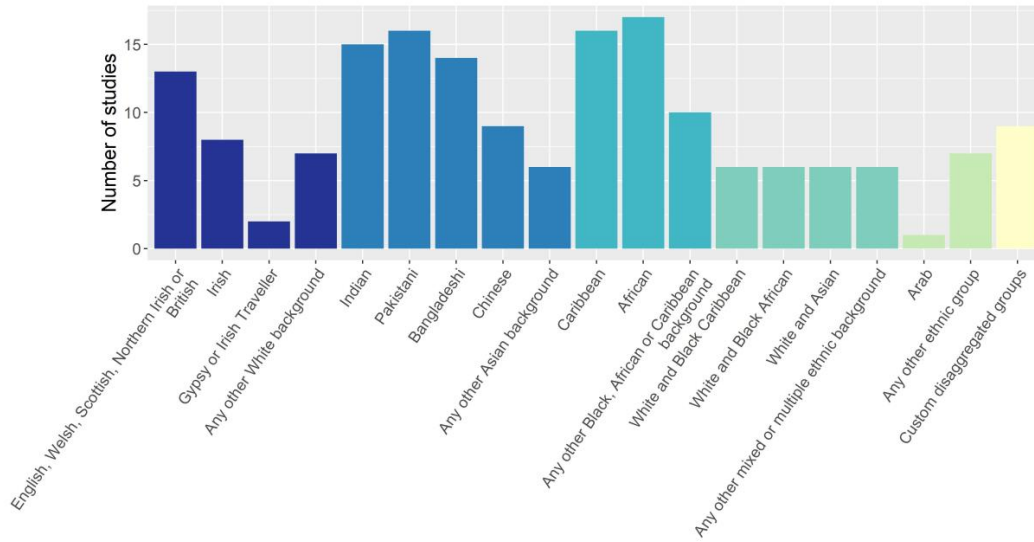
	Number (%)
<b>Year</b>	
2001-2005	30 (49)
2006-2010	32 (52)
2011-2015	30 (49)
2016-2021	12 (20)
<b>Country</b>	
UK	8 (13)
England	41 (67)
England & Wales	3 (5)
England, Scotland & Wales	3 (5)
Scotland	1 (2)
Wales	1 (2)
Northern Ireland	0 (0)
Not specified	4 (7)

Appendix 7. Number of studies by ethnic group

**A. Studies that used aggregate groups**



**B. Studies that used disaggregated groups**



## Appendix 8. Quality appraisal ratings for individual studies

## A. Items 1.1 – 2.5.

Author (year)	1.1. Is the source population or source area well described?	1.2 Is the eligible population or area representative of the source population or area?	1.3 Do the selected participants or areas represent the eligible population or area?	2.1 Selection of exposure (and comparison) group. How was selection bias minimised?	2.2 Was the selection of explanatory variables based on a sound theoretical basis?	2.3 Was the contamination acceptably low?	2.4 How well were likely confounding factors identified and controlled?	2.5 Is the setting applicable to the UK?
Baker et al (2011)	++	++	+	+	NR	+	+	++
Battersby (2017)	-	++	NR	NR	NR	NR	NR	++
Blair et al (2018)	++	+	+	NR	NR	NR	-	++
Byrne et al (2018)	+	++	+	-	-	NR	-	++
Chowdhury et al (2005)	++	++	+	NR	NR	NR	NR	++
Chui et al (2021)	++	++	+	NR	-	-	+	++
Cook et al (2014)	++	++	+	-	-	NR	-	++
Cook et al (2015)	++	++	+	-	-	NR	-	++
Corrigall et al (2010)	++	+	++	NR	NR	+	NR	++
Coughlan et al (2021)	++	++	+	+	-	NR	NR	++
Dar et al (2013)	++	+	-	+	NR	-	NR	++
Davies et al (2020)	++	+	+	-	NR	NR	NR	++
Davis et al (2018)	+	++	++	+	-	+	NR	++
de Graaf et al (2019)	+	++	+	-	-	NR	NR	++
Deshpande (2004)	+	++	+	NR	NR	NR	NR	++
Dixon et al (2016)	+	-	+	-	-	-	NR	++
Edbrooke-Childs et al (2016)	++	+	+	-	NR	NR	+	++
Edbrooke-Childs et al (2020)	-	NR	-	-	-	NR	+	++
Fernandez de la Cruz et al (2015)	++	++	+	-	-	NR	NR	++
Forbes et al (2008)	NR	-	NR	NR	NR	NR	NR	++
Fraser et al (2010)	++	++	++	+	NR	-	+	++
French et al (2017)	+	-	-	NR	NR	NR	NR	++

