


Asthma in African children and adolescents: Burden, barriers, and management strategies

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Background. Asthma is the leading chronic disease in African children and adolescents, yet remains underdiagnosed and poorly managed. Asthma in Africa has been associated with higher mortality rates compared with high-income countries. Barriers to asthma control in African children and adolescents are lack of accurate diagnosis, limited access to inhaled therapy, lack of knowledge about asthma, and poor air quality.

Objectives. To review the asthma burden, risk factors, barriers to care and management strategies in an African setting.

Methods. A narrative review of peer-reviewed literature from 1990 to 2024 was conducted using PubMed, global asthma guidelines, Global Initiative for Asthma, Scopus, Google Scholar and African Journals Online.

Results. The prevalence of asthma is rising, with urban-rural disparities and multifactorial risk profiles. Barriers to control include poor access to diagnostics, underutilisation of inhaled corticosteroids, and limited education.

Conclusion. A multisectoral approach is needed to improve asthma care, including adaptation, education, and access to essential medicines.

Keywords. Asthma burden, asthma prevalence, asthma control.

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Study synopsis

What the study adds. This study highlights the burden of disease secondary to asthma. It reports on prevalence, risk factors, and barriers in management.

Implications of the findings. The findings raise awareness of all the gaps identified, which in turn will activate actions and strategies to reduce the burden and update guidelines.

Chronic respiratory diseases (CRDs) are among the leading causes of death worldwide, with asthma being the most common non-communicable chronic disease affecting children.^[1] Globally, ~300 million people have asthma.^[1] According to the Global Initiative for Asthma (GINA), a detailed and compatible history, physical examination, and lung function tests with spirometry or peak expiratory flow rate (PEF) measurements are required for the diagnosis and management of asthma.^[1]

Asthma in Africa has been associated with higher mortality rates than in high-income countries.^[2] Contributing factors are multifactorial, including diagnostic limitations, urbanisation, and health system constraints. Barriers to asthma control in African children and adolescents are lack of accurate diagnosis, limited access to inhaled therapy, lack of asthma knowledge, and poor air quality.^[3] In South Africa (SA), an upper middle-income country, only 31.5% of children with asthma had well controlled asthma, and 17.6% had

been admitted to hospital during the previous year.^[4] In this narrative review, we will focus on asthma in children and adolescents in Africa.

Definition

The majority of people living with asthma have mild to moderate asthma (up to 70% of children, adolescents and adults). A smaller proportion have severe asthma.^[5,6] In African countries, asthma is underdiagnosed, and the prevalence of severe asthma is high (Table 1).^[7,8]

Burden of disease

Asthma is an important and increasing public health concern in Africa, which receives inadequate priority and attention.^[9] The prevalence of asthma in children and adolescents has been increasing across Africa, from 12.1% in 1990 to 15.1% in 2021 (Table 2).^[9-11] Although 50 - 75% of children and adolescents with asthma are classified as having mild disease, ~30 - 40% of all severe exacerbations

