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Burden of allergic disease among ethnic minority groups in high income countries

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Abstract
The COVID-19 pandemic raised acute awareness regarding inequities and inequalities and poor clinical outcomes amongst ethnic minority groups. Studies carried out in North America, the UK and Australia have shown a relatively high burden of asthma and allergies amongst ethnic minority groups. The precise reasons underpinning the high disease burden are not well understood but it is likely that this involves complex gene-environmental interaction, behavioural and cultural elements. Poor clinical outcomes have been related to multiple factors including access to healthcare, engagement with healthcare professionals and concordance with advice which are affected by deprivation, literacy, cultural norms and health beliefs. It is unclear at present if allergic conditions are intrinsically more severe amongst patients from ethnic minority groups. Most evidence shaping our understanding of disease pathogenesis and clinical management is biased towards data generated from white population resident in High Income Countries. In conjunction with standards of care, it is prudent that a multi-pronged approach towards provision of composite, culturally-tailored, supportive interventions targeting demographic variables at the individual level is needed, but this requires further research and validation. In this narrative review, we provide an overview of epidemiology, sensitisation patterns, poor clinical outcomes and possible factors underpinning these observations as well as highlight priority areas for research.

Key words: Asthma, Allergy, Ethnicity, Clinical outcomes, Inequality, Inequity, Disparity

Key messages
• Greater burden and poorer clinical outcomes among ethnic minority groups with allergic diseases are reported
• Reasons involve deprivation, literacy, proficiency of local language, access to specialists, cultural and religious beliefs
• Priorities include: improved access/referral pathways, co-produced and evaluated interventions, delineation of ethnicity-specific phenotypes and endotypes

Healthcare inequities and inequalities have been recognised as a major problem in High Income Countries (HICs) such as the UK and USA for over two decades. The COVID-19 pandemic attracted major attention and renewed interest on this subject owing to disproportionate high mortality
Allergic disease in ethnic minority groups amongst patients from ethnic minority groups. Healthcare disparities have been linked to multiple socio-demographic variables including age, gender, socio-economic status, geographical location, cultural and religious factors. Evidence suggests a strong intersection between poor clinical outcomes and deprivation and literacy, as a significant proportion of the ‘most deprived population’ and those with poor general and health literacy are likely to be from ethnic minority groups. This is highly relevant in patients with allergies and allergic conditions as clinical outcomes depend on patient education and empowerment with implementation of self-management plans. Whilst socio-demographic variables are likely to strongly impact on clinical outcomes, it remains unclear at present if disease severity is intrinsically greater in ethnic minority patients resident in HICs.

The aim of this narrative review is structured to provide an overview of disparities in allergic diseases amongst patients from ethnic minority groups including epidemiological aspects, risk of sensitisation and patterns and clinical outcomes. Reasons underpinning these disparities and mitigation strategies going forward to address gaps in research and healthcare are also incorporated in subsequent sections. The approach adopted by majority of studies presented in this review involves comparison of specific ethnic minority groups with reference white population.

**Allergic diseases in ethnic minority population in HICs – disparities and poor clinical outcomes**

*(Table 1 for an overview)*

**Allergic rhinitis and asthma:** Most published evidence on this subject comes from North America, with few studies from the UK, Europe and Australia. A recent large retrospective longitudinal cohort study in UK primary care involving six million patients showed that the incident risk of common allergic diseases including allergic rhinitis, asthma and atopic eczema is greater amongst South Asians, Afro-Caribbean’s and those from mixed ethnic groups. In another longitudinal cohort study spanning over 25 years, the same authors showed that the long-term risk of organ-specific and systemic autoimmune disorders was significantly greater in the British patients with a pre-existing allergic disease. These observations raise further questions regarding gene-environment interactions, as allergic diseases and autoimmune disorders are relatively less prevalent in Low Income Countries and Low-Middle Income Countries such as in the Indian subcontinent and Africa.

