

The Global Asthma Report 2022



1 in 10 children have
asthma symptoms
Half have inadequately
controlled symptoms
Many have no access to
essential asthma medicines

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GLOBAL ASTHMA REPORT 2022

Foreword.....	4
Preface.....	5
Executive Summary	6
Key Recommendations	8
PART ONE: THE BURDEN OF ASTHMA	12
1. Global Asthma Network.....	14
P Ellwood, I Asher, K Bissell, C-Y Chiang, E Ellwood, A El Sony, L García-Marcos, G Marks, R Masekela, E Morales, K Mortimer, N Pearce, D Strachan	
2. Asthma and Factors Affecting it.....	16
N Pearce, L García-Marcos, E Morales, D Strachan, G Marks, I Asher	
3. The Global Burden of Asthma.....	20
C Rutter, R Silverwood, V Pérez Fernández, N Pearce, D Strachan, K Mortimer, M Lesosky, I Asher, P Ellwood, C-Y Chiang, L García-Marcos	
4. Asthma Deaths	24
D Strachan, C Rutter, E Morales, V Pérez Fernández, K Mortimer	
5. Global Asthma Management and Asthma Control.....	29
L García-Marcos, C-Y Chiang, R Silverwood, I Asher, G Marks, K Mortimer, P Ellwood, E Morales, A El-Sony	
6. COVID-19 and Asthma	32
C-Y Chiang, L García-Marcos, P Ellwood, E Ellwood, R Masekela, N Pearce	
PART TWO: ASTHMA IN THE WHO REGIONS	36
7. Asthma in the African Region.....	38
Introduction R Masekela	
38	
Nigeria A Falade	
39	
Cameroon AE Ndikum, BH Mbatichou Ngahane	
40	
South Africa R Masekela, HJ Zar	
41	
Spirometry in Africa	
L Zurba, N Ndimande, R Masekela	
42	
8. Asthma in the Region of the Americas	43
Introduction BE Del-Río-Navarro	
43	
Mexico BE Del-Río-Navarro, N Reyes Noriega, A Berber.....	
44	
Argentina H Badellino.....	
45	
Brazil M Urrutia-Pereira, D Solé.....	
46	
Costa Rica ME Soto-Quirós, ME Soto-Martínez.....	
47	
9. Asthma in the Eastern Mediterranean Region	48
Introduction A El Sony, Y Mohammad	
48	
Kingdom of Saudi Arabia SA Alomary, WA Althagafi, IF Adam, OE Elsherif, AJ Almadani, AA Alabdullah	
49	
Pakistan O Yusuf	
50	
Syria G Dib, G Alkhayer, LD Nahas, K Azhari, M Yassine, J Allouch, M Ibrahim, R Shaaban.....	
51	
Sudan H El Sadig, SA Hassanain, S Hamza, N Mohamed Abass, R Ahmed	
52	
Iran M Tavakol	
54	





GLOBAL ASTHMA REPORT 2022

10. Asthma in the European Region.....	56
Introduction L García-Marcos	56
Greece D Moriki, O Sardeli, K Douros	57
Kosovo L Ahmetaj, Y Ahmetaj, M Shahini	58
Russia K Kuzmicheva, O Richkova	59
Spain L García-Marcos, AE Martínez-Torres, A Moreno-Salvador	60
11. Asthma in the South-East Asian Region	61
Introduction V Singh	61
India N Singh, M Sabir, S Awasthi, SK Kabra, S Salvi, M Singh, PA Mahesh, TU Sukumaran, AG Ghoshal.....	62
Sri Lanka JC Ranasinghe, ST Kudagammana	63
Thailand S Chinratanapisit, P Vichyanond.....	64
12. Asthma in the Western Pacific Region	65
Introduction I Asher	65
China G Wong, Y Xing	66
Taiwan J-L Huang, K-W Yeh, K-W Su.....	67
New Zealand I Asher.....	68
Pacific S Foliaki, G 'Aho	69
PART THREE: IMPROVING ASTHMA MANAGEMENT.....	70
13. New Approaches with Asthma Medicines	72
C-Y Chiang, I Crossingham, A El Sony, R Fortescue, L García-Marcos, G Marks, R Masekela, H Reddel	
14. Asthma in the Context of other Chronic Respiratory Diseases in LMICs.....	74
K Mortimer, K Bissell, A Cruz, L García-Marcos, A El Sony	
15. Improving Access to Essential Asthma Medicines.....	76
K Bissell, C Plum, K Mortimer, Z-U-D Babar, O Ozoh	
16. Asthma Management in Low- and Middle-Income Countries.....	81
A El Sony, A Yorgancioğlu, K Bissell, R Masekela, S Rylance, G Marks, C-Y Chiang	
17. The role of patient advocacy.....	84
TA Winders	
18. Asthma, Climate Change and Planetary Health.....	86
A Yorgancioğlu, ZJ Andersen, K Hansen, O Usmani, N Pearce, K Mortimer, AE Ndikum	
APPENDICES	88
Glossary.....	90
Appendix A: References.....	92
Appendix B: Authors.....	96
Appendix C: GAN Phase I Study Group.....	99
Appendix D: Acknowledgements	101

Foreword



Noncommunicable diseases and asthma - where are we in 2022?

Noncommunicable diseases (NCDs) continue to represent a huge threat to the health, growth, and development of countries across the globe. This diverse group of conditions includes chronic respiratory diseases, cardiovascular diseases, diabetes, and cancers. In 2019, 74% of global deaths were due to NCDs, with approximately 4 million deaths caused by chronic respiratory diseases.

Despite political commitments from three United Nations High Level Meetings on NCDs and the United Nations Sustainable Development Goals, progress to reduce the impact of NCDs is regrettably inadequate. This is particularly true in poorer parts of the world.

Currently, there are no countries on track to achieve all the nine voluntary global targets for 2025 set by the World Health Assembly in 2013, against a baseline in 2010. The World Health Organization (WHO) Global Monitoring Report for Universal Health Coverage in 2019 shows very little change on NCD services and capacities since 2000, particularly in low-income countries.

To compound the situation, the COVID-19 pandemic has caused widespread disruption to the provision of services for chronic diseases, with over half of countries reporting disruption to asthma services in late 2021.

The Global Asthma Report 2022 comes at a time when the world has heightened understanding of the importance of healthy lungs. Three years into the COVID-19 pandemic, many have watched friends and relatives struggle to breathe, and know the limitations that lung-related problems can place on daily activities.

The report highlights the many challenges relating to the prevention and management of asthma. Case studies describe the frustrations of people living with asthma, their families, and their health care providers. Delay in diagnosis and limited access to safe, effective, quality, and affordable essential inhaled medicines, adversely affect the provision of asthma care in many countries.

Congratulations to the Global Asthma Network for bringing together the most recent research findings, treatment recommendations and country perspectives. The result is a valuable tool which can be used for advocacy at many levels, with suggested actions for a variety of stakeholders.

With less than ten years left to achieve the Sustainable Development Goals, we need to act now to save lives and reduce health inequities. We look forward to continuing efforts together with the Global Asthma Network, and many others, to improve care for people living with asthma across the world.

Dr Bente Mikkelsen
Director, Noncommunicable Diseases Department,
World Health Organization

Preface

The Global Asthma Report (GAR) 2022 is the fourth in a series of GARs published in 2011, 2014 and 2018. The latest three reports have been produced by the Global Asthma Network (GAN), while the first was a combined production by The International Union Against Tuberculosis and Lung Disease (The Union) and the International Study of Asthma and Allergies in Childhood (ISAAC). The value of these first three reports is indicated by more than 200,000 downloads.

Recognition of asthma as one of the most common non-communicable diseases (NCDs) has increased. The United Nations (UN) has included asthma in all its NCD deliberations, with three High Level Meetings to date (2011, 2014, 2018) and another scheduled for 2025. In 2015 the UN created the 2030 Agenda for Sustainable Development, in which Goal 3 “*ensure healthy lives and promote well-being for all at all ages*” specifically addresses health priorities. Several targets and indicators under this goal relate to reducing the global burden of asthma death and disability.



In this GAR, authored by 97 people from 31 countries, we summarise new asthma research by GAN – prevalence and severity of asthma, changes over time, and how it is managed. We write this in the third year of the COVID-19 pandemic, which has had devastating effects on people around the world and we report GAN research on children with asthma and COVID-19. Before the pandemic many people with asthma, especially in low- and middle-income countries (LMICs), were unable to access the quality-assured essential asthma medicines and care they need, and that may have worsened.

The Global Asthma Network has been advocating for equitable access to affordable good quality essential medicines for the treatment of asthma for more than 10 years. Unfortunately, progress to achieve this important goal within World Health Organization’s (WHO) Universal Health Coverage policy has been very limited in many low- and middle-income countries. Lack of commitment by governments and financial instruments to purchase these essential medicines are not the only barriers. Increased engagement from WHO is needed to start prequalifying affordable inhalers and convince its member states to only purchase and stock medicines from reliable sources. Health care systems and their health care personnel, national professional societies and patient advocacy organisations need to increase their efforts to ensure that patients use their medicines and inhalers correctly and as prescribed. This will also contribute to improved access to medicines.

Our section on the six WHO regions, includes insightful accounts, mainly from some countries which have participated in GAN Phase I. It is particularly sobering to read about large impacts that conflict has on asthma written by colleagues in Syria. Tragically these issues affect all people with asthma caught up in conflict. GAN supports all efforts to strive for peace and avoid conflict wherever it is occurring or may arise.

We hope you will find this report useful. We will continue to work together to increase the worldwide understanding of this disease, and to reduce the burden and suffering from asthma, over the next few years.

Innes Asher
Chair, Global Asthma Network

Nils Billo
Founding member of the Global Asthma Network

Executive Summary

The purpose of this report

The Global Asthma Report (GAR) 2022, prepared by the Global Asthma Network (GAN), is the fourth such report (others 2011, 2014, 2018). GAN builds upon the work of the International Study of Asthma and Allergies in Childhood (ISAAC) and The International Union Against Tuberculosis and Lung Disease (The Union) to monitor asthma and improve asthma care, particularly in low- and middle-income countries (LMICs).

This 2022 report brings together in one document an up to date account on what is known and where the major gaps lie in asthma information and management. It is intended to influence those in authority to act promptly and wisely to reduce the global burden of asthma.

What's new?

At the time of our last report in 2018, the most recent information on asthma prevalence and severity from international surveys was about 15 years old. This gap has now been remedied by the completion of GAN Phase I surveys of over 450,000 children (aged 6-7) or adolescents (aged 13-14), and in addition their parents or guardians in 63 centres from 25 countries during the period 2015-2020.

