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Association between socioeconomic deprivation, ethnicity and health outcomes in preschool children with recurrent wheeze in England: a retrospective cohort study

David Lo , Claire Lawson, Clare Gillies, Sharmin Shabnam, Erol A Gaillard , Hilary Pinnock, Jennifer K Quint

ABSTRACT
Background Pre-school aged children have among the highest burden of acute wheeze. We investigated differences in healthcare use, treatment and outcomes for recurrent wheeze/asthma in preschoolers from different ethno-socioeconomic backgrounds.

Methods Retrospective cohort study using data from the Clinical Practice Research Datalink linked to Hospital Episode Statistics in England. We reported number of acute presentations and hospitalisations stratified by index of multiple deprivation (IMD) and ethnicity; and factors associated with treatment non-escalation, and hospitalisation rates using multivariable logistic and Poisson regression models.

Results 194,291 preschool children were included. In children not trialled on asthma preventer medications, children from the most deprived IMD quintile (adjusted OR 1.67; 95% CI 1.53 to 1.83) and South Asian (1.77; 1.64 to 1.91) children were more likely to have high reliever usage and where specialist referral had not occurred, the odds of referral being indicated was higher in the most deprived quintile (1.39; 1.28 to 1.52) and South Asian (1.86; 1.72 to 2.01) children compared with the least deprived quintile and white children, respectively.

Hospitalisation rates for wheeze/asthma were significantly higher in children from the most deprived quintile (adjusted IRR 1.20; 95% CI 1.13 to 1.27) compared with the least, and in South Asian (1.57; 1.44 to 1.70) and black (1.32; 1.22 to 1.42) compared with white children.

Conclusions We identified inequalities in wheeze/asthma treatment and morbidity in preschool children from more deprived, and non-white backgrounds. A multifaceted approach to tackle health inequality at both the national and local levels, which includes a more integrated and standardised approach to treatment, is needed to improve health outcomes in children with preschool wheeze/asthma.

WHAT IS ALREADY KNOWN ON THIS TOPIC
⇒ In adults and older children with asthma, there is evidence of inequality in treatment, healthcare utilisation and burden of illness between different ethnic and socioeconomic groups.
⇒ We do not know if similar differences in wheeze/asthma-related health outcomes exist in preschool children.

WHAT THIS STUDY ADDS
⇒ This is the first study to explore the impact of socioeconomic and ethnic factors on the severity and frequency of wheezing illnesses in preschool children.
⇒ We have identified inequalities in the treatment and morbidity experienced by preschool children with wheeze/asthma from more deprived socioeconomic and from non-White ethnic backgrounds.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY
⇒ National initiatives and strategies to reduce health inequalities and improve health outcomes in people with asthma and wheeze should include a focus on preschool children and consider the additional resources that are needed specifically for this age group and their families.

INTRODUCTION
Wheezy illnesses in young children are extremely common, with up to half experiencing an episode by the age of 6 years. Most episodes are mild, but some children will experience persistent or frequent symptoms resulting in multiple emergency healthcare attendances, and poor quality of life. The prevalence of preschool children presenting acutely with wheeze is already higher than in any other age group and increasing. Although not every preschool child who wheezes has asthma, many will go on to be diagnosed with asthma in later childhood.

The decision to initiate effective regular treatments to prevent asthma attacks, including inhaled corticosteroids, should ideally follow a confirmed physician diagnosis of asthma. However, objective lung function testing is not practical in very young children, and the sheer volume of preschool wheezing illnesses seen by clinicians, many of which will be self-limiting viral respiratory infections, means clinicians are often hesitant to label preschool...
children, even those with frequent wheezing, as having asthma.\textsuperscript{10} This has resulted in overreliance on ad hoc symptomatic treatment with short-acting relievers (ie, short-acting beta-2 agonists (SABAs)) and short courses of oral corticosteroids (OCS).