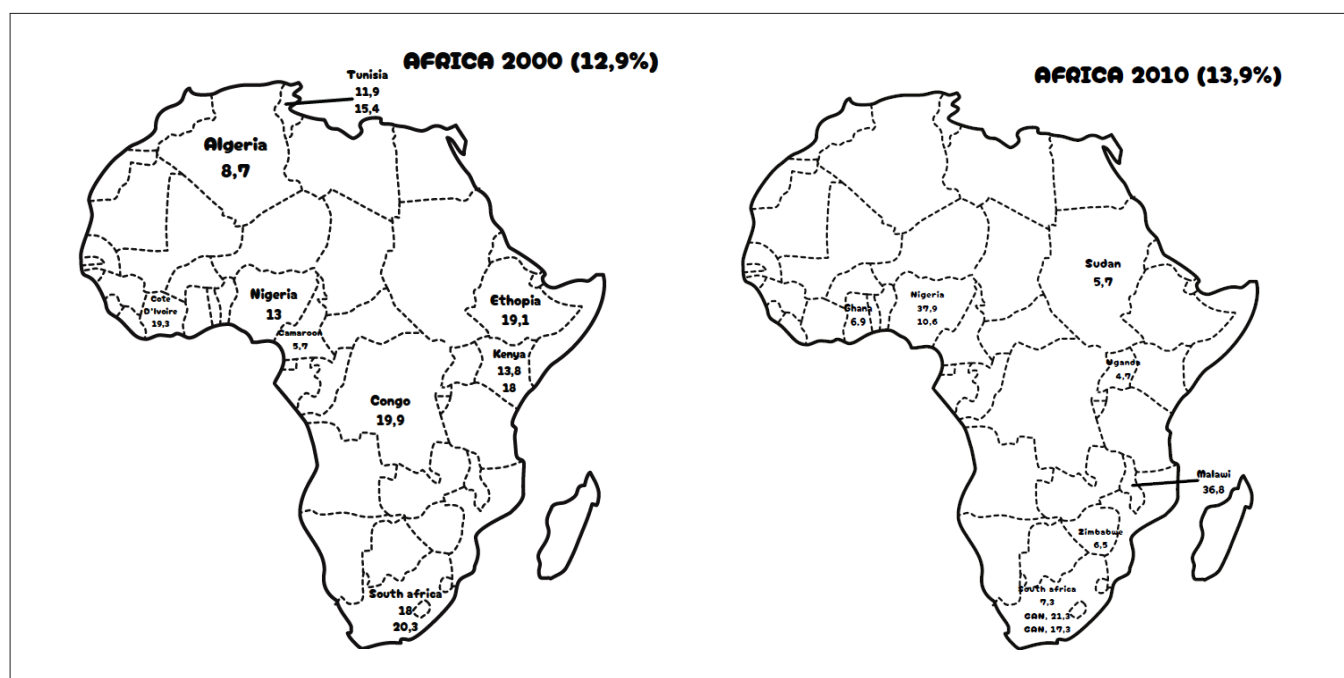


Fig 1: Prevalence of asthma symptoms in children and adolescents in Africa (left year 2000 & right year 2010)

occur in this age group.^[5,6] The World Health Organization (WHO) estimates that there are 250 000 deaths per year from asthma, mainly in low- to middle-income countries (LMICs), and asthma remains one of the top 20 causes of disability in children globally.^[12]

According to the International Study of Asthma and Allergies in Children (ISAAC) Phase III global study, the prevalence of asthma varied in African countries from as low as 8.7% (Algeria) to 9.1% (Ethiopia), 10.4% (Morocco), 11.9% (Tunisia), 13.0% (Nigeria), 15.8% (Kenya), and as high as 20.3% in SA.^[2,13,14] Over 298 disability-adjusted life-years per 100 000 people were associated with asthma in 2017.^[2,15] Factors implicated in individuals with an increasing asthma burden in Africa include poverty, rapid urbanisation, and lack of organised health promotion programmes, such as effective control strategies for environmental triggers, air pollutants, climate change and occupational dusts (Fig. 1).^[16-18]

Urban-rural differences

In Africa, as on other continents, the prevalence of asthma varies from country to country and among relatively small geographical areas within countries.^[19,20] The prevalence of asthma is reported to be higher in urban compared with rural areas.^[9] The prevalence in adolescents has been reported at 17% in children in more rural settings and 21% in urban settings.^[11,21] Previous studies comparing urban with rural settings showed prevalences of exercise-induced bronchospasm of 14.9% v. 8.9%, respectively ($p < 0.0001$), prevalences of asthma of 3.1% v. 1.5%, and prevalences of reversible airway obstruction of 5.8% v. 3.1%.^[22-24] More recent childhood asthma prevalence studies, from Kenya and Ghana, have confirmed a narrowing of the urban-rural difference.^[9] In part, this may be the result of exposure of rural children to agricultural pesticides and irritants, as well as an increasing tendency to adopt a more westernised lifestyle.^[9,25]

In a cross-sectional study of children in Uganda, a strong rural-town-city gradient, higher parental socioeconomic status and

urbanicity were risk factors for asthma.^[26] In summary, social inequalities, poor access to medical services, poor health education, lack of access to basic infrastructure, fast modernisation and 'urbanisation' of the rural environment, increasing air pollution, smoking habits, and changes in diet are some of the factors associated with the rise of asthma in rural communities.^[17] Urban-rural differences are influenced by living standards, leading to higher prevalences in urban compared with rural areas.