Although the prevalence of asthma symptoms in each age group was greater in high- and upper-middle-income countries than in low- and lower-middle-income countries, the proportion of affected individuals with more severe symptoms was similar (between one-third and one-half) in each income category and age group.

Comparisons with previous ISAAC surveys using the same methods in the same centres from 14 countries show that the prevalence and severity of asthma symptoms among children and adolescents has changed little, on average, since the early 2000s.

The recent GAN surveys provide new evidence concerning the clinical management of asthma in both higher- and lower-income settings. About one-half of affected children and adolescents and about one-third of affected adults had asthma symptoms that were inadequately controlled by treatment. One in five affected children and adolescents had received no effective medicine for their asthma.

Since the last GAR in 2018, international guidance on asthma management has changed. In 2019, the Global Initiative for Asthma (GINA) recommended that short-acting β_2 -agonists should not be used alone and that all adults and adolescents with asthma should receive inhaled corticosteroid (ICS)-containing therapy, either daily or, in mild asthma, as-needed. Based on evidence, the reliever preferred by GINA across all treatment steps is a combination of ICS and formoterol, a rapid-onset long-acting β_2 -agonist.

Systematic review of the evidence by the Cochrane Collaboration supports the use of these combined inhalers on an as-needed ("reliever") basis in mild asthma, reducing the need for daily ICS as "preventer" medication. However, these combined inhalers are currently much more expensive than the short-acting β_2 -agonist alone; this cost barrier needs to be addressed.

GAR 2018 included national perspectives on the burden and management of asthma from several countries. In this report we have included profiles from 23 places in six World Health Organization (WHO) Regions – Africa: Cameroon, Nigeria, South Africa; Americas: Argentina, Brazil, Costa Rica, Mexico; Eastern Mediterranean: Iran, Pakistan, Saudi Arabia, Sudan, Syria; Europe: Greece, Kosovo, Russia, Spain; South-East Asia: India, Sri Lanka, Thailand; Western Pacific: China, New Zealand, Pacific Islands, Taiwan.

Two of the major global challenges of this decade – COVID and climate change – are addressed in the context of asthma in this report.

Asthma remains a worldwide health problem

Asthma is a common chronic disease that is estimated by the Global Burden of Disease collaboration in 2019 to affect as many as 262 million people worldwide. It is a cause of substantial burden of disease, including both premature death and reduced quality of life, in people of all ages in all parts of the world. Globally, asthma is ranked 24th among the leading causes of years lived with disability and 34th among the leading causes of burden of disease, as measured by disability adjusted life years (DALYs).

Asthma continues to be a major source of global economic burden in terms of both direct and indirect costs. Strategies to improve access and adherence to evidence-based therapies can be effective in reducing the economic burden of asthma in both developed and developing countries.

About 1000 people per day die from asthma. These fatalities are of serious concern because many of them are preventable. Although age-specific asthma mortality rates have fallen in many countries over the last decade, the number of deaths certified as asthma has changed little, due to ageing of the population. Avoidable asthma deaths are still occurring due to inappropriate management of asthma, including over-reliance on reliever medication, rather than preventer medication, and this needs to be rectified.

Effective treatments for asthma are often unavailable or unaffordable

Many governments have overlooked asthma in their plans to address non-communicable diseases (NCDs) and have made little progress in improving access to asthma management and medicines, especially the ICS crucial for the long-term control of asthma.

Evidence from the ongoing COVID-19 pandemic suggests that ICS are unlikely to have adverse effects on the outcome of SARS-CoV2 infection among asthmatics, so their use should continue to be promoted, either alone or in combination with a long-acting β_2 -agonist inhaler.

In many countries, essential asthma medicines are unavailable, unaffordable, or are of unreliable quality, resulting in unnecessary burden and mortality from asthma. Patients are dying of asthma in low-income countries from lack of effective management. Prompt action is needed from leaders (including WHO, governments, health authorities) to address this and achieve more success stories.

Asthma is a global priority requiring global action

Asthma is one of the most significant NCDs. Two of the five interventions adopted by WHO to tackle NCDs – tobacco control, and essential medicines and technologies – will directly reduce the worldwide burden of asthma. A third priority aimed at reducing obesity – improved diets and physical activity – is likely to be beneficial for asthma.

The focus of the United Nations 2030 Sustainable Development Goals on mortality alone does not capture morbidity and the imperative to reduce the worldwide burden of asthma. Economic prosperity will be helped by correctly treating asthma, especially in LMICs. Global and national policies to control greenhouse gas emissions and mitigate the effects of climate change should consider their impact on asthma.

Policies are needed to enable access to affordable, good quality medical care and quality-assured asthma medicines for all people with asthma worldwide. Patient advocacy can ensure integration of patient viewpoints into planning and policy decisions.

Asthma monitoring needs to be ongoing and widespread. Nearly half of the world's countries have never studied the prevalence of asthma. Routinely collected information on hospital admissions due to asthma is almost entirely restricted to high-income countries, limiting the value of admission rates for surveillance of the global burden of this disease.

Asthma persists as a major but remediable global health problem. We call upon world leaders to action the recommendations in this report, which are summarised on the following pages.

Key Recommendations



For the World Health Organization (WHO)

- strengthen its teams and consultant capacity on chronic respiratory disease (CRD) including asthma at its headquarters, and at regional and country level
- emphasise the need for asthma to be managed as a chronic disease, rather than a series of acute episodes or asthma attacks
- develop a global asthma control strategy
- mobilise high-level political commitment to increase investment in a chronic care-based approach to asthma services in low- and middle-income countries (LMICs)
- provide a framework for the establishment of national asthma programmes to improve asthma service delivery including standard case management and asthma management guidelines
- consider asthma in climate change strategies
- support the establishment of a global observatory on asthma
- recommend that during the COVID-19 pandemic, people with asthma should continue their inhaled corticosteroid (ICS)
- increase access to affordable quality-assured essential asthma medicines by:
 - engaging in coordinated international advocacy for access to essential asthma medicines
 - establishing a procurement mechanism similar to the Global Drug Facility
 - encouraging manufacturers of both generic and innovator pharmaceutical products to make greater efforts to provide affordable, quality-assured, essential asthma medicines for all
 - advocating for WHO to be funded to add

quality-assured essential asthma inhaled medicines to the WHO Prequalification Programme

advocating for WHO to receive adequate funding to help countries strengthen their pharmaceutical procurement systems and practices

calling for countries to apply WHO pricing policy recommendations to increase access to quality assured essential asthma medicines

working with partners to re-energise the piloting of national asthma programmes in LMICs with a systems-strengthening strategy based on essential asthma medicines

For Governments

- ensure all people with asthma can access and afford essential asthma medicines and care
- implement WHO's pharmaceutical pricing policies and Essential Medicines List
- stimulate in-country demand for unmet need for essential asthma medicines and care by:
 - establishing national asthma programmes to improve asthma service delivery including standard case management with essential asthma medicines
 - engaging with their professional societies, civil society, asthma patient organisations, health services
- use asthma programme data to track improvements in diagnosis and reductions in emergency visits and hospital admissions, and to quantify the effectiveness of and need for essential asthma medicines
- ensure their country has a national asthma programme with curriculum, education, management guidelines including essential asthma medicines, and that asthma training materials are current and reach all relevant healthcare workers
- strengthen policies to reduce tobacco consumption, encourage healthy eating and reduce exposure to potentially harmful chemicals, smoke and dust
- commit to research that increases the understanding of asthma, its causes, known asthma triggers and identifies the causes of asthma, and improves asthma management



Key Recommendations cont.



- provide standardised and regular data on asthma symptoms, using population representative surveys
- participate in a global observatory on asthma, to track country burden and indicators
- consider people with asthma in climate change strategies

For health authorities

- monitor rates of emergency visits and hospital admissions for asthma
- report rates of asthma deaths in children and adults to monitor progress in asthma care, and as an early warning of epidemics of fatal asthma
- take responsibility for ensuring all people with asthma have equitable access to affordable asthma care and essential asthma medicines
- implement WHO's pharmaceutical pricing policies and Essential Medicines List
- ensure they have an asthma programme with curriculum, education, management guidelines including essential asthma medicines, and that asthma training materials are current and reach all relevant healthcare workers
- develop joined-up approaches for people with asthma and CRDs in LMICs
- recommend that during the COVID-19 pandemic, people with asthma should continue their ICS
- have the capacity to conduct representative population health surveys including on asthma

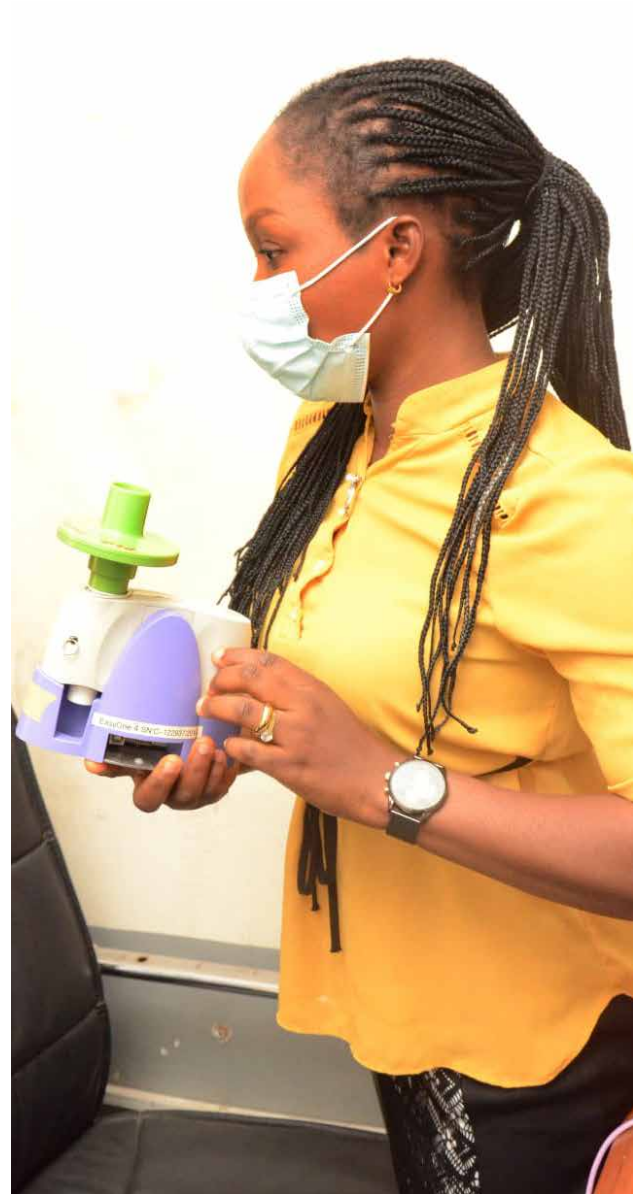
For health professionals, professional societies and patient organisations

- promote programmatic management to improve asthma service delivery

- promote the use in children, adolescents and adults with asthma of ICS-containing medicine, either symptom-driven in mild asthma, or daily as preventative
- develop joined-up approaches for people with asthma and CRDs in LMICs
- recommend that during the COVID-19 pandemic, people with asthma should continue their ICS
- encourage patient advocacy to improve asthma care and outcomes

For the Global Asthma Network (GAN)

- commit to working with all the above stakeholders to:
 - continue to conduct global asthma surveys
 - publish a further GAR before 2030
 - collaborate with individuals and organisations on work aligned with our vision and mission
 - advocate for equitable access to affordable asthma care for all





Asthma should be well controlled.