Recent guidance, therefore, recommends that health professionals should base decisions to treat preschool children with maintenance preventer medications on the severity and frequency of wheeze episodes, and not necessarily on confirming an asthma diagnosis.\textsuperscript{11}

In older children and adults with asthma, treatment approaches, healthcare use and burden of illness vary between different ethnic and socioeconomic groups.\textsuperscript{12–14} The majority of previous studies have been in adults, and the limited data available for children have predominantly been from survey-based studies reliant on patient recall.\textsuperscript{15–17} In the UK, addressing the impact of poverty, and ethnicity on asthma outcomes has been identified as a research\textsuperscript{18} and health policy\textsuperscript{19} priority.

We aimed to improve understanding of the burden of wheezing illnesses in preschool children, regardless of an ‘asthma’ diagnosis, by exploring whether healthcare use and treatment decisions for preschool wheeze differ between children from different socioeconomic and ethnic backgrounds, and to describe factors associated with worse clinical outcomes.

By finding groups of young children with the highest frequency of wheeze episodes, and those where treatment and/or referrals for specialist care are not initiated despite a high burden of illness, future health policies and interventions to improve management of recurrent preschool wheeze can be designed to target at-risk groups.

METHODS

Data source

For this retrospective cohort study, we used routinely collected healthcare data from the Clinical Practice Research Datalink (CPRD) Aurum national primary care database, containing deidentified patient information from consenting general practices (GPs). As of 2022, the dataset included over 13 million currently registered patients\textsuperscript{20} and is broadly representative of the UK population in terms of age, gender and ethnicity.\textsuperscript{21} CPRD contains detailed coded data on patient demographics, diagnoses, prescription records, laboratory tests and hospital referrals. Primary care data from the May 2022 build\textsuperscript{20} were linked via patient residential postcode to small-area-level data\textsuperscript{22} for socioeconomic deprivation measures, and rural–urban classification data.\textsuperscript{23} Linkage to secondary care data was available from NHS England’s Hospital Episode Statistics (HES) Admitted Patient Care (APC),\textsuperscript{24} Outpatient (OP)\textsuperscript{25} and Accident and Emergency (A&E)\textsuperscript{26} databases.

Population

The study population was derived from children aged under 5 years old, registered with GPs in England contributing data to CPRD Aurum who were eligible for linkage with HES.

Children born in a 5-year timeframe (1 January 2009 to 31 December 2013 inclusive), presenting to primary or secondary care with at least one episode of wheeze before their fifth birthday were potentially eligible for inclusion. A wheeze event was defined by the presence of a wheeze or asthma clinical diagnostic code, or prescription data for wheeze/asthma medications from primary care records, or a visit to the A&E department and/or hospital for treatment of asthma/wheeze (based on ICD10 and A&E codes).

We excluded children with a coded diagnosis of primary ciliary dyskinesia, cystic fibrosis, bronchopulmonary dysplasia, bronchiolitis obliterans, interstitial lung disease or bronchiectasis.

Outcomes

Children fulfilling the inclusion criteria had their electronic records searched for further acute wheeze/asthma-related episodes, medication prescriptions and hospital attendances/admissions from birth until their sixth birthday. Follow-up until the sixth birthday was to allow for at least 1 year of follow-up in children presenting for the first time near their fifth birthday. Only children with complete CPRD records until their sixth birthday were included. The 5-year recruitment period was chosen to allow for a child to be followed up until their sixth birthday (potentially up to 31 December 2019) without overlapping with the start of the COVID national lockdown measures in 2020.

Acute attendances to primary or secondary care were defined using clinical diagnostic ‘medcodes’ for primary care, and ICD10/A&E wheeze/asthma codes for secondary care. Medication codes were used to determine prescriptions for asthma relievers (ie, SABAs) and preventers (inhaled steroids, long-acting beta-2 agonists and leukotriene receptor antagonists) from primary care records. A secondary care referral was defined by the presence of a paediatric clinic appointment at any point during follow-up using HES outpatient activity data.