One study from the USA reported that the adverse impact of allergic rhinitis on African American children was greater than that reported amongst Latinos and non-Latino white patients. There is similar evidence regarding a higher risk of atopy amongst South Asian British children. The Allergy and Infection study reported that Pakistani children were more likely to be sensitised to house dust mite than white children. Also, a greater proportion of children whose mothers were born outside UK were sensitised to dust mite in comparison to those whose mothers were born in the UK.
Data from the US Centers for Disease Control and Prevention (CDC) showed that the prevalence of asthma is greater amongst Black Americans, Puerto Ricans and mixed-race patients in comparison to Hispanics, Asians and non-Hispanic white patients over the last 2 decades\(^9\). Furthermore, prevalence is greater in those belonging to lower socio-economic strata. Asthma morbidity is also greater amongst Black American patients in comparison to white patients with respect to number of emergency room visits and hospitalisations. The US CDC 2017 data also reported higher rates of fatal asthma amongst Black non-Hispanic patients in comparison to white non-Hispanics, other non-Hispanic and Hispanic patients (Table-1).\(^10\)

Data from the UK severe asthma registry and the optimum patient care research database showed that, as compared to the white population, the ethnic minority population was more atopic, expressed higher type 2 inflammation markers and serum total immunoglobulin E (IgE), had lower lung function and worse asthma control\(^11\). The refractory asthma stratification program demonstrated that patients from ethnic minority groups were less likely to adhere to treatment advised in the clinical trial and had higher asthma exacerbations than white patients\(^12\). Current guidelines for use of biologics in asthma are based on data from translational research and clinical trials conducted mainly in white populations from HICs. Whilst ethnicity is considered to be mainly a social construct, a recent case control study from the USA involving African American, Mexican and Puerto Rican children highlighted key differences in blood parameters influencing eligibility for biologic therapies\(^13\). Serum total IgE was significantly higher in Puerto Rican children compared to the other two groups. Peripheral blood eosinophil and neutrophil counts were significantly greater amongst Puerto Rican patients compared to African Americans. A greater proportion of Puerto Ricans were ineligible for anti-IgE therapy in comparison to African American and Mexican patients. Similarly, a greater proportion of African American patients were deemed ineligible for eosinophil directed therapies compared to Puerto Ricans.\(^13\) This study highlights the need for (1) defining reference ranges for key blood parameters in ethnic minority groups, (2) developing selection criteria for biologic therapies to be more equitable and (3) ensuring drugs in development address the mechanism of disease in the non-white population rather than assuming it is the same. Poor inclusion of the non-white population in research results in the potential for white dominant therapies.

**Food Allergy and Anaphylaxis:** In the Learning Early About Peanut (LEAP) study, the relationship between skin prick test (SPT) response and specific IgE level to peanut differed significantly in the black population, the so called Simpson paradox (i.e., a statistical association or trend that appears for two groups with a particular variable is opposite when data for the two groups are combined).
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This may lead to over diagnosis of allergy if SPT profiles alone are used for black children. At study entry, participants were twice as likely to be in the peanut positive stratum if they were South Asian than white\cite{14-15}. In the Enquiring About Tolerance (EAT) study, only 199 of the infants enrolled were non-white compared with 1104 white participants. At enrolment, within group sensitisation to one or more foods significantly differed by ethnicity - black/south Asian (48.6%), Mixed (22.9%) and white (12.3\%)\cite{16}. In the standard introduction group, the proportion of food allergy cases by ethnicity was 28.6% in the white study population and 71.4% in the non-white study population, which was incongruent with the overall study population (84.7% white vs 15.3% non-white)\cite{16}. A recent study from the USA noted higher rates of self-reported food allergies amongst ethnic minority groups including Black and Asian patients, in comparison to white patients (11.2% and 11.4% vs 10.1\%)\cite{17}. Furthermore, the authors reported that the prevalence of food allergies and other allergic conditions, such as asthma, eczema and allergic rhinitis, were significantly higher amongst deprived patients. Similar observations regarding greater prevalence and severity of food allergies, more frequent emergency room visits and food insecurity has been reported amongst ethnic minority groups in the USA and Australia\cite{18-21}. A study from the USA, employing electronic medical records in 2.7 million patients, reported a higher prevalence of food allergies and intolerances amongst the Asian population\cite{22}. There is also some evidence regarding a higher rate of self-reported peanut allergy, tree nut allergy and sea food allergy amongst Black American patients compared to white American patients\cite{17-18,23-25}. Interestingly, a rural-urban contrast with respect to food allergy prevalence was reported in a study from South Africa, with lower rates amongst children from rural communities\cite{26}.