PART ONE:

THE BURDEN OF ASTHMA

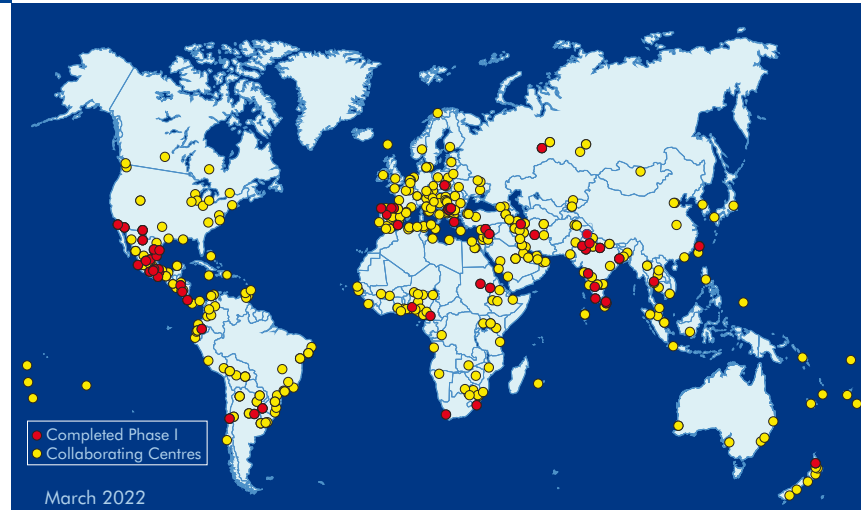
1.

Global Asthma Network

Philippa Ellwood, Innes Asher, Karen Bissell, Chen-Yuan Chiang, Eamon Ellwood, Asma El Sony, Luis García-Marcos, Guy Marks, Refiloe Masekela, Eva Morales, Kevin Mortimer, Neil Pearce, David Strachan

Asthma is an important non-communicable disease (NCD) affecting people of all ages and is a large worldwide health problem, especially in low- and middle-income countries (LMICs). The Global Asthma Network (GAN) is a joint initiative of members of the International Study of Asthma and Allergies in Childhood (ISAAC) and the International Union against Tuberculosis and Lung Disease (The Union), retaining key elements of both organisations. GAN was established in 2012, following ISAAC and The Union's co-production of the first Global Asthma Report (GAR) launched in 2011. GAN is coordinated by a 13-member Steering Group who are authors of this chapter.

Standardised studies of the global burden of asthma are vital, to further our understanding of asthma, and may contribute to reducing asthma prevalence, severity and mortality. GAN has established a unique network of collaborators enabling a range of such studies to advance knowledge about asthma. The aspirations of GAN are listed in the Table (on page 15).



Source: Global Asthma Network 2022.

Figure: Global Asthma Network Centres at March 2022

Activities of GAN

GAN has a large network of investigators from 386 centres in 138 countries, who have been engaged in a wide range of work. GAN also published GARs in 2014 and 2018. GAN investigators have contributed to a number of on line surveys providing new data on various aspects of asthma such as the availability of (i) asthma guidelines; (ii) national asthma strategies; and (iii) the availability of affordable, quality-assured, essential asthma medicines, all of which were summarised in GAR 2014. GAN Phase I (below) has been undertaken from 2015-2020. The main findings have been published and further publications are emerging. More recently GAN developed and undertook a survey in 2020-2021 on COVID-19 in children with asthma. The findings are summarised in Chapter 6.

The figure shows the distribution of GAN centres. The red circles are centres that completed the Phase I fieldwork. The collaborating centres participate in other activities such as online short surveys.

GAN Phase I

GAN Phase I (Chapter 3) has extended the proven surveillance methodology of ISAAC Phases I and III. In addition to 13-14 year old school pupils (adolescents) and 6-7 year old school pupils (children), the survey now includes adults - the parents/guardians of participating pupils. Questions on asthma management and risk factors of asthma identified by ISAAC were also added. GAN Phase I involved: 157,784 adolescents from 63 centres in 25 countries; 101,777 children from 44 centres in 16 countries; and 193,192 adults from 43 centres in 17 countries.

The hypotheses for GAN Phase I were:

1. Globally, the burden of asthma is changing in children, adolescents and adults;
2. There is large variation in the diagnosis of asthma;

3. In many locations, asthma is underdiagnosed and its management is suboptimal; and
4. There are potentially modifiable risk factors for asthma.

The aims of GAN Phase I were:

1. To conduct asthma surveillance around the world in two age groups of school pupils, and their parents/guardians, measuring prevalence, severity, management and risk factors of asthma following the methods of ISAAC Phase III;
2. To examine time trends in prevalence, severity, management and risk factors of asthma from centres which completed ISAAC Phases I and III; and
3. To evaluate the appropriateness of asthma management, especially access to affordable, quality-assured, essential asthma medicines, as defined by The World Health Organization (WHO)

GAN Phase I has provided, by conducting global surveillance for the first time since 2003, new standardised worldwide data on the prevalence and severity of asthma symptoms in children, adolescents and adults. This enables comparisons to be made over time and to provide a new picture of the global burden of asthma. Importantly, examination of time trends and global variation of identified risk factors may provide new information on causation.

Global Asthma Network has provided new standardised worldwide data on asthma including the prevalence and severity of asthma symptoms in children, adolescents and adults.

Additionally, GAN can provide information about unscheduled visits to doctors, Emergency Department visits or hospital admissions which could be used, at least in part, to measure the burden of asthma to health systems.

GAN Collaborations

GAN has established links with worldwide organisations concerned with respiratory health and NCDs. These include: WHO; Global Alliance against Chronic Respiratory Diseases (GARD); Global Allergy and Airways Patient Platform (GAAPP); NCD Alliance; The Healthy Caribbean Coalition (HCC); NCD Child; and Global Initiative for Asthma (GINA). Collaborations with these organisations and other nongovernmental organisations (NGOs) are essential to ensure asthma prevention and control. Efforts need to be consistent and properly coordinated to be effective.

Establish a global observatory on asthma

There is an urgent need for an ongoing global observatory on asthma, which would track global burden of disease and indicators, including access to affordable, quality-assured, essential asthma medicines, guidelines, diagnostics and health care delivery to identify opportunities to intervene. This observatory could adopt the GAN methodology, which is cost-effective, standardised, used throughout the world and can provide valuable, reliable and ongoing data. Funding to establish this observatory would need to be sourced.

Conclusion

The findings of GAN Phase I have provided, for the first time in two decades, new standardised worldwide data on prevalence, severity, risk factors, and management of asthma in school pupils and their parents/guardians. This is an opportunity to identify and implement strategies which lessen the burden of asthma worldwide. Goal 3 of the United Nations 2015 Sustainable Development Goal is to “ensure healthy lives and

promote well-being at all ages”. GAN is contributing towards this goal.

Table: Aspirations of the Global Asthma Network

- Strive for a world where no-one suffers from asthma.
- Be the asthma surveillance hub for the world.
- Raise the profile of asthma as a non-communicable disease.
- Stimulate and encourage research capacity strengthening in low- and middle-income countries.
- Promote access to appropriate management of asthma.
- Research ways of reducing the burden of asthma.

Key Recommendation

Establish a global observatory on asthma to collect and track reliable data on prevalence, morbidity, mortality, hospitalisations, diagnostic criteria and management guidelines and progress on access to affordable, quality-assured, essential asthma medicines.

2.

Asthma and Factors Affecting it

Neil Pearce, Luis García-Marcos, Eva Morales, David Strachan, Guy Marks, Innes Asher

Although physicians first recognised asthma more than 1800 years ago, over the past four decades our understanding of underlying pathophysiology and different clinical presentations has developed rapidly.

Asthma remains one of the most important non-communicable diseases. It is a cause of substantial disability and death worldwide. As such, asthma requires global attention and commitment to lessen its burden.



Although different mechanisms may lead to asthma, the clinical diagnosis of asthma will help most patients because it is a key step on the pathway to appropriate management to reduce symptoms.

History

During much of the 20th century, researchers thought that constriction of airway smooth muscle due to excessive sensitivity of the airway to external stimuli (hyper-responsiveness) was the key feature of asthma. In the 1980s, it was recognised that airway inflammation was a cardinal feature, with structural changes in the airway (remodelling) present early in the development of disease.

Defining asthma

The definition and classification of asthma has also evolved. The Global Initiative for Asthma (GINA) describes asthma as “a heterogeneous disease, usually characterised by chronic airway inflammation. It is defined by the history of respiratory symptoms such as wheeze, shortness of breath, chest tightness and cough that vary over time and in intensity, together with variable expiratory airflow limitation”. This description captures the essential features of asthma for clinical purposes.

For population-based studies, where doctor diagnosis is not practicable, questionnaires are the tool of choice. Questions about more recent symptoms (in the past 12 months) are more reliable than questions about symptoms further in the past, reducing errors of recall. The most commonly used standard question is “Have you [has this child] had wheezing or whistling in the chest in the past 12 months?”; when the answer is ‘yes’, the term ‘current wheeze’ is commonly used, or ‘current asthma symptoms’. However, asthma can also cause shortness of breath, chest tightness and cough.

In 2018, a Lancet Commission suggested a range of new ways of thinking about asthma, its mechanisms and its treatment, challenging conventional concepts of asthma as a single disease and proposing a more targeted approach. Notwithstanding these novel ideas, it remains clear that most people with asthma symptoms improve with asthma medicines. The use of the term asthma as a clinical diagnosis is still useful in most patients because it opens the door to appropriate management to reduce disease burden; however in low- and middle-income

countries (LMICs), where most of the people with asthma live, this basic asthma care may still be non-existent or out of reach.