To explore factors associated with non-referral to secondary care in children where a referral was potentially indicated, we agreed on a threshold to define ‘referral indicated’ based on the previous burden of illness:

1. More than five reliever prescriptions AND either (a) >2 A&E attendances, (b) >1 hospital admission or (c) >2 courses of OCS OR
2. More than 10 reliever prescriptions OR
3. More than 5 OCS prescriptions OR
4. One or more critical care admissions with asthma/wheeze OR
5. More than five A&E attendances with asthma/wheeze OR
6. More than two hospital admissions with asthma/wheeze

A trial of preventer medication was defined as being indicated based on a previous prescription history of >5 reliever inhalers.

Variables

The following demographic data were extracted from CPRD and HES datasets and included in analyses: age of first wheeze, sex, region of GP, socioeconomic status, ethnicity, and urban/rural status of home address.

Socioeconomic status for each participant was based on the 2019 English Index of Multiple Deprivations (IMD) linked to the patient’s postcode, grouped into quintiles. IMD is a composite measure derived from a number of ‘domains’ covering different aspects of material deprivation including health, employment, income, education and skills, housing, crime, living environment and access to services. The overall composite index (IMD) is calculated as a weighted sum of the individual domain scores. A score of one denotes ‘least deprived’ and five denotes ‘most deprived’.\textsuperscript{22} Ethnicity was defined, from HES datasets, as the most commonly recorded ethnicity value across all healthcare episodes recorded in HES APC, outpatient and A&E datasets.

For children, CPRD provides month and year of birth only. The date of birth was, therefore, approximated as the first day of the month of birth combined with the recorded month and year of birth.
Paediatric lung disease

The rural–urban dataset was used to categorise patient residences as either primarily ‘rural’ or ‘urban’ as a binary variable at the patient postcode level. The rural–urban classification for England is produced by the United Kingdom’s Office for National Statistics and is based on census population data. The ‘rural’ or ‘urban’ designation is given based on the size of the resident population in a given geographical area and does not reflect the land use, policy or financial characteristics of an area. Areas are classified as rural if they fall outside of settlements with more than a 10 000-resident population.27

Clinical diagnostic codes (medcode) were used to define the presence of clinical comorbidities including atopy (defined as the presence of eczema, hayfever, food allergy and/or rhinitis), gastro-oesophageal reflux, prematurity and history of bronchiolitis. The comorbidity was classified as being present (or absent) based on the presence (or not) of the relevant code at any point during follow-up.

**Statistical analyses**
Baseline characteristics of the cohort were presented by sex, region of GP, urban/rural classification, IMD and ethnicity. The age of first presentation with wheeze/asthma, number of healthcare attendances, hospital admissions and reliever prescriptions was summarised as: mean (SD) or median (IQR) for continuous variables as appropriate, and as counts and percentages for categorical and binary variables.

Healthcare use was explored comparing differences in the number of children with >1 acute wheeze/asthma presentations to either GP or A&E by socioeconomic and ethnic group using the χ² test. Differences in the mean percentage of acute attendances to primary care (as a proportion of all presentations to either primary or secondary care) were compared between different socioeconomic and ethnic groups using the analysis of variance (ANOVA) test.

Poisson regression analyses were performed to determine factors associated with higher rates of (1) hospital admissions, (2) acute healthcare attendances and (3) relievers prescribed for preschool wheeze/asthma during the first 6 years of life, adjusted for available clinical and demographic characteristics. Robust SEs were used to control for mild violations of underlying model assumptions.

Factors associated with treatment escalation were described using the number of relievers prescribed (as a surrogate marker for duration/severity of symptoms) before the first trial of a preventer medication reported by socioeconomic status and ethnicity.

Separate multiple logistic regression analyses were performed in children never trialled on a preventer medication, and in those never referred to secondary care, to identify factors associated with poor symptomatic control in children where treatment had not been escalated. We restricted the logistic regression analyses to children in whom a referral was ‘never made’ because it was