In the UK, Dias et al established that 52.6% of paediatric allergy referrals were from a non-white population compared with 35.9% in the general paediatric clinic and the complexity of allergic disease was greater in the non-white population with them having more food allergens (2.05 vs 1.22)\cite{27}. Over a fourteen year time period from 1990 to 2004, Fox et al found that the proportion of children with peanut allergy from a non-white heritage increased significantly from 26.8% to 50.31%, this was not the case in the white group or for egg allergy\cite{28}.

In a cross-sectional survey in the USA involving 385 caregivers of Black and white American children with physician diagnosed food allergies, Vincent et al reported association of knowledge, behaviour and attitude with socioeconomic status, ethnicity and clinical factors\cite{29}. Carers of Black children had comparatively lower knowledge scores regarding food allergy. Children of carers with higher food allergy knowledge scores were less likely to consume foods with precautionary allergy labels and
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more likely to consume allergen free foods. However, no differences were detected in emergency
room visits between the two groups for severe food allergy reactions. The timing of food allergen introduction during infancy has an important implication on risk of food
allergies during childhood. The Food Allergy Outcomes Related to White and African American Racial Differences cohort reported ethnicity-based differences in the introduction of food allergens early in infancy amongst children with parent reported food allergies. African American children with an
allergy to peanut, milk or egg were less likely to be introduced to respective allergens early in infancy
compared to white children, although reasons underpinning the delay were not explored. Within
the LEAP study, early introduction of peanut to high risk infants, between the ages of 4 and 11
months, was shown to significantly reduce the likelihood of peanut allergy at 60 months of age.
When this primary outcome was stratified by race, peanut consumption was shown to be
significantly more effective at reducing peanut allergy in the non-white infants, whilst in the
avoidance group, a higher percentage of non-white infants developed peanut allergy. This raises
questions as how best to target this intervention to ensure maximal benefit. The EAT study looked at
early introduction of six allergens into an infant diet from 3 months of age to prevent food allergy.
At the end of the study the intervention did not reach statistical significance for the primary
outcome, but it was noted that the food allergy rates were higher in the non-white participants, and
that this group (especially South Asians), were less able to introduce new foods according to
protocol in the weaning period. This again raises the question of how we can ensure appropriate
education to these groups in any population-based intervention.

Buka et al systematically reviewed emergency room records of anaphylaxis occurring in Birmingham,
UK and reported a higher rate in the British South Asian patients in comparison to white patients. The age standardised incidence rate for anaphylaxis and severe anaphylaxis was 58.3 (42.8-76.3,
95% C.I) and 20.4 (10.6-33.1, 95% C.I) cases per 100,000 person years respectively for British South
Asians as opposed to 31.5 (27.2-36.3, 95% C.I) and 10.7 (8.3-13.6, 95% C.I) per 100,000 person years
respectively for White patients. Furthermore, this study also showed higher odds of severe
anaphylaxis amongst patients <16 years old (2.37 [1.83-2.90]). It also demonstrated that if you were
from a non-white population you were less likely to be referred to allergy clinic after an episode.
Fatal anaphylaxis to food, medication and unspecified allergens in the USA were associated with
African Americans and older age groups, and the incidence rate of fatal food anaphylaxis in African
American males increased from 0.06 in 1999-2001 to 0.21 per million in 2008-2010. Asthma is an
independent risk factor for anaphylaxis, and uncontrolled asthma in food allergy puts patients at an
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enhanced risk of severe anaphylaxis\textsuperscript{33-34}. This is particularly relevant in ethnic minority groups as prevalence of asthma is significantly greater and a large proportion of cases are uncontrolled.

**Atopic dermatitis (AD):** Studies have demonstrated that African American children have an increased risk of developing AD, that the presentation varies dependent on skin colour, and that current scoring mechanisms will underestimate the severity of severe AD in black skin\textsuperscript{35-37}. The prevalence, persistence, severity and impact on health-related quality of life of AD is greater amongst Black American patients and those from urban areas\textsuperscript{38-41}. US based studies have found that black children were less likely to see an outpatient provider for AD, but when they did they required more intensive treatment\textsuperscript{42}. In addition, non-Hispanic black children and Hispanic children were more likely to have missed days of school, compared to non-Hispanic white children, because of AD, which can affect learning and attainment and further impact on the cycle of deprivation\textsuperscript{43}. Filaggrin mutations are less frequent amongst Black patients. Also, there may be differences in Staphylococcus aureus colonisation in skin between different ethnic groups. Some differences in phenotypes have also been described\textsuperscript{44-46}; Black patients present with extensor dermatitis as opposed to flexural involvement, erythema may not be well delineated in Black skin, and other differences have also been described, including peri-follicular involvement, palmar hyper-linearity, peri-ocular dark circles, and diffuse xerosis. It is important that these points are embedded into medical education to raise awareness amongst healthcare professional delivering allergy care\textsuperscript{44-45}.