Asthma medicines

The two key essential asthma medicines are: (i) relievers (most commonly β_2 -agonists) that reverse airway narrowing by relaxing airway smooth muscle; and (ii) corticosteroids, which treat the underlying airway inflammation. Inhaled corticosteroids (ICS) are known as preventers (called "controllers" by GINA). The inhaled route is more effective and has fewer side effects than the oral route. In 2017 the World Health Organization added an ICS/long-acting β_2 -agonist (LABA) combination to its Essential Medicines List. Approaches to management with these medicines, and access to them are discussed in

Chapters 5, 13 and 15.

Course of asthma over the lifespan

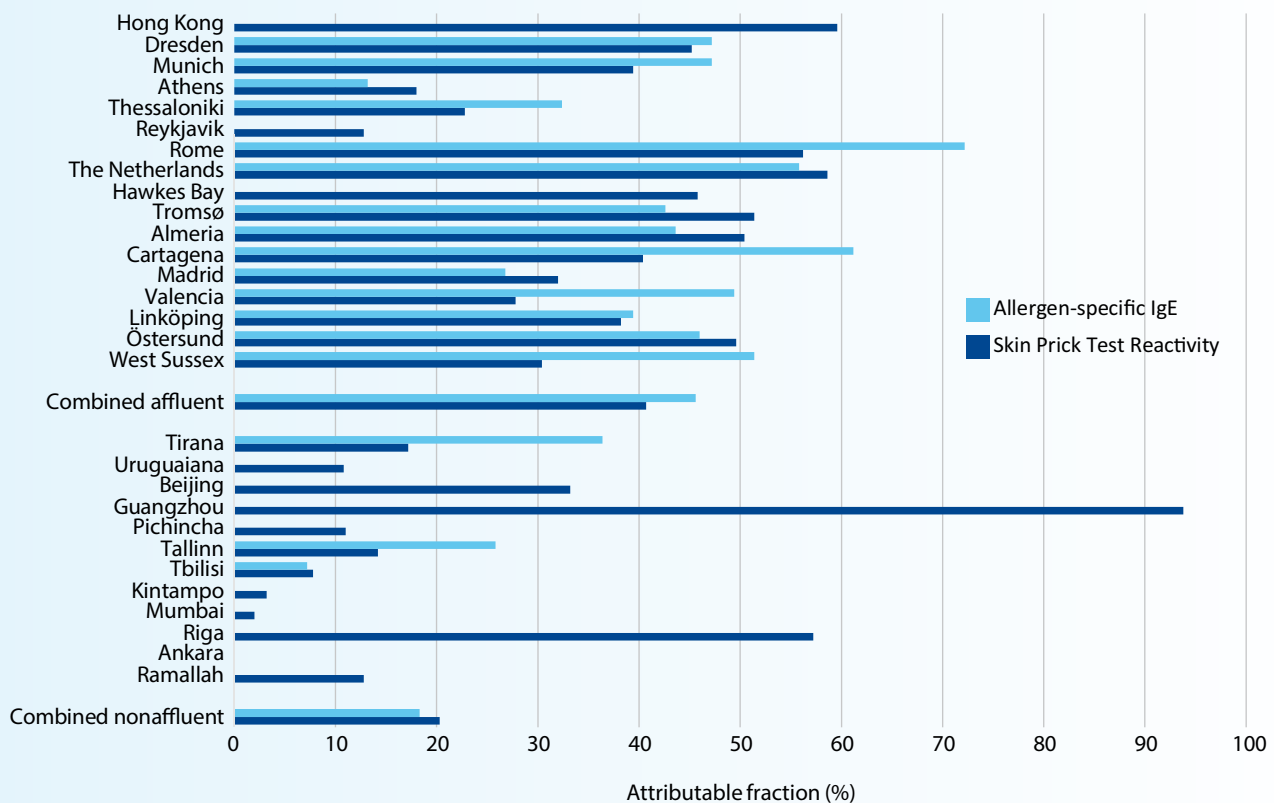
It is not possible to define a single natural history for asthma and it can develop at any stage in life, including adulthood. However, asthma symptoms most commonly develop for the first time in early childhood. Young children of pre-school age often wheeze with viral infection, but only about half of them go on to have characteristic asthma at school age. Children who have frequent or persistent wheeze are more likely to have evidence of airway inflammation and remodelling, impaired lung function, and persistently troublesome symptoms into adulthood. Some reports raise the possibility that

childhood asthma, persisting into adulthood, may predispose people to chronic obstructive pulmonary disease (COPD).

Factors affecting asthma

It has been believed that asthma is an allergic disease in which allergens or certain workplace exposures can trigger attacks of airway narrowing and, through continued exposure, lead to airway inflammation and enhanced airway responsiveness. However when populations are compared around the world, the proportion who are sensitive to common allergens ("atopic" individuals) is not correlated with asthma symptom prevalence and the majority of wheezing even in high-income centres is not atopic. The proportion of wheezing attributable to atopy is greater in high-income centres, but





Source: Weinmayr et al, AJRCCM 2007, Table 3.

Figure: Estimated fraction (%) of current wheeze attributable to allergic sensitisation (measured as skin prick test reactivity >3 mm, or presence of allergen-specific IgE in serum)

the majority of wheezing even there is not atopic (see Figure). Some occupational causes of asthma do not appear to involve allergy. In many people, asthma probably involves non-allergic inflammation of the airways, although we do not understand well the mechanisms involved.

Research has found that both genetic and non-genetic factors affect asthma. Asthma attacks are often triggered by upper respiratory tract infections, including common colds. Other factors that may provoke asthma attacks include inhaled allergens (dust mites, animal fur, cockroaches,

pollens, moulds, allergens in the workplace), inhaled irritants (cigarette smoke, fumes from cooking, heating or vehicle exhausts, cosmetics, aerosol sprays), medicines (including aspirin), exercise, emotional stress, and certain foods or beverages.

However, there is no recognised cause, either biological or environmental, for the underlying asthmatic process. In addition to triggers, asthma may be influenced by genetic susceptibility, environmental tobacco smoke, air pollution, mould and damp, animals, antibiotics

and paracetamol (acetaminophen), some occupational exposures, diet and obesity, and (lack of) breastfeeding. Repeated exposure to triggers and/or influencers can contribute to the severity and persistence of asthma.

Conclusion

The understanding of asthma has developed since the 1980s, with new ways of thinking about asthma recently proposed. It is vital that essential asthma medicines are accessible and affordable for all people who have asthma symptoms. At



In LMICs the proportion of people with non-allergic asthma is greater than in high-income countries. Also, environmental factors may act differently in these settings.

the same time, commitment to and investment in research is essential to increase the understanding of asthma and its causes, potentially leading to improvements in asthma management.

Environmental factors are much more likely than genetic factors to have caused the increases in asthma prevalence in some regions of the world, but we still do not know all the factors and how they interact with each other and with genes. Some of these factors may act in different ways in affluent and non-affluent countries.

Key Recommendation

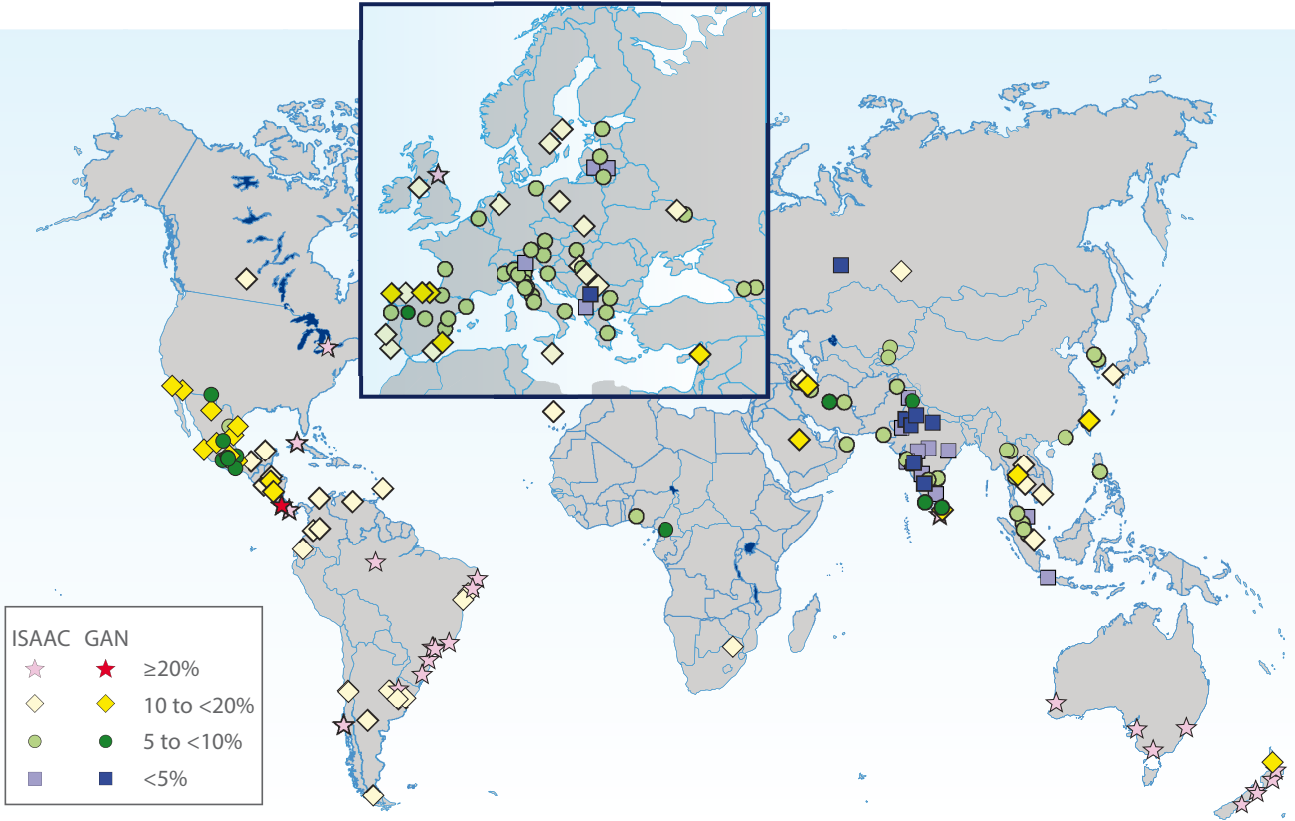
Governments

- *need to ensure all people with asthma can access and afford reliable supplies of essential asthma medicines.*
- *should commit to research that increases the understanding of asthma, its causes, and leads to improvements in management.*
- *should strengthen policies which may lessen asthma, such as those reducing tobacco consumption, encouraging healthy eating and reducing exposure to potentially harmful chemicals, smoke and dust.*
- *should support further research into known asthma triggers and identifying the causes of asthma.*
- *need to strengthen human resources capacity and allocate enough budget to implement asthma control.*

3.