![Flow diagram of study population](image)
Paediatric lung disease

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Baseline characteristics of cohort and healthcare utilisation during follow-up</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Total N=1 94,291</td>
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<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>84,112 (43%)</td>
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<tr>
<td>Male</td>
<td>110,169 (57%)</td>
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<td>Region of registered practice</td>
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<td>North West</td>
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<td>Yorkshire and Humber</td>
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<td>West Midlands</td>
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<td>Urban</td>
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<td>2019 English IMD quintiles (1=least deprived)</td>
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<tr>
<td>1</td>
<td>37,345 (19%)</td>
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<tr>
<td>2</td>
<td>34,610 (18%)</td>
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<td>34,783 (18%)</td>
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<td>History of atopy (eczema/hurtis/hayfever/allergy)</td>
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<td>History of bronchiolitis</td>
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<td>History of GORD</td>
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<td>History of premature birth</td>
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<td>Median (IQR) age of first wheeze episode in years</td>
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<td>Healthcare utilisation during follow-up</td>
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<tr>
<td>Median (IQR) number of acute GP attendances*</td>
<td>0.0 (0.0–1.0)</td>
</tr>
<tr>
<td>Median (IQR) number of A&amp;E attendances*</td>
<td>0.0 (0.0–0.0)</td>
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<tr>
<td>Median (IQR) number of hospital admissions*</td>
<td>0.0 (0.0–0.0)</td>
</tr>
<tr>
<td>Median (IQR) number of relievers prescribed</td>
<td>2.0 (1.0–4.0)</td>
</tr>
</tbody>
</table>

*Refers to healthcare use for acute episodes of wheeze or asthma only.
A&E, accident and emergency; GORD, gastro-oesophageal reflux disease; GP, general practice; IMD, index of multiple deprivation.

not possible to accurately determine the reason for referral (in children who were referred to secondary care) from the data available, that is, whether for wheeze/asthma or an unrelated condition. Similarly, we only included children ‘never trialled’ on a preventer medication to allow for methodological consistency between logistic regression models. Second, children trialled on preventer medications were not homogenous in terms of the number of relievers prescribed prior to their first preventer trial. The dependent (response) variable for each logistic regression model was, therefore, (1) whether a trial of preventer was indicated or not and (2) whether referral was indicated or not as dichotomous variables based on criteria detailed earlier.

All models were adjusted using the covariates listed earlier. Statistical significance was set at p<0.05. All analyses were performed using STATA statistical software, V.17.

Patient and public involvement

Two patient and public involvement (PPI) members identified through the Generation R alliance with experience of caring for a child with recurrent preschool wheeze were part of the project steering committee. They have commented on the study protocol and have been consulted on the contextual interpretation of the study findings and dissemination strategies.

RESULTS

Baseline characteristics

The cohort consisted of 194,291 children (figure 1). The majority were male (57%), lived in an urban area (87%) and were from a white ethnic background (75%). Regions in England contributing the most children to the cohort were the North-West, West Midlands, London and South-East. Median age of presentation with the first episode of wheeze/asthma (not including bronchiolitis) was 1.0 (IQR 0.0–2.0) years. Almost half (46%) of the cohort had evidence of atopy (table 1).

Healthcare use

The majority of preschool children had one or no A&E attendance with acute wheeze/asthma in the first 6 years of life. For each increasing deprivation quintile, there was an increasing proportion of children with >1 A&E attendances. The proportion of children from IMD quintile 5 with >1 A&E attendances was 1.6 times greater compared with children from IMD quintile 1 (3.1% vs 1.9%, p<0.001). Similarly, a larger proportion of children from the most deprived quintile had >1 primary care presentations with acute wheeze/asthma compared with children from the least, however the difference was much smaller (14.6% vs 14.1%, p=0.025) (figure 2A).

White children had the lowest proportion of >1 A&E or GP attendances with acute wheeze/asthma compared with any other ethnic background. By comparison, black children had more than double the proportion of >1 A&E attendances (4.6% vs 2.2%, p<0.001), and South Asian children had 1.4 times the proportion of >1 acute GP attendances (18.9% vs 13.8%, p<0.001) (figure 2B).