**Factors influencing outcomes**

Poorer clinical outcomes such as those described above, are likely to result from a myriad of factors (Figure 1), with the literature documenting that access, treatment, and outcomes vary by ethnicity. Canino et al state that asthma disparities have multiple, complex and interrelated sources including patient beliefs, health literacy and financial barriers to disease management\textsuperscript{47}. However, even before patient-level factors have been considered, ethnic minority groups are often disadvantaged with regards to healthcare access and healthcare interactions, factors not unique to allergic disease. That said, socio-demographic variables might influence the diagnosis and management of allergic airways diseases. A US study involving 275 children with no clinical and family history of allergic disease showed a two-fold greater risk of sensitisation to one or more aero-allergens in African American children\textsuperscript{48}. Another reported that the risk of sensitisation to cockroach was several-fold greater (OR – 16.4 [4.8-55.9]) in African American children. The same study also showed a significantly higher risk of cockroach sensitisation in children resident in urban locations (OR- 4.0 [4.0-10.7]) and that the risk was significantly greater in those living in deprived geographical...
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locations (OR – 11.9 [4.3-40.8])⁴⁹. There is also evidence regarding under-recognition and delayed
diagnosis of allergic rhinitis in African American patients⁹. This has important implications not only
with respect to health-related quality of life but also on the long-term management of asthma, as
allergic rhinitis is the most frequent co-morbidity in asthma.

Similar observations have been reported by Asthma UK. There was a strong correlation between
emergency room admissions and Index of Multiple Deprivation (IMD) average score as per the 2016-
17 dataset⁵⁰. Analysis of fatal asthma as per age and IMD quintile showed higher rates in men
between 45-74 years and >75 years from the most deprived areas. Those from disadvantaged socio-
economic groups are more likely to be exposed to asthma environmental triggers such as allergens,
cigarette smoke and air pollution. There is significant variation in access to basic asthma care across
geographical locations, age groups and ethnicity. The main causes of deaths identified in National
Review of Asthma Deaths were over reliance on short acting beta-agonists and underuse of inhaled
corticosteroids. This was driven by lack of provision of asthma self-management plans, and poor
patient knowledge and understanding of asthma and its associated risk. The asthma UK report
suggests suboptimal basic asthma care across the country⁵⁰. Furthermore, in the US, after adjusting
for other patient characteristics, Black patients with asthma were less likely to see an outpatient
physician than white patients⁵¹, whilst others have shown healthcare utilisation related to food
allergy varies by ethnicity⁵². There is also evidence that black and Puerto-Rican children were absent
from school more often because of asthma compared to white and Mexican children⁵³-⁵⁴. Moreover,
the Yorkshire-based Itchy, Sneezy and Wheezy project reported delays in referral of South Asian
children to specialist allergy clinic compared to white children⁵⁵.

Once within the healthcare system pathway, several further barriers become evident. Key barriers in
UK-specific studies include under-diagnosis and reporting of asthma, lower prescription and lower
use of beta-agonists and inhaled corticosteroids, which may partly contribute to greater health care
utilisation⁵⁶-⁵⁸. One factor which has been highlighted as contributing to under-reporting and impact
on prevalence of asthma is the misidentification of symptoms amongst South Asians and those from
deprived backgrounds, leading to an underestimation of wheeze⁵⁹. Under-reporting of asthma and
wheeze may also be explained by poor or suboptimal local language proficiency of parents, with one
study showing that participants requiring translation reported half the levels of asthma and wheeze
compared with those parents who could respond in English⁶⁰. Factors at the individual-level
contribute to underuse of medication included beliefs that medication would cause more harm
than good and a reluctance to disclose their child’s asthma status⁶¹. Furthermore, stigma of
respiratory illness specifically related to erroneous beliefs about contagiousness of asthma, were
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found to be present within Bangladeshi participants, but not amongst those who have migrated, thought to be as a result of acculturation. In a systematic review involving 25,755 children in 15 studies (2 in Pakistan, 5 in India and 8 in the UK), Lakhanpaul et al investigated facilitators and barriers in asthma care. The authors make a strong case to differentiate ethnicity-based barriers to those that relate to minority ethnic group position per se at a population-level (e.g. language-related). As mirrored in the adult data, uncontrolled asthma in South Asian children has been linked to multiple ethnicity-based barriers involving South Asian families, including denial regarding diagnosis, poor concordance, stigmatisation regarding use of inhalers, self-beliefs that asthma is a contagious disease and overreliance on emergency management in hospital rather than preventive therapy via primary care.