Risk factors

Risk factors for asthma are multifactorial and include environmental factors such as indoor and outdoor pollution, socioeconomic status, which is controversial as both poor and higher status are reported as risk factors, lifestyle factors such as smoking, pet ownership, and genetic factors.

Environmental factors

Indoor pollution, such as use of gas for cooking, tobacco smoking and *in utero* exposure to tobacco smoke, and exposure to outdoor pollution can predispose to or exacerbate asthma.^[21,27,28] Sensitisation to dust mite and cockroach allergens, inner-city residence, and low position in sibship were found in to be independent risk factors for asthma in children in Ghana.^[12,29] A recent multi-country African study on the effects of pollution exposure on children with asthma found in a mixed-effects model that the determinants for higher particulate matter with a diameter of $\leq 2.5 \mu\text{m}$ (PM_{2.5}) exposure were the presence of smokers at home (23.0%; 95% confidence interval (CI) 10.8 - 36.4), use of coal or wood for cooking (27.1%; 95% CI 3.9 - 56.3), and kerosene lamps for lighting (30.2%; 95% CI 9.1 - 55.2).^[30] Overall, PM_{2.5} exposures measured were inverse to relative country income status,^[23] with children in the lower-income country (Blantyre, Malawi) having the highest exposures, while children in the lower middle-income country (Kumasi, Ghana)

Table 1. Definitions of severe asthma and uncontrolled asthma*

Severe asthma, ISAAC (at least one)	<ul style="list-style-type: none"> • Asthma that requires treatment with GINA steps 4 - 5 treatment for the previous year • Systemic corticosteroids for $\geq 50\%$ of the previous year • Remains 'uncontrolled' despite therapy • ≥ 4 attacks of wheeze in the past 12 months • ≥ 1 night per week sleep disturbance from wheeze in the past 12 months • Wheeze affecting speech in the past 12 months
Uncontrolled asthma, GINA (at least one)	<ul style="list-style-type: none"> • Poor symptom control <ol style="list-style-type: none"> a) Asthma Control Questionnaire consistently ≥ 1.5, or b) Asthma Control Test < 20 • Frequent severe exacerbations: <ol style="list-style-type: none"> a) two or more bursts of systemic corticosteroids (≥ 3 days each) in the previous year • Serious exacerbations: <ol style="list-style-type: none"> a) at least one hospitalisation, intensive care unit stay or mechanical ventilation in the previous year • Airflow limitation: <ol style="list-style-type: none"> a) FEV₁ $< 80\%$ after appropriate bronchodilator b) reduced FEV₁/FVC • Controlled asthma that worsens on tapering of high doses of inhaled corticosteroids or systemic steroids (or additional biologicals)

ISAAC = International Study of Asthma and Allergies in Children; GINA = Global Initiative for Asthma; FEV₁ = forced expiratory volume in 1 second; FVC = forced vital capacity. *American Thoracic Society/European Respiratory Society and ISAAC.^[7,8]

Table 2. Prevalence of asthma symptoms in children and adolescents in Africa, 1990 - 2021

Country, reference	Children and adolescents, n (%)
Africa, 1990 ^[9]	34.1 million (12.1)
South Africa, ISAAC Phase I 1995 ^[11,18]	5 178 (16)
Africa, 2000 ^[9]	43.1 million (12.9)
Africa, ISAAC Phase III ^[14,18]	589 (10) children 10 168 (15.3) adolescents
Africa, 2010 ^[9]	49.7 million (13.9)
Africa, GAN 2021 ^[11]	9 876 (15.1)

ISAAC = International Study of Asthma and Allergies in Childhood; GAN = Global Asthma Network.

and upper middle-income country (Durban, SA) had the lowest exposures.^[30] An SA study found that poor living conditions were associated with more severe asthma; exposures that were highly prevalent included outdoor pollution (33.5%), maternal smoking (24.7%), paternal smoking (35.2%), participant self-reported current smoking (8.8%), and exposure to pets, occurring in 68.1%.^[21]

Socioeconomic and genetic factors

Poor living conditions, such as those characterised by damp, mould and pests, were associated with an increased risk of wheezing.^[28] Interestingly, one study found that high levels of education in the caretaker were associated with asthma risk.^[27]