As a proportion of healthcare attendances to either primary or secondary care with acute wheeze/asthma, the majority of presentations were to primary care. For each increasing deprivation quintile, the proportion of presentations to A&E increased (from 12.7% in the least to 18.2% in the most deprived). A one-way ANOVA was performed to compare the effect of ethnicity on the proportion of acute presentations to GP versus A&E. Black children had the highest proportion of acute presentations to A&E (24.3%) and white children the least (15.1%) (p<0.0001) (online supplemental table S1).
Adjusted associations between characteristics and rates of preschool wheeze-related hospital admissions

Increasing deprivation was associated with higher rates of hospitalisations. Compared with children from the least deprived quintile 1, children from quintile 2 had 5% (adjusted IRR 1.05; 95% CI 1.00 to 1.10), quintile 3 had 13% (1.13; 1.08 to 1.19), quintile 4 had 17% (1.17; 1.11 to 1.23) and quintile 5 had 20% (1.20; 1.13 to 1.27) higher rates of acute hospital admissions with wheeze/asthma.

Compared with white preschool children, those from South Asian (adjusted IRR 1.57; 95% CI 1.44 to 1.70), black (1.32; 1.22 to 1.42), other (1.21; 1.10 to 1.32) and mixed (1.25; 1.16 to 1.34) ethnic backgrounds all had higher rates of acute hospital admissions with wheeze/asthma (figure 3).

Geographically, compared with children living in the North East of England, the rate of hospital admissions for wheeze/asthma were approximately 30% lower in children living in the East Midlands (adjusted IRR 0.71; 0.61 to 0.82), East of England (0.70; 0.63 to 0.79) and London (0.73; 0.67 to 0.80), 16% lower in children living in Yorkshire and Humber (0.84; 0.74 to 0.95) and 10% lower in children living in the South East of England (0.90; 0.82 to 0.98).

In terms of clinical predictors, children with a history of bronchiolitis had almost double the rate of hospital admissions with wheeze/asthma compared with those who did not have a history of bronchiolitis (adjusted IRR 2.0; 1.5 to 2.5).
admissions (adjusted IRR 1.97; 1.89 to 2.04), compared with children without a history of bronchiolitis, whereas children with a history of atopy had 67% (1.67; 1.61 to 1.73), Gastro-oesophageal reflux disease had 6% (1.06; 1.01 to 1.11), and being born prematurely had 37% (1.37; 1.28 to 1.46) higher rates of wheeze-related hospitalisations (figure 3).

Additional Poisson analyses were performed to explore factors associated with increasing rates of acute presentations to GP or A&E (online supplemental table S2) and prescriptions of reliever medications (online supplemental table S3), which demonstrated similar associated factors as those for hospital admission rates.

**Escalation of treatment—trial of preventer medication**

A higher proportion of children from increasing deprivation quintiles were prescribed ≥10 relievers prior to a trial of preventer (from 1.6% in the least to 3.5% in the most deprived) (online supplemental table S4), and almost double the proportion of South Asian (1.57; 1.44 to 1.70) and black (1.32; 1.22 to 1.42) children received ≥10 reliever prescriptions prior to a trial of preventer medication compared with children from white (2.1%), other (2.5%) or Mixed (2.6%) ethnic backgrounds (online supplemental table S5).

Of those children not trialled on preventer medication (n=128,351), when adjusted for IMD, ethnicity, sex, urbanicity, region and clinical characteristics, children from the most deprived background were more likely to have an indication for preventer medication compared with children from the most affluent background (OR 1.67; 95% CI 1.53 to 1.83). Compared with white children, South Asian (1.77; 1.64 to 1.91) and black (1.43; 1.28 to 1.60) children were also at higher risk of having an indication for preventer medication, despite this not being trialled.

Male sex (OR 1.24; 1.17 to 1.31), a rural postcode (OR 1.22; 1.12 to 1.33), living in the East Midlands (OR 1.30; 1.03 to 1.64) or West Midlands (OR 1.19; 1.01 to 1.39) of England, and the presence/history of atopy (OR 1.51; 1.43 to 1.59) or bronchiolitis (OR 1.64; 1.53 to 1.75) or premature birth (OR 1.25; 1.11 to 1.41) or younger age of first wheeze presentation (OR 0.72; 0.70 to 0.74) were all found to be associated with non-escalation of treatment despite indication based on number of reliever prescriptions (figure 4).