The Global Burden of Asthma

Charlotte Rutter, Richard Silverwood, Virginia Pérez Fernández, Neil Pearce, David Strachan, Kevin Mortimer, Maia Lesosky, Innes Asher, Philippa Ellwood, Chen-Yuan Chiang, Luis García-Marcos



Pop out box shows expanded map of Europe

Sources: García-Marcos L et al. Eur Resp J 2022; Lai et al. Thorax 2009; ISAAC. Eur Respir J 1998.

Figure 1: Prevalence of current asthma symptoms in children aged 6-7

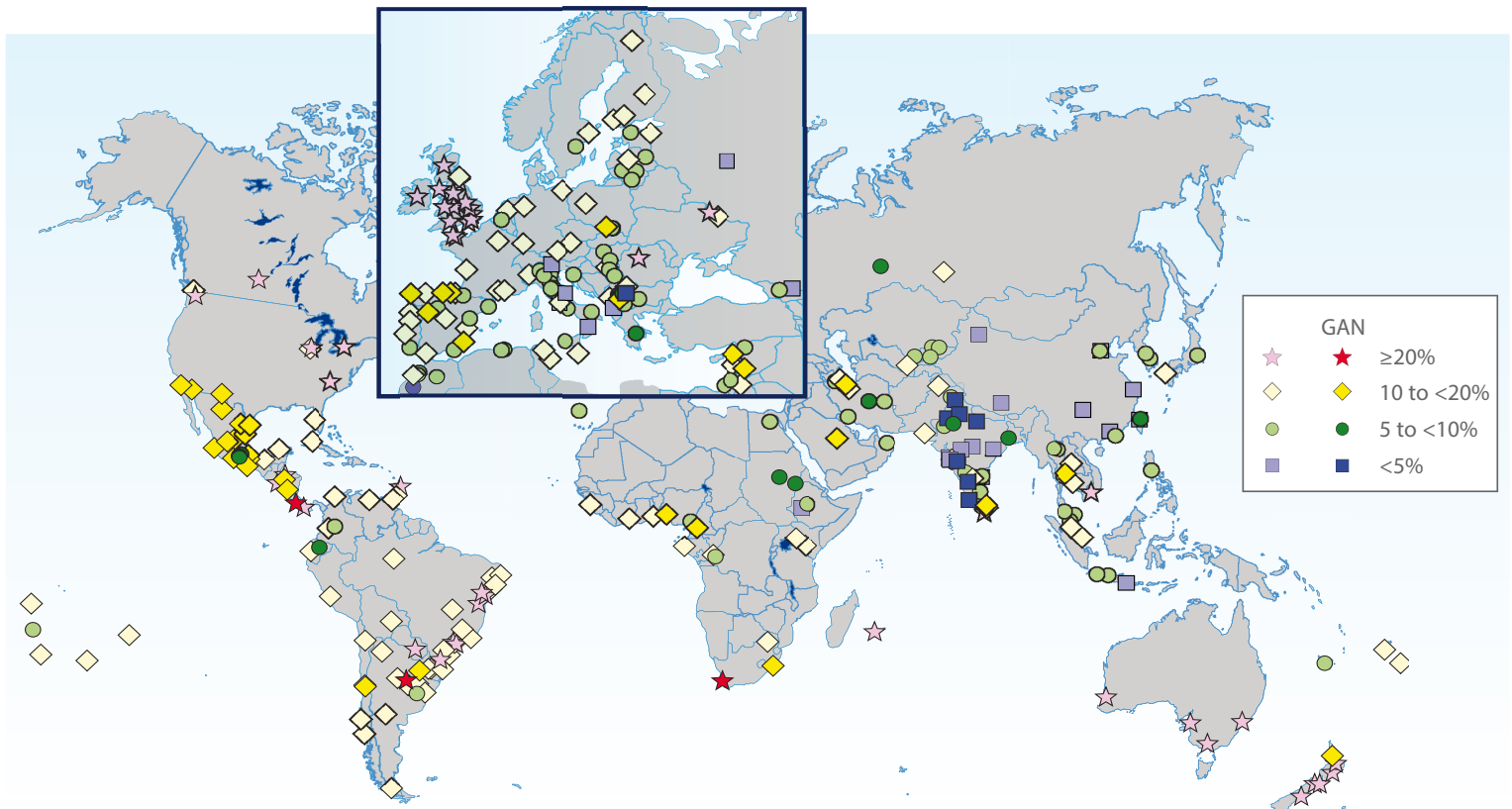
Asthma is a chronic disease affecting people around the world at all life stages. Severe disease may cause a substantial burden on individuals and health services, including premature death or a severely reduced quality of life. Global patterns are similar across children, adolescents and

adults but the burden in terms of prevalence and severity of disease is highest in adolescents.

How many people have asthma?

The prevalence of asthma is hard to estimate globally due to differences in survey methods, and in the diagnosis and reporting of asthma. The

Global Asthma Network (GAN) Phase I assessed prevalence of asthma symptoms between 2015-2020 via questionnaires, using the same standardised study protocol as the International Study of Asthma and Allergies in Children (ISAAC), Phase I 1992-1995 and Phase III 2000-2003. School pupils aged 13-14 years (adolescents), and optionally aged 6-7 years (children) participated from centres selected within a geographical sampling frame. Additionally in GAN, there was an option to include parents/guardians of the adolescents and/or children as an adult group. All



Pop out box shows expanded map of Europe

Sources: García-Marcos L et al. Eur Resp J 2022.; Lai et al. Thorax 2009; ISAAC. Eur Respir J 1998.

Figure 2: **Prevalence of current asthma symptoms in adolescents aged 13-14**

three age groups answered a question on whether they had experienced wheezing or whistling in the chest in the past 12 months; a positive answer was used to calculate the prevalence of current asthma symptoms.

GAN Phase I surveyed 101,777 children in 44 centres within 16 countries, 157,784 adolescents in 63 centres, within 25 countries, and 193,912 adults (54% female; median age 38, interquartile range 33, 43) in 43 centres within 17 countries. For

each age group, Figures 1-3 show prevalence of current asthma symptoms by centre in GAN Phase I, and for children and adolescents (Figures 1 and 2), the most recent ISAAC result where GAN data was not available. Similar to ISAAC Phases I and III, GAN Phase I showed wide variations between centres, both within and between countries. Across all age groups Indian centres had generally low prevalence. Asian and Eastern European centres were slightly higher, followed by Mexican and South American centres. For adolescents

Between a third and one half of children, adolescents and adults with asthma symptoms have severe symptoms that regularly interfere with everyday life.

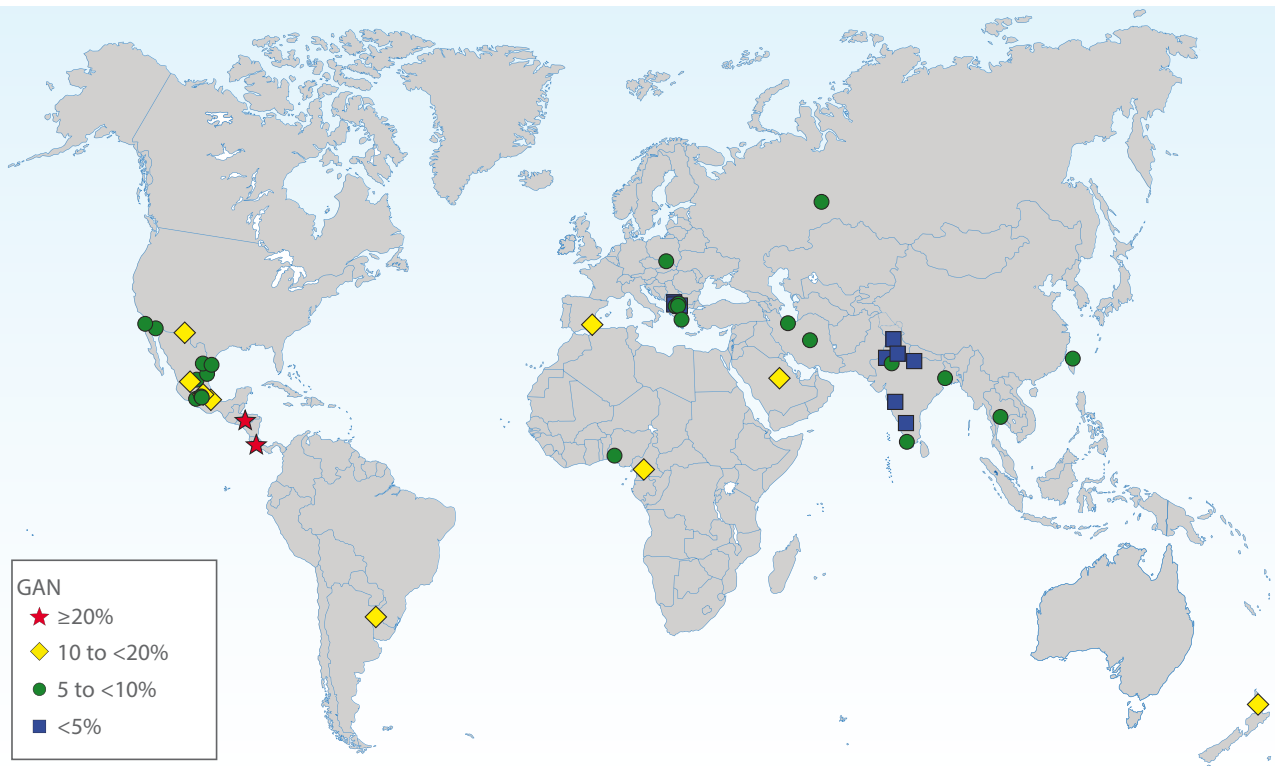


Figure 3: Prevalence of current asthma symptoms in adults

Source: Mortimer K et al. Eur Resp J 2022.

and children, highest rates were generally seen in English speaking countries in ISAAC but not many English speaking countries completed GAN Phase I.

The overall prevalence of current asthma symptoms in GAN Phase I was 9.1% for children, 11.0% for adolescents, and 6.6% for adults. This differed by country income level with lower prevalences across all three age groups in low- to lower-middle-income countries and highest prevalences in high-income countries (Figure 4). Overall, wheeze prevalence in children and adolescents has remained fairly stable from ISAAC Phases I to III and to GAN Phase I, though some individual centres have changed substantially. In general, low-income countries saw a small decrease of prevalence of current asthma

symptoms but lower-middle-income countries saw an increase.