Lifestyle factors

Several factors may account for the greater severity of asthma. Poor living conditions were a key risk factor, as were self-reported smoking, pet ownership and outdoor pollution.^[21] Severe asthma was associated with self-reported smoking (odds ratio (OR) 2.29; 95% CI 1.78 - 2.94), living in an informal settlement (OR 1.38; 95% CI 1.05 - 1.81), exposure to outdoor pollution (OR 1.26; 95% CI 1.05 - 1.51), and exposure to pets (OR 1.32; 95% CI 1.09 - 1.61).^[21] Other lifestyle factors included obesity, a low level of physical activity, and a Western diet, characterised by high amounts of fat and processed foods.^[31]

Genetic factors

Childhood asthma is strongly linked to atopy and is characterised by a T-helper 2 (Th2)-polarised immunological response.^[32] Asthma is not caused by a single mutation in one gene, but is a polygenic, multifactorial disorder.^[33] The recurrence risk of asthma in children with one affected parent is ~25%, whereas the risk if both parents are affected is ~50%.^[33] Maternal asthma (adjusted odds ratio (aOR) 2.4; 95% CI 1.2 - 4.6; $p=0.009$) and a history of allergy in the patient (aOR 2.6; 95% CI 1.2 - 5.4; $p=0.015$) were associated with asthma.^[27]

Asthma control

Assessment tools

A multi-centre cross-sectional study including seven countries – Morocco, Algeria, Tunisia, Mauritania, Senegal, Niger and Mali – assessed factors that influenced asthma control in 521 children.^[34] The study found that 45% of the children had suboptimal asthma control according to the GINA assessment of control.^[34] Asthma control should be assessed using the validated Asthma Control Test or Asthma Control Questionnaire.^[35,36] Asthma control in the Middle East and North Africa is unsatisfactory, with fewer than one-third of asthma patients having well-controlled disease, underscoring the need to improve treatment access, along with better follow-up and education among healthcare providers and patients.^[37]

Barriers to asthma care

The Global Asthma Network Phase I (GAN I) reported that poor asthma control in African children is widespread.^[38] Reasons for poor control are postulated to be limited availability and affordability of asthma inhalers and a lack of diagnosis, poorly co-ordinated asthma management, a lack of asthma knowledge among children, teachers and parents, and stigma associated with

this long-term condition.^[38] A large proportion of adolescents in sub-Saharan Africa with symptoms of severe asthma do not have a formal diagnosis of asthma and therefore do not receive appropriate asthma therapy.^[39]

The reasons for underdiagnosis of asthma include lack of community knowledge and perceptions of asthma. In some rural areas of Africa, it is believed that asthma is caused by the wrath of God on a child, and this leads the parents to look for spiritual care such as rituals and traditional healing practices to treat the condition rather than seek medical care.^[40] Some parents hide their asthmatic children at home for fear of being stigmatised by their community.^[41] These belief systems promote delays in accessing proper routine and emergency services for diagnosis and appropriate care.^[41]

Diagnosis

Spirometry to assess bronchodilator reversibility and/or serial PEF measurements are required to obtain evidence of variable expiratory airflow limitation, to support the diagnosis of asthma. In Africa, the availability of spirometry is limited.^[42] Spirometry, the objective diagnostic tool for asthma diagnosis, is not universally available, and the concomitant lack of trained practitioners to perform spirometry, limited expertise for test interpretation, and the relatively high cost of tests all contribute to its underutilisation.^[43-45] Reliable spirometry requires a well-trained, competent operator, properly maintained and calibrated equipment, and availability of technical support to maintain equipment and disposables, which are usually not available in the supply chain in many countries in Africa.^[46]

GINA recommends use of a PEF meter to demonstrate variable airflow obstruction for diagnosis of asthma in resource-limited settings.^[1] PEF is measured using a simple, cheap meter, requiring limited co-operation from the patient. However, PEF is not being fully utilised owing to lack of knowledge of its clinical utility and poor availability, particularly in LMICs.^[45]

There is significant misclassification of childhood asthma when the diagnosis relies solely on a clinical history. In one study, 45% of asthma cases were overdiagnosed.^[47] Overdiagnosis of childhood asthma is common in primary care, leading to unnecessary treatment, disease burden, and impact on quality of life.^[48] However, only in a small proportion of children is a diagnosis of asthma confirmed by lung function tests.^[48] The differential diagnosis of asthma needs to be considered (Table 3).