**Escalation of treatment—referral to secondary care**

In children where referral to secondary care had not occurred (n=103,491), the risk of indication was 40% higher in children from the most deprived background, than children from the most affluent background (adjusted OR 1.39; 95% CI 1.28 to...
1.52) and almost 90% higher in South Asian than white children (1.86; 1.72 to 2.01).

Other factors found to be significantly associated with indication despite non-referral were male sex (adjusted OR 1.37; 1.29 to 1.44), a rural postcode (1.14; 1.05 to 1.24) and a history of atopy (1.91; 1.81 to 2.01), bronchiolitis (1.59; 1.49 to 1.70) or younger age of first wheeze presentation (OR 0.75; 0.73 to 0.77). Compared with living in the North East of England, living in the North West (1.73; 1.39 to 2.14), the East Midlands (1.45; 1.08 to 1.93), the West Midlands (1.56; 1.26 to 1.94), the East of England (1.32; 1.03 to 1.68), the South East (1.49; 1.20 to 1.85) and the South West (1.68; 1.35 to 2.10) were all significantly associated with an indication for hospital referral (figure 5).

**DISCUSSION**

In this large retrospective cohort study of just under 200 000 preschool children, we observed significant differences in burden of illness, healthcare use, risk of acute wheeze attacks and escalation of treatment for wheeze/asthma between children from different socioeconomic and ethnic backgrounds.

Preschool children from more deprived socioeconomic, and those from South Asian and black ethnic backgrounds presented more frequently to healthcare with acute attacks of wheeze/asthma and had higher rates of hospital admissions compared with children from less deprived socioeconomic and those from White ethnic backgrounds, even after correcting for clinical and demographic covariates.

Worryingly, these same groups of children were also less likely to be commenced on a trial of asthma preventer medication and/or referred to a hospital specialist despite this being warranted based on their burden of illness.

**Comparison with other studies**

Depreivation has consistently been shown to be associated with poorer asthma outcomes and more frequent attacks in adults and school-aged children. A recent systematic review, which included 61 mostly adult studies comprising over 1 million patients (median age 27.9 years), found that more deprived socioeconomic status was associated with increased asthma-related A&E attendances (OR 1.61, 95% CI 1.40 to 1.84), hospitalisations (OR 1.63, 95% CI 1.34 to 1.99) and need for critical care (OR 1.76, 95% CI 1.13 to 2.73).

There have been reported differences in asthma care and outcomes observed among people of different ethnicities. Supporting the findings from our study, these studies observed
higher rate of asthma attacks in patients (mostly adults) from black and South Asian backgrounds.

Despite preschool children having the highest burden of wheeze/asthma-related illnesses presenting to healthcare, there have been relatively few studies exploring the impact of ethnicity or socioeconomic status in this age group. Previous studies in preschool children have focused on reporting the prevalence of a 'physician-confirmed asthma diagnosis' as the primary outcome and have often been based on parental survey responses which are limited by recall bias.

In contrast to previous studies, we chose not to use 'asthma diagnosis' as the primary outcome. In preschool children, due to symptom overlap with other self-limiting conditions and the lack of practical objective tests, confirming an asthma diagnosis is not straightforward. Recent national guidelines and strategy documents rightly recommend escalation of treatment based on a suggestive asthma history, and on the severity and frequency of symptoms. To our knowledge, ours is the first study to explore the impact of socioeconomic and ethnic factors on the severity and frequency of wheezing illnesses in preschool children, and their association with hospitalisation rates and treatment escalation decisions, regardless of an asthma diagnosis.

Other key strengths of our study are its large sample size, which is representative of the wider preschool population in England, and our use of routine electronic healthcare data and standardised clinical codes for case finding and outcome definitions. Linkage to hospital discharge data further allowed us to capture episodes more accurately regardless of healthcare setting.

Limitations
Routine healthcare data are not primarily collected for research purposes. How and what information is coded is not standardised between health professionals. However, to avoid missing potential wheeze/asthma episodes, we used a broad inclusion criterion, incorporating both clinical diagnostic and prescription codes for commonly used asthma medications.