Much less is known about the prevalence of asthma symptoms in adults. This reflects both a paucity of survey data and the greater difficulty of distinguishing asthma from other respiratory conditions, such as chronic obstructive pulmonary disease (COPD), in older age groups. There have been no internationally standardised comparisons of prevalence of asthma symptoms in the elderly.

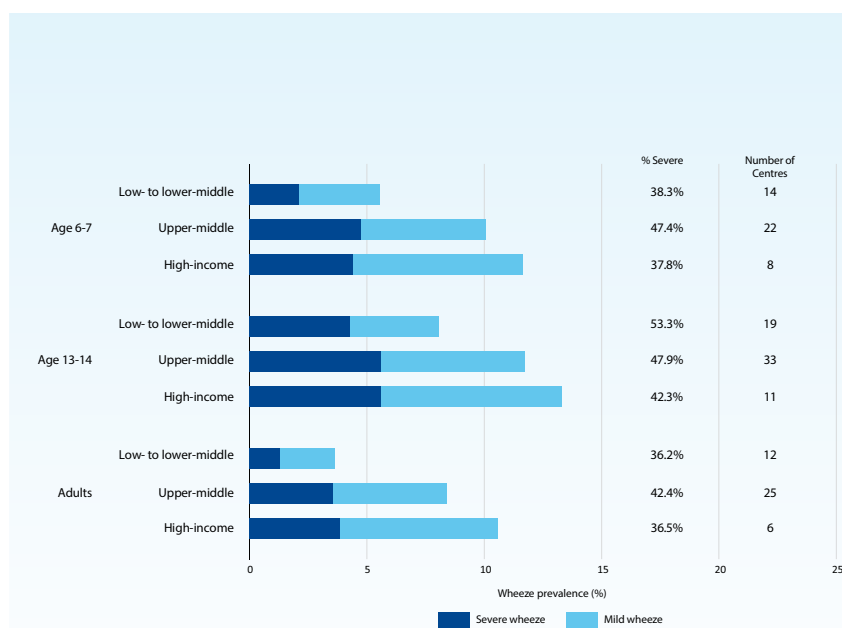
In terms of overall numbers, the Global Burden of Disease Study (GBD) estimated that in 2019, there were 262 million people affected by asthma, equating to an age-standardised rate of 3416 cases per 100,000 population.

What is the impact of asthma on people's lives?

GAN Phase I defined severe asthma symptoms as current asthma symptoms along with 4 or more attacks of wheeze, waking at night with asthma symptoms one or more times per week, and/or any episodes of wheeze severe enough to limit the ability to speak, over the past 12 months. Results showed that between a third and one half of children, adolescents and adults with asthma symptoms, have severe symptoms that regularly interfere with everyday life. Children and adults in upper-middle-income countries had a higher proportion with severe asthma symptoms than

Figure 4:
GAN Phase I: Severity of
asthma symptoms by
age group and country
income level

Sources: García-Marcos L, et al. ERJ 2022;
Mortimer K, et al. ERJ 2022; Epub ahead of print.



those in low- to lower-middle- or high-income countries whereas adolescents had a high proportion of severe asthma symptoms across all income levels (Figure 4). However, there is some evidence that the prevalence of severe asthma symptoms in adolescents has been gradually decreasing over the past 27 years.

Burden of disease is a measure of health loss attributable to specific diseases. GBD has used prevalence, mortality statistics and health survey data, where available, to estimate two components of disease burden: years of life lost due to premature death (YLL); and years of life lived with disability (YLD). YLL and YLD are added together and expressed as disability adjusted life years (DALYs). YLD quantifies both the extent of disability and its duration. The GBD 2010 categorised asthma disability into three categories: controlled asthma; partially controlled asthma (wheezing and cough once a week, causing some difficulty with daily activities); and uncontrolled asthma (wheezing, cough and shortness of breath more than twice

a week, causing difficulty with daily activities and sometimes waking the person at night).

GBD estimated that in 2019, there were 21.6 million DALYs attributed to asthma across all ages globally and asthma was ranked 34th among the leading causes of burden of disease, responsible for a fifth of total DALYs from chronic respiratory diseases. Almost half of the burden attributable to asthma was due to the 10.2 million YLD. Asthma was ranked 24th in the leading causes of YLD globally in 2019, the burden being slightly higher in males than females.

How can we improve this?

The burden of asthma is high, measured by prevalence, severity of asthma symptoms and premature death. Effective management of asthma needs to be implemented everywhere to mitigate the consequences of severe disease. Further standardised monitoring of the burden of asthma in all age groups is needed and finding ways to prevent asthma are vital.

Key Recommendation

Provision of standardised and regular data on asthma symptoms, using population representative surveys, is vital across all countries to accurately measure and track the global burden of asthma.

4. Asthma Deaths

Deaths due to asthma are of serious concern because there is evidence that many of them are preventable. Although most deaths certified as caused by asthma occur in older adults, comparisons of mortality rates have tended to focus upon children and younger adults, among whom alternative diagnoses are less common. Over the past 50 years, mortality rates in younger age-groups have fluctuated markedly in several higher-income countries, due to changes in medical care for asthma. Nowadays, age-adjusted asthma mortality rates are generally higher in lower-income countries, where effective asthma management may be either non-existent or inaccessible.

More than 1000 people per day die from asthma and many of these deaths are avoidable due to inappropriate or inadequate management of asthma.

David Strachan, Charlotte Rutter, Eva Morales, Virginia Pérez Fernández, Kevin Mortimer



Global mortality and international comparisons

Asthma is a rare cause of mortality, contributing less than 1% of all deaths in most countries worldwide. Rates of death from asthma rise almost exponentially from mid-childhood to old age, so the majority of asthma deaths occur after middle age. However, there is considerable potential for diagnostic confusion with other forms of chronic respiratory disease in the older age groups, such as chronic obstructive pulmonary disease (COPD), so comparisons of mortality rates tend to focus upon children and younger adults.

The Global Burden of Disease (GBD) collaboration estimated that in 2019, 461,000 people in the world died from asthma – more than 1000 per day. This headline count has changed little since 2006, because while the average age of the population increased, age-standardised asthma death rates declined over this period.

Figure 1 compares the age-standardised mortality rates for asthma among countries reporting at least 100 asthma deaths in each of two 5-year periods (2001-2005 and 2011-2015). There is 100-fold variation in age-adjusted rates, for instance between Netherlands (low) and South Africa (high). When the comparisons are limited to 5-34 year olds, the large disparities persist although numbers of deaths are fewer and margins of error are larger (Global Asthma Report 2018 Chapter 3).

Trends over time

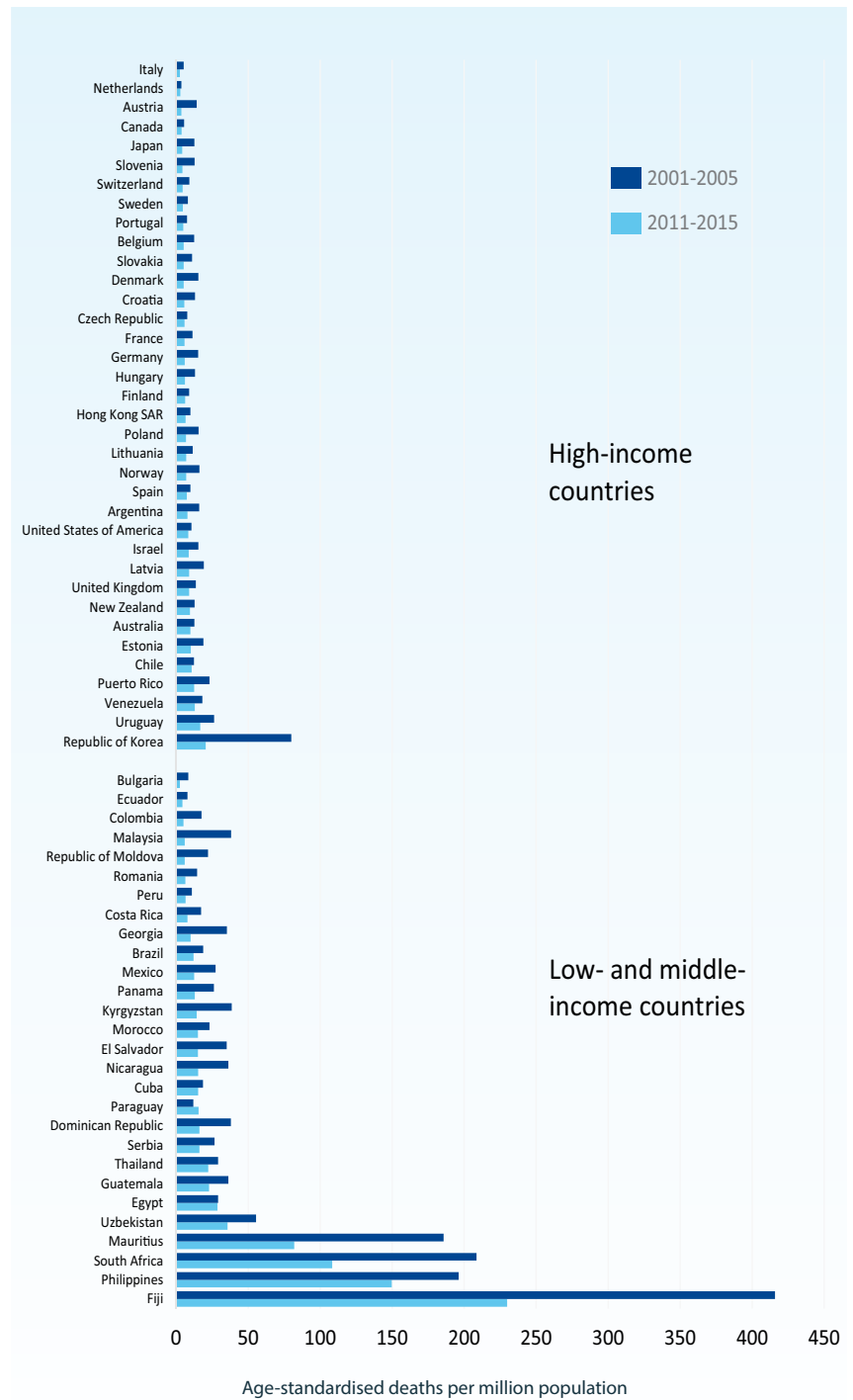
Figure 1 shows that age-standardised death rates from asthma fell substantially (by about one-half) in most countries from 2001-2005 to 2011-2015. This decline also affected the age group 5-34 years. Over the past half-century, there have been two epidemics in asthma mortality for this age-group in multiple higher-income countries.