For young children aged <5 years, asthma should only be diagnosed if all other causes of wheezing have been considered and excluded, and if there is a response to a therapeutic trial and worsening with withdrawal of asthma medication.^[49] Even in older children and adults, a differential diagnosis is broader than in high-income countries, where conditions such as tuberculosis and HIV infection may complicate the picture.

In Africa, several studies in SA, Nigeria and Uganda have reported that asthma is underdiagnosed in children.^[18,50-53] Of concern is that almost half of children in urban communities experience severe asthma symptoms, but lack a formal diagnosis and therefore access to treatment.^[54] The problems of underdiagnosis and undertreatment of asthma are juxtaposed in the high-burden settings and also contribute to poor quality of life.^[2]

Table 3. Differential diagnosis of asthma

Diagnosis	Presenting features
Recurrent lower respiratory infection	Viral, bacterial and fungal infection. Shortness of breath, cough, wheezing and fever.
Reactive airway disease	Temporary symptoms: wheezing, shortness of breath and coughing, triggered by an irritant and subsides after removal of the irritants.
Bronchiolitis	Difficult breathing, wheezing and coughing. Usually resolves spontaneously within few days.
Bronchiolitis obliterans	History of viral pneumonia. Shortness of breath, persistent cough, wheezing and cough.
Tuberculosis	Persistent cough, chest pain, coughing up blood or mucus, fatigue, weight loss, night sweats, wheezing, and fever.
Bronchopulmonary dysplasia	History of prematurity. Airway hyperactivity and asthma-like symptoms.
Cystic fibrosis	Productive cough. Chronic lung features. Failure to thrive.
Primary ciliary dyskinesia	Neonatal upper airway symptoms. Wet cough. Chronic sinusitis. Recurrent sinusitis
Foreign body aspiration	Abrupt onset of symptoms. Unilateral wheezing and hyperinflation.
Airway malacia	Monophasic wheezing when active. Worsens when crying, feeding, lying down or coughing. Stridor may be present.
Allergic rhinitis	Sneezing, runny nose, itchy eyes. Triggers like asthma.
Bronchiectasis	Chronic cough with excessive mucus production, often producing purulent sputum. Other common features are dyspnoea, wheezing, and haemoptysis.
Congenital heart defects	Shortness of breath, fatigue.
Gastro-oesophageal reflux disease	Recurrent cough, wheezing and other symptoms. History of vomiting or regurgitation.
Pulmonary oedema	Shortness of breath, cough (initial dry then pink/blood-tinged frothy sputum).
Immunodeficiency	Recurrent lower respiratory infection. Recurrent systemic infection.
Vascular rings	Noisy breathing, shortness of breath and coughing
Vocal cord dysfunction	Sudden worsening of asthma symptoms. No response to asthma medication.

Education and training

Although the term ‘asthma’ is widely known in communities, there is limited understanding of the details of the diagnosis and its management. Many consider asthma to be a contagious disease, which carries a social stigma.^[55] Family-friendly community-based educational programmes can help alleviate this problem.^[56] Many doctors lack the knowledge, skill set and confidence to diagnose and manage asthma, particularly in young children, and therefore prescribe oral medications that do not treat the underlying chronic inflammation.^[55] A multi-country qualitative study across six African countries identified key barriers to achieving good asthma control that included poor understanding and lack of knowledge and skills among teachers, adolescents and caregivers.^[57,58]

Pharmacological management

Effective management of asthma requires regular monitoring of symptoms and lung function, adherence to treatment, and patient education to reduce exposure to environmental triggers.^[42] Although there are global strategies for management and control, it is critical that locally adapted guidelines are implemented.^[12] Essential inhaled medicines must be part of universal health coverage to provide effective care for children, adolescents and adults with asthma, wherever they live in the world.^[42]

Essential medicines for treating asthma are largely unavailable and unaffordable in LMICs, and this is particularly true for inhaled corticosteroids (ICS).^[59] The prevalence of underutilisation of ICS is high, and the contributing factors include limited affordability of ICS, inaccessibility of treatment, poor knowledge of patients regarding asthma disease and asthma treatment, myths around inhaled steroids, and lack of recently reviewed local guidelines for asthma treatment.^[60]