Goldacre et al (2014)	-	++	++	NR	NR	NR	NR	++
Greenfield et al (2021)	++	++	+	-	NR	NR	-	++
Gronholm et al (2015)	-	+	NR	-	-	NR	+	++
Hawley et al (2013)	+	-	+	NR	NR	NR	NR	++
Hegazi et al (2014)	++	+	++	NR	-	NR	NR	++
Herbert et al (2015)	+	++	++	NR	+	+	+	++
Heys et al (2017)	++	++	+	NR	-	NR	+	++
Hull et al (2016)	+	++	+	NR	NR	NR	+	++
Hull et al (2018)	++	+	++	NR	NR	-	+	++
Jarvis et al (2018)	+	++	+	+	NR	NR	+	++
Jones et al (2018)	+	++	+	NR	NR	NR	NR	++
Kanthimathinathan et al (2021)	-	++	++	NR	NR	NR	NR	++
Knapp et al (2015)	+	+	+	+	NR	NA	+	++
Marshman et al (2017)	-	-	+	NR	-	NR	-	++
Mixer et al (2006)	++	+	++	NR	NR	-	NR	++
Morris et al (2021)	++	-	-	NR	NR	NR	NR	++
O'Donnell et al (2010)	+	++	+	NR	NR	-	NR	++
Parslow et al (2009)	+	++	+	NR	NR	-	+	++
Pearce et al (2008)	+	++	+	NR	NR	NR	+	++
Powell et al (2013)	-	+	+	-	NR	NR	NR	++
Pruthi et al (2014)	+	++	++	NR	NR	NR	NR	++
Ring et al (2004)	+	-	-	NR	NR	NR	NR	++
Rowe et al (2021)	+	++	++	+	+	NR	+	++
Saatci et al (2021)	+	++	++	+	NR	+	+	++
Samad et al (2006)	+	++	+	NR	NR	NR	+	++
Santorelli et al (2020)	+	+	+	NR	+	NR	+	++
Srinivasan et al (2006)	++	+	+	NR	-	NR	NR	++
Streetly et al (2010)	++	+	+	NR	NR	NR	NR	++
Swann et al (2020)	+	+	+	NR	NR	NR	+	++



Tiley et al (2018)	+	++	++	NR	NR	NR	+	++
Tolmac et al (2004)	+	-	-	NR	NR	NR	NR	++
Venkatesan et al (2018)	+	+	+	NR	NR	NR	-	++
Wagner et al (2014)	++	++	+	NR	NR	NR	+	++
Wald et al (2019)	-	-	NR	NR	NR	NR	NR	++
Walker et al (2017)	++	++	+	+	+	+	NR	++
Wang et al (2019)	+	++	+	NR	NR	NR	+	++
Weston et al (2017)	++	-	+	-	NR	+	-	++
Wilson et al (2013)	+	+	++	NR	-	+	+	++
Yoong et al (2005)	++	++	+	+	NR	NR	NR	++

## B. Items 3.1 – 5.2.

Author (year)	3.1 Were the outcome measures and procedures reliable?	3.2 Were the outcome measurements complete?	3.3 Were all the important outcomes assessed?	3.4 Was there a similar follow-up time in exposure and comparison groups?	3.5 Was follow-up time meaningful?	4.1 Was the study sufficiently powered to detect an intervention effect (if one exists)?	4.2 Were multiple explanatory variables considered in the analyses?	4.3 Were the analytical methods appropriate?	4.4 Was the precision of association given or calculable? Is association meaningful?	5.1 Are the study results internally valid (i.e. unbiased)?	5.2 Are the findings generalisable to the source population (i.e. externally valid)?
Baker et al (2011)	++	+	NA	NA	NA	+	+	+	+	+	+
Battersby (2017)	+	+	NA	NR	++	NR	NR	-	NR	-	-
Blair et al (2018)	+	+	NA	NR	++	+	-	+	+	+	+
Byrne et al (2018)	+	+	NA	NR	-	++	+	+	++	+	+
Chowdhury et al (2005)	+	+	NA	NR	-	-	+	-	-	-	+
Chui et al (2021)	+	+	NA	NR	-	+	+	+	+	+	+
Cook et al (2014)	++	++	NA	NA	NA	++	+	-	+	-	+
Cook et al (2015)	++	++	NA	NA	NA	++	+	-	+	-	+
Corrigall et al (2010)	+	+	NA	NR	-	+	-	-	+	-	+
Coughlan et al (2021)	+	+	NA	NR	-	++	-	-	+	-	+
Dar et al (2013)	-	-	NA	NA	NA	-	NR	-	-	-	-
Davies et al (2020)	+	NR	NA	NR	+	-	+	-	-	-	+
Davis et al (2018)	+	+	NA	NA	NA	NR	-	-	NR	-	+
de Graaf et al (2019)	++	+	NA	NA	NA	-	NR	-	-	-	+
Deshpande (2004)	+	NR	NA	NA	NA	-	NR	-	-	-	+
Dixon et al (2016)	+	-	NA	NA	NA	-	NR	-	-	-	-
Edbrooke-Childs et al (2016)	+	+	NA	NA	NA	+	+	+	+	+	+
Edbrooke-Childs et al (2020)	+	+	NA	NA	NA	+	+	+	+	+	-
Fernandez de la Cruz et al (2015)	+	+	NA	NR	-	++	NR	-	+	-	+
Forbes et al (2008)	+	+	NA	NA	NA	-	+	-	-	-	-
Fraser et al (2010)	+	+	NA	NA	NA	+	+	+	+	-	+
French et al (2017)	+	+	NA	NR	-	-	-	-	-	-	-