It is clear that ethnicity is confounded with social status and that it can be difficult to determine the independent effects of each. Social and financial hardships, combined with management and environmental factors, explain much of the observed disparity in asthma-related re-admissions between Black and white children in the US. This is consistent with the notion that disparities arise from structural racism and social adversity. Those patients with more information, influence, resources, and social networks may take more advantage of new technology and scientific development, which may further increase health disparities generally, a theory consistent with the Minority Stress Model. Non-adherence to national asthma guidelines has been associated with patient’s ethnicity which would have exacerbated ethnic disparities in a vicious cycle. There is evidence of lesser adherence to controller medication amongst ethnic minority groups with particular risk factors including race, education, income, baseline symptoms and attitude. Further evidence of lower adherence to prescription receipt, prescription initiation, and medication use amongst ethnic minority groups has been reported, with medication beliefs and depressive symptoms acting as barriers, which may in part serve to reinforce the implicit bias of healthcare professionals to under-prescribe beta-agonists and inhaled corticosteroids if they believe their patients will not use them.

What can we do to reduce these inequalities?

Some of the structural factors identified above (e.g. underdiagnosis and low prescription rates) may reflect a lack of cultural competence which requires improved training and communication skills of healthcare professionals. The impact of institutional or systemic patterns of racism upon many allergic conditions is noted by Davis, and cultural competency training to combat these barriers and reduce implicit bias is advocated. That said, there is a paucity of high quality research showing a
positive relationship between cultural competency training and improved patient outcomes which needs to be addressed by clearer descriptions and replicability of training curricula. The need for improved communication and education between health professionals and patients is evident from the factors stated above. In a qualitative study involving interviews with South Asian British mothers of children <5 years with food allergies, Peckover et al. highlighted the need to raise awareness and improve knowledge amongst the South Asian community regarding allergies, as mothers sought help from family and friends as their first port of call regarding their child’s health.

Within anaphylaxis, several ‘Prevention of Future Death Reports’ highlight the fact that healthcare professionals should emphasise and ensure understanding for the requirement of adrenaline auto-injectors to be carried at all times by patients and families.

The lack of diversity in research remains problematic with clinical trials failing to recruit a representative population, meaning new interventions may not be generalisable to certain ethnic minority groups. Again, this issue is not unique to allergic disease with relatively few clinical trials reporting complete ethnicity-related data. That said, the challenges of recruiting to ethnic minority groups are to asthma studies have been distilled to four key issues: patients where there are competing demands and inaccurate beliefs about diagnosis, institutions which have policies restricting incentives, research teams where staff training is needed, and interventions which may be unappealing or inconvenient to some. Also, the translation of patient-facing materials carry significant cost implications, however the cost of not doing this proactively can be seen throughout this paper. One further barrier could be the need to balance scientific rigour with pragmatism as highlighted by Abrams, who suggests there is little focus on pragmatic research which permits variation in therapy to suit different ethnic groups. A way forward is to have proportionate representation of ethnic minority groups in clinical trials and translational research. However, sample size and heterogeneity would still not allow for meaningful sub-analysis to be conducted. Standardisation of international nomenclature with respect to ethnicity might create opportunities for systematic reviews and meta-analysis. At present, national and international guidelines for allergic diseases are largely based on data generated from white population, thus not addressing disparities related to genetics and ethnicity.

Learning from research from other non-communicable diseases

As evidenced above, the importance of providing tailored health education (to both patients and healthcare professionals) is required on a number of levels (Figure 1). Existing theoretical models in...
health education have been criticised for emphasising individual cognitive process without giving much attention to the embedment of cultural contexts and social structures in human behaviour. Indeed, a recent systematic review found few theory-based asthma self-management interventions for South Asians and African Americans. The importance of culture as a factor in health and health behaviours has been increasingly recognised, including its potential role in enhancing health messaging and interventions. The cultural characteristics of a group may have a direct or indirect relationship with health-related priorities and decision-making, as well as receptivity and adoption of health messages and interventions. It is therefore important that health programmes and interventions are culturally tailored not only to improve acceptance but also salience of health communication. Cultural tailoring of health information involves recognising and reinforcing cultural values, beliefs, norms and practices of a group, and developing health messages based on these to provide context and meaning to the message.