The available datasets only allowed us to capture prescriptions issued from primary care, and not prescriptions dispensed from either hospital or A&E. This likely resulted in an underestimate of prescriptions for asthma medications in children with at least one episode, resulting in a hospital attendance or admission. Conversely, prescriptions recorded in the electronic primary care records do not necessarily represent what was dispensed by pharmacies or what was used by patients, potentially overestimating medication usage.

Although we included clinical covariates within our analyses, it was not possible to account for all possible clinical comorbidities which may have an impact on wheeze/asthma outcomes.
Obesity, as a potential confounder, was not included due to poor, infrequent and inconsistent recording of children’s weights and heights within electronic records.

The coding of clinical diagnoses from outpatient appointments was largely missing, so we could not be certain that outpatient appointments were for wheeze/asthma or for another unrelated clinical condition. We accounted for this in our analyses by looking specifically at ‘non-referrals’, as we felt we could be relatively certain that a child had not been reviewed by a hospital specialist for recurrent wheeze/asthma symptoms if there was no coded outpatient appointment on record.

Finally, due to the availability of linked secondary care data, our study cohort consisted of English preschool children only. However, as all four United Kingdom (UK) nations have access to a tax-funded universal healthcare system, our findings should be generalisable to the UK as a whole, and to other populations with similar health systems.

Implications
Reasons for variations in clinical outcomes between groups of children we observed are likely complex, multifactorial and have significant implications for the well-being of young children with recurrent episodes of wheeze. Inequalities in asthma care and outcomes have been reported in adults and older school-aged children. Initiatives to address these inequalities have been set out by national bodies, but key details pertaining specifically to preschool-aged children are lacking.

The measure of deprivation used in this study (2019 English IMD) is a composite measure derived from seven different domains of material deprivation, described in more detail earlier. Any initiatives to tackle deprivation and reduce health inequalities would, therefore, need to address multiple social challenges in parallel, including access to services, poverty, education and the living environment. These barriers are beyond the capabilities of individual clinicians to overcome, but require collaborative effort from all stakeholders in child health to petition for better support and funding for children at the national level.

Individually, healthcare professionals need to be cognisant that while wheezing episodes are self-limiting and mild in most preschool children, some will follow a more severe clinical course and would benefit from regular treatment and healthcare follow-up.

Our PPI collaborators voiced personal experiences of challenges in conveying concerns pertaining to their children’s recurrent wheeze-related illnesses to health professionals, often feeling ‘not listened to’ and made to feel ‘like (overly) anxious parents’.

Physical and cultural barriers to accessing and delivering healthcare to preschool children with recurrent wheeze need to be explored further from both families’ and health professionals’ perspectives. A better understanding of cultural (health beliefs, stigma and perception of chronic illness and communication barriers) and physical (accessing healthcare, continuity of care and treatment uncertainties) barriers to the delivery of care is needed to inform effective strategies and centralised policies to improve how preschool children with troublesome wheeze/asthma are cared for. These questions are currently being addressed as part of a National Institute for Health and Care Research-funded study.

CONCLUSIONS
Our study highlights clinically important inequalities in the treatment and morbidity experienced by a representative sample of English preschool children with wheeze/asthma from different socioeconomic and ethnic backgrounds. A multifaceted approach to tackle health inequality at both the national and local levels, which should include a more integrated and standardised approach to treatment escalation, is needed to improve health outcomes in children with preschool wheeze and asthma.

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Competing interests
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Patient consent for publication
Not applicable.

Ethics approval
The protocol for this research was approved by the Clinical Practice Research Datalink’s (CPRD) Research Data Governance (RDG) for MHR Database Research (protocol number: 22_002173). CPRD has ethics approval from the Health Research Authority to support research using anonymised patient data. Research Ethics Committee (East Midlands—Derby, REC reference number 21/EM/0265).

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Data availability statement
Data may be obtained from a third party and are not publicly available. Datasets used in this analysis were obtained via a Clinical Practice Research Datalink (CPRD) institutional licence. Requests for data should be made directly to the CPRD via their online application portal (https://cprd.com/