Figure 1:

**Age-standardised
asthma mortality rates
(all ages) 2001-2005 and
2011-2015 by country,
ranked by 2011-2015
age-standardised
mortality rate within
World Bank 2014 income
group**

Source: WHO Mortality Database, October 2017 update. Population denominators from UN World Population Prospects, June 2017 revision. Income groups based on the World Bank 2014 definitions.

Restricted to countries where asthma is separately coded as a cause of death and rates were based on at least 100 asthma deaths (all ages) in each time period. Rates were calculated from the average number of deaths and average population for each 5-year age-group over the periods 2001-2005 and 2011-2015, using all available data for each country (the number of available years over each period ranged from 1 to 5). Rates were standardised to the age distribution of the World Standard Population.



The first, during the mid-to-late 1960s, represented an approximately 50% increase in asthma death rates among 5-34 year olds, and is generally attributed to the introduction of high-dose isoprenaline inhalers, which can have toxic effects on the heart during acute asthma attacks. When these medicines were withdrawn, the 1960s epidemic of asthma deaths subsided.

The second epidemic, during the mid-1980s, represented an increase of approximately 38% in asthma death rates among 5-34 year olds. In at least some of the affected countries, it was probably due to the widespread use of inhaled fenoterol, another asthma medicine with potential cardiac toxicity. However, this second epidemic was also observed in some countries, such as the United States of America, where fenoterol was never approved or widely used.

Relationship between mortality time trends and trends for other measures of the burden of asthma

Taking a 50-year perspective, the epidemics of asthma mortality bear little relationship to the time trends for asthma prevalence or hospital admission rates for asthma. In several higher-income countries, asthma admission rates among children rose to a peak in the 1990s, after the 1980s peak in asthma mortality.

Both hospital admission rates and asthma mortality rates have been declining since 2000, as shown in Figure 2 which compares changes in age-standardised rates of mortality and hospital admissions for asthma in 24 European countries reporting both measures during 2001-2005 and 2011-2015. Death rates declined more (in relative terms) than did admission rates, but there was very little correlation between these national trends.

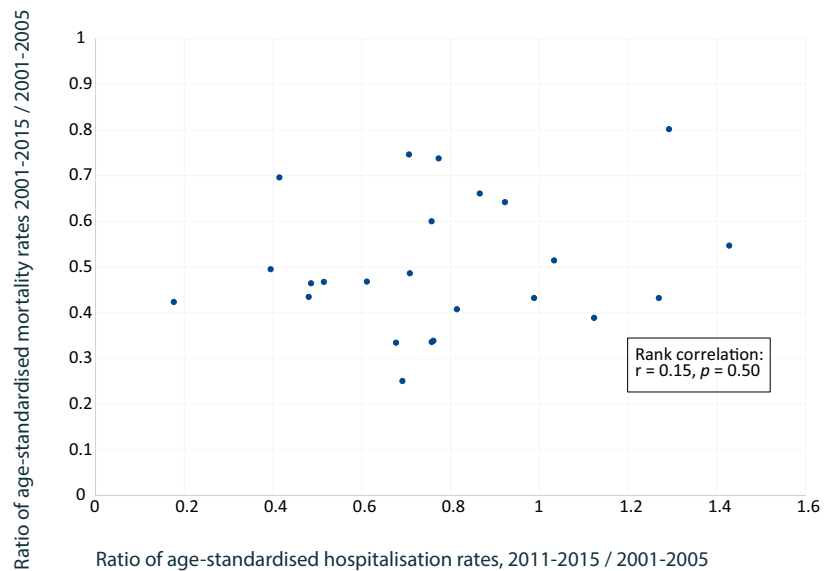
In contrast, changes in hospital admission rates over time do seem to correlate with changes in the population prevalence of severe asthma (as estimated by nocturnal wheeze prevalence), at least among children (Figure 3). Comparisons of population survey results from ISAAC and GAN in the same study centres using the same methodology show a slight decline in prevalence of asthma symptoms, both milder and more severe, among children over recent decades (Figures 4a-4d, on page 28).

Avoidable factors in asthma deaths

Although asthma mortality rates have declined in many countries, avoidable factors still play a part in the majority of asthma deaths.

A comprehensive review of 195 asthma deaths in the United Kingdom during 2012-2013, found that nearly half died without seeking medical assistance or before emergency medical care

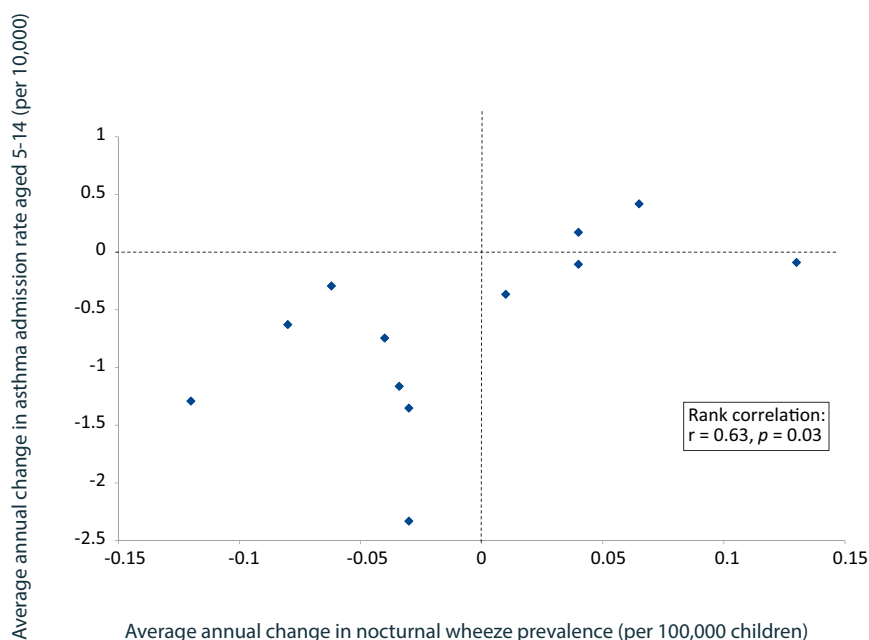
Figure 2: Scatter plot of age-standardised asthma mortality rates and age-standardised hospital admission rates for asthma, in European countries providing recent data for both (2001-2015)



Source: WHO Mortality Database, October 2017 update, Eurostat, November 2017 update.

Figure 3:

Annual change in hospital admission rates for childhood asthma (ages 5-14) by change in prevalence of nocturnal wheezing among 13-14 year olds in countries with one or more ISAAC centres providing prevalence data for both ISAAC Phase One (around 1995) and ISAAC Phase Three (around 2002)



Sources: National admissions data from Anderson HR et al. IJE 2008; (updated by WHO Hospital Morbidity Database). Prevalence data from Pearce NE et al. Thorax 2007.

could be provided. Additionally, the majority were not under specialist medical supervision during the year prior to death. Only one-quarter had been provided with a personal asthma action plan, acknowledged to improve asthma care, and there was evidence of excessive prescribing of short-acting reliever medicine, under-prescribing of preventer medicine, and inappropriate prescribing of long-acting β_2 -agonist (LABA) bronchodilator inhalers as the sole form of treatment.

These observations, from a high-income country with a tradition of evidence-based medicine and a national health service which is free at the point of use, suggests that improved access to appropriate asthma medicines and emergency care is a key goal in reducing asthma mortality worldwide.

Conclusion

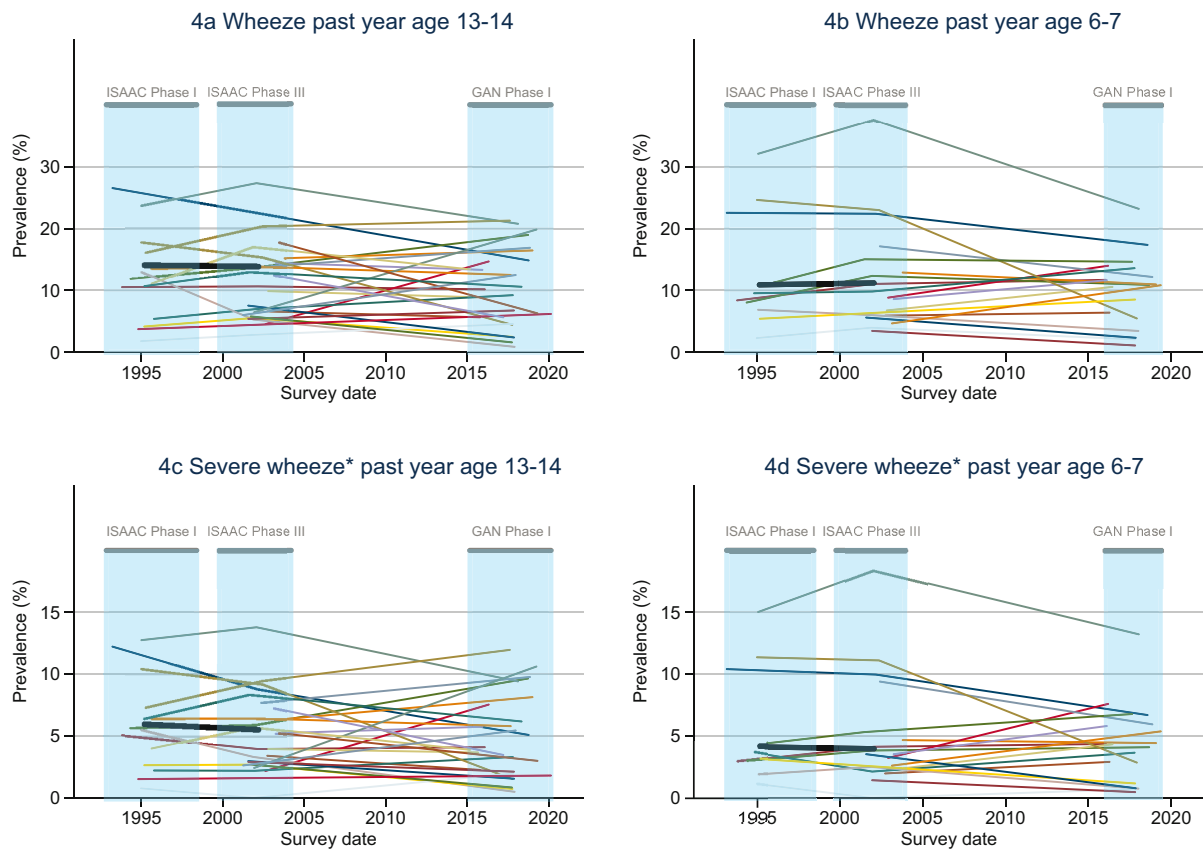
Asthma deaths represent the “tip of the iceberg” of the global burden of asthma. Although the risk of any individual person with asthma dying of their disease is thankfully very low, many of these deaths are avoidable, being due to inappropriate management of asthma, including over-reliance on reliever medicines rather than preventer medicines. Although age-adjusted rates of asthma mortality have generally halved over a recent decade, they remain much higher in lower-income countries, where effective asthma management may be either non-existent or inaccessible.