Community-based culturally tailored interventions have been reported to be acceptable, feasible and effective in improving the management of various chronic conditions including cardiovascular disease and diabetes. A recent systematic review suggests that interventions incorporating surface structure (tailoring intervention to observable characteristics of the target group) and deep structure (acknowledging the cultural, social, historical, environmental and psychological context of the target group that influences the health behaviour) are successful in improving disease awareness, healthcare access and self-management. The review highlights that, in addition to linguistically relevant materials, integration of deep structural components is key to intervention success. It suggests that awareness of fundamental philosophies of chronic disease self-management, cultural practice of the target group, and involvement of families are important factors in intervention effectiveness. This was further emphasised in another review which recommends the provision of social support (deep structure) via linguistically and ethnically matched healthcare professionals, peers and family members as the most effective cultural component of the intervention in chronic disease. Identifying and measuring the cultural context of risks and resilience that influence disease is key to designing and evaluating culturally adapted interventions. Although surface variables (matching ethnicity and language) are important, cultural adaptations should focus on factors such as cultural norms, traditions and values that impact the intervention effectiveness.

The use of culturally tailored interventions is increasing in community and healthcare settings, but clear and pragmatic guidelines for (co-)developing, implementing and evaluating these interventions are lacking. In the current context of widening health disparities, strategic focus is required...
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towards adopting culturally relevant programmes and practices to improve quality of care and
promote health equity.

What needs to change in allergic disease?

**Service delivery aspects:** To address the disparities above, several immediate and longer-term
changes requiring a concerted effort from all stakeholders will need to be implemented. We need an
ethnically diverse multidisciplinary workforce to build trust with communities and offer services that
are accessible. This is in keeping with recent results from the NHS staff survey. Inclusion of
ethnicity-based disparities in allergic disease within healthcare professional curricula and continuing
professional development is imperative. This is to raise awareness not only of phenotypic
differences in allergic disease, but also to identify, model, and cultivate attitudes, behaviour and
appropriate communication skills, that can help eliminate, rather than exacerbate, health and health
care disparities. Inclusion of these disparities will enable a cultural transformation within health
services to address systemic and structural racism and implicit bias. The need for healthcare
professionals to acknowledge diversity within ethnic minority groups is required, with awareness
that common cultural patterns may exist. Effective communication with diverse patient groups will
be facilitated by the provision of accessible tools and resources, not least the availability of patient-facing materials which are appropriate for different literacy levels, languages and cultures, given that
these factors intersect and compound, leading to poorer clinical outcomes. Through consultation
with patients and patient organisations and examination of ‘Prevention of Future Death Reports’,
the need for materials which address perceptions of severity, vulnerability and stigma within the
ethnic minority population are required, whilst also considering ways to empower patients (and
their carers) to challenge healthcare professionals when it comes to appropriate prescriptions of
emergency medication and referral to specialists.

**Research initiatives:** Further research involving a) UK-based samples, b) multi-disciplinary expertise,
c) food-allergy populations and d) underrepresented ethnicities (e.g. Arabic and Chinese) is
desperately needed, given that the majority of research included in this comprehensive review has
been taken from asthma populations and North America studies. The latter being important given
the differences in the US healthcare system (especially lack of access to care in respect to insurance
coverage and ease of access to clinical facilities in underserved neighbourhoods) and lack of
universal healthcare compared to the UK. There are a number of unanswered questions relating to
epidemiology (e.g. what is the true prevalence of food allergy in ethnic minority groups within HIC
and the UK-specifically?) and phenotypes (e.g. is uncontrolled asthma in ethnic minority groups
directly attributable to an individual’s social context or is the disease intrinsically more severe?), in
addition to those more behavioural in nature (e.g. how might cultural and religious practices impact
on help-seeking and referral pathways within ethnic minority groups as well as identifying the
barriers and facilitators to effective self-management) (Table 2). The answers to these questions are
likely to result in development of composite supportive interventions which may be tailored to
individuals based on their demographics and social context. It is likely that in time, artificial
intelligence, in particular machine learning, will enable us to improve our ability to match
interventions to particular subgroups. One hurdle which must be overcome in order to pave the way
to these developments are a greater and proportionate representation of ethnic minority groups
within clinical research. An integrated approach and strategy to improve clinical outcomes in allergic
diseases is summarised in Figure 2.