Goldacre et al (2014)	+	+	NA	NR	-	++	-	-	-	-	++
Greenfield et al (2021)	+	+	NA	NR	+	++	+	+	++	+	+
Gronholm et al (2015)	+	-	NA	NA	NA	+	+	+	+	+	-
Hawley et al (2013)	+	+	NA	NA	NA	+	NR	-	+	-	-
Hegazi et al (2014)	+	+	NA	NR	-	+	+	-	+	-	+
Herbert et al (2015)	+	+	NA	NR	-	++	+	+	++	+	++
Heys et al (2017)	+	+	NA	NR	++	+	+	+	+	+	+
Hull et al (2016)	+	+	NA	NR	++	+	+	+	+	+	+
Hull et al (2018)	+	+	NA	NR	++	++	+	+	++	+	+
Jarvis et al (2018)	+	+	NA	NR	-	++	+	+	++	+	+
Jones et al (2018)	+	+	NA	NA	NA	++	+	-	+	+	+
Kanthimathinathan et al (2021)	+	+	NA	NR	-	-	+	-	-	-	++
Knapp et al (2015)	+	NR	NA	NR	+	-	+	+	+	+	+
Marshman et al (2017)	+	+	NA	NA	NA	+	+	-	+	-	-
Mixer et al (2006)	+	+	NA	NA	NA	+	-	-	+	-	+
Morris et al (2021)	+	+	NA	NA	NA	-	+	-	-	-	-
O'Donnell et al (2010)	+	+	NA	NA	NA	++	+	-	+	-	+
Parslow et al (2009)	+	+	NA	NA	+	+	+	+	+	+	+
Pearce et al (2008)	+	+	NA	NR	++	+	+	+	+	+	+
Powell et al (2013)	+	+	NA	NA	NA	+	+	-	+	-	+
Pruthi et al (2014)	++	++	NA	NR	+	+	NR	-	+	-	++
Ring et al (2004)	+	NR	NA	NA	NA	+	+	-	+	-	-
Rowe et al (2021)	++	++	NA	NA	NA	+	+	++	++	+	++
Saatci et al (2021)	+	+	NA	NR	+	++	+	+	++	+	++
Samad et al (2006)	+	+	NA	NR	++	++	+	+	+	+	+
Santorelli et al (2020)	+	+	NA	NR	+	++	+	+	++	+	+
Srinivasan et al (2006)	+	NR	NA	NA	NA	-	NR	-	-	-	+
Streetly et al (2010)	+	+	NA	NA	NA	-	NR	-	-	-	+
Swann et al (2020)	+	+	NA	NR	+	+	+	-	+	+	+

Tiley et al (2018)	+	+	NA	NR	+	+	+	+	+	+	++
Tolmac et al (2004)	+	+	NA	NA	NA	-	NR	-	-	-	-
Venkatesan et al (2018)	+	+	NA	NA	NA	+	-	-	-	-	+
Wagner et al (2014)	+	+	NA	NA	NA	++	+	-	+	-	+
Wald et al (2019)	NR	NR	NA	NA	NA	NR	NR	-	-	-	-
Walker et al (2017)	+	+	NA	NR	+	+	-	-	++	+	+
Wang et al (2019)	+	+	NA	NR	-	++	+	+	+	+	+
Weston et al (2017)	+	NR	NA	NA	NA	-	+	+	-	-	-
Wilson et al (2013)	+	NR	NA	NA	NA	+	+	+	+	+	+
Yoong et al (2005)	+	+	NA	NR	+	-	+	-	-	-	+