Since 2019, GINA has recommended the use of combination budesonide/formoterol for asthma in adults and children aged >12 years from step 1 of treatment.^[11] The WHO Global Action Plan for the Prevention and Control of Noncommunicable Diseases includes a target of 80% availability of the essential medicines to treat CRDs.^[42] A recent systematic review showed that only 6 out of 58 LMIC countries met the WHO 80% availability target for short-acting beta-2-agonists (SABAs), 3 out of 48 met the target for ICS, and none met the 80% availability target for combination ICS/fast-acting, long-acting beta-2-agonists (ICS/LABAs).^[59] Three countries described the availability of ICS/LABA inhalers, but no countries reported availability in >80% of their study sites.^[59] There are gaps in the evidence on the clinical and cost-effectiveness of budesonide/formoterol therapy in children aged <12 years, with no data from an LMIC context.

Implementation and solutions

In summary, gaps identified in asthma diagnosis and care include challenges of underdiagnosis, lack of trained staff, non-availability of and lack of training in spirometry, and low levels of peak flow meter use. Risk factors range from environmental to socioeconomic and lifestyle factors that are not open to change at an individual level. Inappropriate management such as overprescription of SABAs and underprescription of ICS and poor access to treatment also contribute to the asthma disease burden.

Potential solutions to bridge these gaps include:

- Raise awareness of the burden of asthma and optimal management. The Forum of International Respiratory Societies launched a campaign to spur action to reduce the wide gaps in access to inhaled medicines for chronic obstructive pulmonary disease and asthma.^[61]
- Updated treatment guidelines relevant to the specific population. These must be culturally acceptable, and must be adapted to each health system, formalised with political engagement and commitment.^[17]
- Local manufacturing of low-cost, good-quality generic medicines.
- Advocacy and policy. The WHO has identified the prevention and control of non-communicable diseases as an urgent development issue and essential to the achievement of the Sustainable Development Goals by 2030.^[62]
- Identify and prioritise feasible strategies that can be adopted and implemented as effective interventions that will address this increasing burden in Africa, especially at the primary care level, where 60% of the population accesses care.^[9,63]
- Asthma education and training for the community and for healthcare professionals, with the aim of improving asthma awareness, diagnosis and outcomes.
- Increased availability of and access to diagnostics, including peak flow meters and spirometry.
- Adopting evidence-based treatment strategies, such as those established by GINA, can drastically drive down asthma morbidity and mortality.^[2]
- The harmonisation of guidelines set by the WHO, the Global Alliance against Chronic Respiratory Diseases, GINA and local guideline development bodies.^[2,64]
- Reduce harmful exposures and environmental factors, particularly smoking.
- Improve housing infrastructure, access to electricity, and socioeconomic development.^[21]
- A comprehensive and collaborative approach is crucial, requiring tailored funding strategies for the diverse African context.^[2] With sufficient targeted resources, collaborative multi-stakeholder action could overcome the barriers in access to affordable, quality-assured, essential inhaled therapies for people with CRDs in LMICs.^[65] By investing in integrative approaches that act across reproductive, maternal and child health and emphasise health education, promotion and disease prevention, we have the opportunity to improve lung health in the world’s poorest populations and enable progress towards the achievement of universal health coverage.^[66]

Conclusion

Collaboration among clinicians, funders, governments, public health organisations, non-governmental organisations, researchers, the WHO, ministries of health and communities is essential for addressing this health crisis by improving infrastructure, accessing resources, and training healthcare providers.^[2,65] The urgency of ensuring that the high worldwide burden of severe asthma symptoms in children is mitigated by enabling equitable and affordable access to the effective therapies for asthma that have been available to those who can afford them for decades.^[11] There are opportunities to achieve

improved access to affordable, quality-assured inhaled medicines in LMICs through co-ordinated, multi-stakeholder, collaborative efforts.^{165]} Future studies, research priorities and collaboration to tackle these identified gaps in diagnosis, management and resources are necessary. There is a need for national governments in Africa to consider the implications of this increasing disease burden and to investigate the relative importance of underlying risk factors such as rising urbanisation and population ageing in their policy and health planning responses to this challenge.

Data availability. The datasets generated and analysed during the present study are available from the corresponding author (RM) on reasonable request. Any restrictions or additional information regarding data access can be discussed with the corresponding author.

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