Conclusion

It is clear from the published evidence that ethnicity-based disparities in allergic disease exist and
the problem is likely to be underestimated due to the factors and unanswered questions highlighted.
Non-white populations are an afterthought in research which has to change. Most research comes
from outside of the UK and/or relates to asthma; proportionate representation of ethnic minority
population in clinical trials and genome datasets, with translational research is desperately needed.
There is encouraging research from other non-communicable diseases that provision of tailored
health education involving both surface structure (e.g. observable characteristics of ethnic minority)
and deep structure (e.g. cultural, social, historical, environmental and psychological context of ethnic
minority) are successful in improving disease awareness, healthcare access and self-management.
We therefore must involve community partners in designing disease prevention/ management
plans, as well as in research more generally. Development, implementation and evaluation of
cultural competency training is required for healthcare professionals, as are targeted biologic
therapies for patients. A concerted effort from multi-disciplinary experts will be required to address
these disparities on a holistic scale.
**Table 1. Summary of published ethnicity-based disparities in allergic diseases in High-Income Countries**

| Key observations | Epidemiology | Sensitisation | Clinical aspects |
|------------------|--------------|--------------|-----------------|
| • Higher incident risk* of allergic rhinitis 2.36 (2.31-2.41), asthma 1.04 (1.01-1.07) and atopic eczema 1.66 (1.64-1.69) amongst British South Asians3 | • Greater risk of aero-allergen sensitisation amongst African American children [2.17 (1.23-2.84, 95% C.I)] from deprived geographical locations46 | • Higher rates of fatal asthma amongst Black NH patients vs White non-Hispanic patients (23.9 (0.76, std error) vs 9.9 (0.22, std error) per million)86 |
| • Higher incident risk* of allergic rhinitis 2.56 (2.50-2.62) and atopic dermatitis 1.31 (1.28-1.33) amongst Afro-Caribbean’s and allergic rhinitis and 1.84 (1.80-1.89) and atopic dermatitis 1.33 (1.31-1.36) mixed ethnic groups in the UK3 | • Greater risk of cockroach sensitisation amongst African American children [16.4 (4.8-55.9, 95% C.I)] and children [11.9 (4.3-40.8, 95% C.I)] from lower socioeconomic status47 | • Higher rates of fatal asthma amongst most deprived male British patients >45 years of age |
| • Higher prevalence of asthma amongst Black population in USA (data as % (standard error)): White non-Hispanic (NH; 7.7(0.13)), Black NH 10.6 (0.36), Asian NH 3.8 (0.33) and Hispanic 6.6 (0.30) in the USA86 | • Higher risk of sensitisation to food allergens including shellfish, peanut, tree nuts, corn, legumes, milk, egg amongst Black American children | • Higher rates of emergency room visits, hospital admissions and corticosteroid use amongst Black American patients |
| • Higher prevalence of asthma in deprived population in the USA: most deprived, below 100% of poverty threshold 11.8 (0.63, std error) vs 450% of poverty threshold 5.9 (0.26, std error)86 | • Delay and/or under recognition of allergic rhinitis amongst Black American children | • Higher rates of emergency room visit for acute asthma amongst patient from most deprived areas in the USA |
| • Higher risk of self-reported food allergy amongst ethnic minority groups in the USA [Asian non-Hispanic 1.28 (1.06-1.54, 95% C.I) Black non-Hispanic 1.20 (1.06-1.36, 95% C.I)]17 | | • Higher standardised incident rates [58.3 (42.8, 76.3 95% C.I) per 100,000 person years] of community anaphylaxis amongst British South Asians compared to White population [31.5 (27.2, 36.3 95% C.I) per 100.000 person years]31 |
| • Higher risk of self-reported food allergies amongst deprived population [1.08 (0.96-1.21, 95% C.I), 25,000-49,000 USD] in the USA7 |
| • Higher rates of single and multiple food allergies amongst Black American children versus other ethnic minority groups (4.7% vs 2.7%; p = 0.0001) considered as a single group)70 | | • Higher rates of risk of food anaphylaxis amongst Asian children [adjusted OR 1.50 (1.16-1.94 95% C.I; p=0.002)] compared to non-Asian children in Australia21 |
| • Higher risk of sensitisation to aeroallergen amongst African American children [2.17 (1.23-2.84, 95% C.I)] from deprived geographical locations46 | |
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|                                                                 |                                                                 |
|------------------------------------------------------------------|------------------------------------------------------------------|
| • Lesser proportion of British patients with severe asthma enrolled for biologic treatments |                                                                 |
| • Differences in proportion of Black American, Mexican American and Puerto Ricans children eligible for biologic therapies for severe asthma based on current selection criteria |                                                                 |

*adjusted incident rate ratios (95% C.I)
Table 2. Evidence gaps and key research questions for addressing ethnicity-based disparities in allergic diseases

| Epidemiology                                                                 | Phenotypes                                                                 | Sensitisation                                                                 | Care pathways                                                                 | Behavioural                                                                 |
|------------------------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| • What is the prevalence of severe allergic rhinitis, asthma and atopic dermatitis amongst ethnic minority groups in High-Income Countries? | • Are there differences in asthma phenotypes and disease clusters between white patients and patients from ethnic minority groups? | • Are there distinct sensitisation patterns (considering both SPT and IgE) amongst ethnic minority patients in High-Income Countries? | • What are the facilitators and barriers in care pathways for allergic diseases with respect to patients from deprived geographical locations and those belonging to ethnic minority groups? | • How can we facilitate greater engagement within ethnic minority groups in clinical research? |
| • What is the incidence rate of anaphylaxis in ethnic minority groups in High-Income Countries? | • Is uncontrolled asthma directly attributable to socio-demographic variables (eg: socio-economic status, literacy, access to specialist, air pollution etc..) or is the disease intrinsically more severe in patients from ethnic minority groups? | • What are the reasons underpinning higher risk of sensitisation amongst Black American children? | • Are there cultural, religious and health literacy barriers impacting on referral pathways amongst patient from ethnic minority groups? | • What are the barriers and facilitators to effective self-management for those with allergic diseases from ethnic minority groups and the healthcare professionals who provide care? |
| • What is the prevalence of true food allergy in ethnic minority groups in High-Income Countries? | • Are there differences in key blood parameters such as peripheral blood and sputum eosinophils/neutrophils and serum total IgE between white patients and those from ethnic minority groups? | • How are breastfeeding and weaning practices different in patients from ethnic minority groups and how might this impact on risk and patterns of sensitisation to foods? | | • What behavioural/psychological constructs are important to address in ethnic minority groups to improve self-management of allergic disease? |
| • Are there time trends in the incidence of allergic diseases by ethnicity? | | | | • What are the preferred mechanisms of health education delivery to encourage effective self-management? |
| • What is the effect of ethnicity, socio-demographic status and rural/urban residency on the incidence and prevalence of allergic diseases? | | | | • How can we encourage healthcare professionals working with those with allergic disease from ethnic minority groups to be culturally competent? |
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Figure 1. Factors to target to improve ethnicity-based outcomes in allergic disease

Policy environment factors
- Inclusion of ethnic minority groups in policy making
- Research in relation to difference and diversity with adequate financial resources
- Guidelines based on inclusive research

Healthcare provider factors
- Awareness of implicit bias (e.g. reduced diagnosis and under prescribing)
- Signposting to culturally appropriate services/resources
- Cultural sensitivity and effective communication

Organisational factors
- Partnering with community based organisations (e.g. schools and faith groups)
- Training for HCPs on cultural competence
- Address institutional and structural discrimination
- Culturally sensitive and translated patient-facing resources
- Equality and diversity advisory committees
- Non-discrimination policies
- Patient navigator/advocate/champions
- Workforce diversity
- Organisational culture

Interpersonal considerations
- Peer/family education awareness of health and needs
- Community and faith leaders opinions/peer support
- Address community misconceptions about allergic disease and treatments
- Relationship with healthcare professional
- Stigma, discrimination

Individual factors (patients and carers)
- Demographics (e.g. education, literacy, economic stability, neighbourhood deprivation, residential segregation)
- Health beliefs (e.g. perceived susceptibility, severity, efficacy of treatment)
- Health seeking behaviour
- Cultural and religious beliefs
- Prior experience with healthcare

Organisational setting
- National, State and local policy environment

Healthcare provider

Interpersonal

Individual
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