Key Recommendation

Health authorities in all countries should report rates of asthma deaths in children and adults to monitor progress in asthma care, and as an early warning of epidemics of fatal asthma.

Figure 4:

Absolute changes over time in population prevalence of asthma symptoms in surveys of school children conducted by GAN Phase I and ISAAC Phases I and III



Each coloured thin line represents one study centre. The thick black line shows the average absolute change from ISAAC Phase I to Phase III for those centres which did not participate in GAN Phase I. The span of the years of data collection for ISAAC Phase I, ISAAC Phase III and GAN Phase I are shown.

* Severe wheeze is defined as one or more of the following symptoms in the past 12 months: 4 or more attacks of wheeze, one or more speech-limiting attacks, nocturnal waking one or more times a week due to wheeze.

Source: Asher, et al. Lancet 2021.

5.

Global Asthma Management and Control

Luis García-Marcos, Chen-Yuan Chiang, Richard Silverwood, Innes Asher, Guy Marks, Kevin Mortimer, Philippa Ellwood, Eva Morales, Asma El-Sony

Most symptoms of asthma in people of any age should be able to be controlled; this is the clear aspiration of asthma guidelines, strategies, and health professionals. However, good control is not always achieved due to factors such as failing to follow the latest relevant national or international guidelines (widely accessible), low adherence to treatment regimens (including poor inhaler technique), and in many low resource settings, unavailability or high cost of quality-assured, essential asthma medicines.



Despite treatment guidelines, in people with asthma only about one half have symptoms that are well controlled; one in five children and adolescents and one in eight adults have uncontrolled symptoms, creating avoidable suffering to patients and their families; and an avoidable burden to health systems.

A global perspective on how asthma is managed, and its gaps is crucial for developing and implementing further interventions to improve asthma control in different settings.

Accordingly, the Global Asthma Network (GAN) Phase I study included several questions on asthma control and management including the use of inhaled and oral medicines as well as the availability of a personal written asthma plan. Inhaled medicines were grouped as short-acting β_2 -agonists (SABA), long-acting β_2 -agonists (LABA), inhaled corticosteroids (ICS) and combinations of ICS and LABA (ICS+LABA). Oral medicines were grouped as: leukotriene receptor antagonists (LTRA); oral SABA (oSABA); theophylline; and oral corticosteroids (OCS). Questions, designed to address the degree of asthma control, were also included i.e. in the past 12 months urgently visiting the doctor, attending the Emergency Department (ED), and/or being admitted to the hospital for asthma symptoms.

This chapter focuses on individuals participating in GAN Phase I whose asthma was confirmed by a doctor, in three age groups: children (6–7 year olds); adolescents (13–14 year olds); and their parents/guardians (adults). Asthma was categorised into three groups depending on the symptoms suffered in the past 12 months. Individuals with severe asthma symptoms were defined as those with current wheeze who, in the past 12 months, had ≥ 4 attacks of wheeze, or ≥ 1 night per week sleep disturbance from wheeze, or wheeze affecting speech. Those with symptoms, but not as severe as the

above definition, were considered as having mild asthma. Those without symptoms were the asymptomatic group.

Lack of control of asthma was defined as the need (in the past 12 months) of urgently visiting their doctor ≥ 4 times; or attending to the ED ≥ 4 times; or being admitted to the hospital ≥ 1 times for asthma symptoms. Those urgently visiting their doctor < 4 times; or attending the ED also < 4 times; but not admitted to hospital, were considered as partially controlled. Those who had no urgent visits or attendance were considered well controlled.

Asthma was confirmed by a doctor in 6.3% of children in 44 centres in 16 countries; 7.9% of adolescents in 63 centres in 25 countries; and 3.5% of adults in 43 centres in 17 countries. Overall, 44.1% of the children, 55.4% of the adolescents and 61.1% of the adults with asthma had their asthma well controlled. There was an important proportion whose asthma was uncontrolled (25.3%, 22.3% and 16.0%, respectively for children, adolescents, and adults (Figure 1).

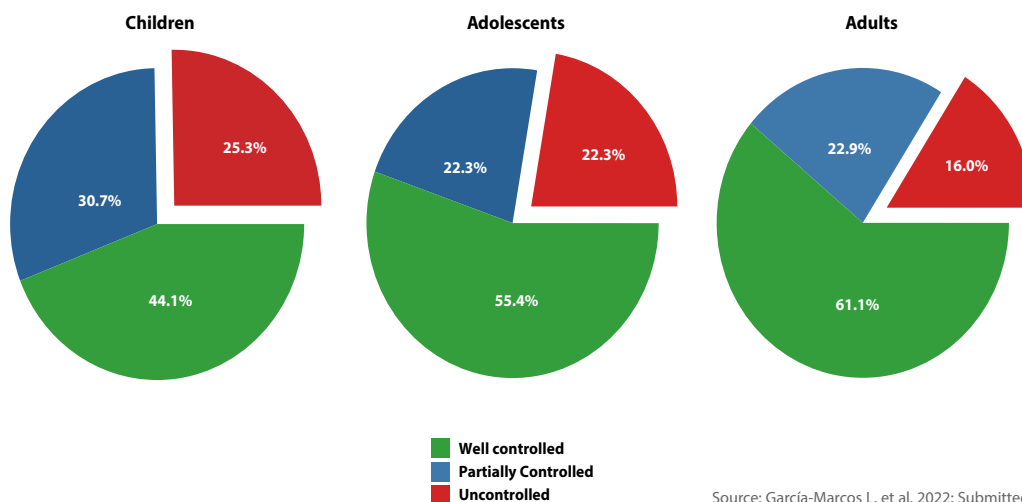
Figure 2 shows the frequency with which inhaled and oral medications were taken by asthmatic children, adolescents and adults depending on the type of asthma symptoms they experienced (asymptomatic, mild, or severe). The percentage of individuals with severe asthma symptoms who used any asthma medicine was usually higher than those with mild asthma. Information on inhaled medication was provided by all centres in the three age groups, while oral medication data was available for only some centres. Two approaches not recommended by international guidelines were reported: (i) oSABA and theophylline, used in all age groups but in a much lower proportion; and (ii) LABA alone, especially among adolescents and adults, in which the proportion was comparable to that of ICS or ICS+LABA.

The proportion of patients with uncontrolled, partially controlled, and well controlled asthma who used ICS or ICS+LABA was 51.6%, 46.0%, and 25.9% for children; 39.5%, 29.2%, and 14.5% for adolescents; and 45.3%, 37.8, and 17.1% for adults, respectively.

Having a written asthma plan was most frequent in children (62.8%); the respective figures for asymptomatic, mild, and severe asthma being 56.4%, 62.9% and 71.4%. About half of the adolescents (53.4%) had a written asthma plan, higher when asthma was more severe (48.6%, 53.0% and 63.6%, respectively). Adults had the lowest proportion of individuals with asthma with written asthma plans (47.5%) and followed the same trend (38.5%, 44.8%, and 62.9%, respectively). The pattern of asthma plans being more frequent in people with severe asthma suggests that when doctors think that asthma is more severe, they use plans in their management strategy for better controlling the disease.

In people with asthma, only about one half have symptoms that are well controlled. This proportion could be increased if the medicines recommended in current guidelines were used, rather than outmoded medicines such as LABA alone, oSABA, or theophylline. This would be possible if affordable, quality-assured, essential asthma medicines included in the guidelines were available to all people with asthma worldwide.

Figure 1: Asthma control among children, adolescents, and adults worldwide

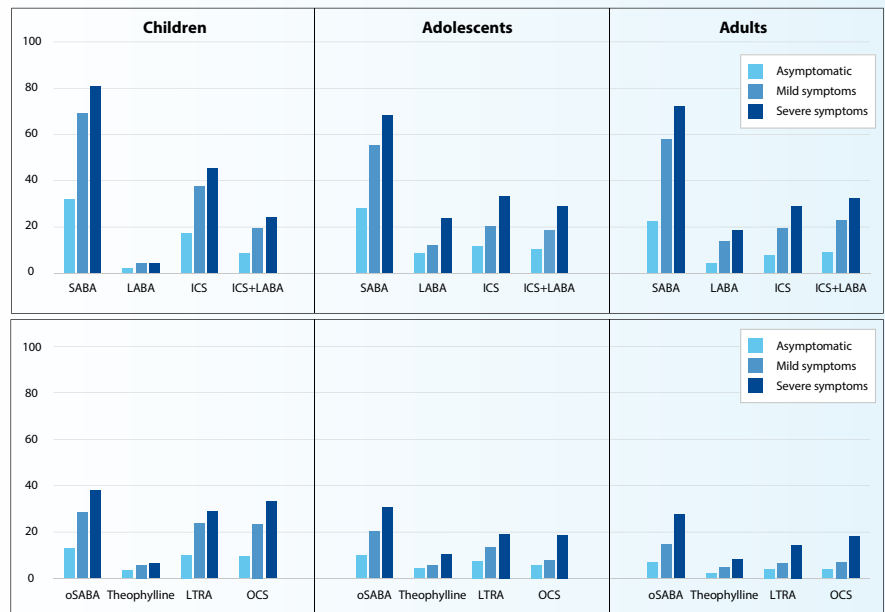




Key Recommendation

Health authorities have the responsibility that all children, adolescents, and adults with asthma have equitable access to affordable care that gives them the best possible opportunity to achieve control of their asthma.

Figure 2:
Use of asthma medications according to asthma severity in the past year, in children, adolescents, and adults



Upper panel: inhaled medications.
Lower panel: oral medications.
SABA: short-acting β_2 -agonists; LABA: long-acting β_2 -agonists; ICS: inhaled corticosteroids; oSABA: oral SABA; LTRA: leukotriene receptor antagonists; OCS: oral corticosteroids.

Source: García-Marcos L, et al. 2022; Submitted.

6.

COVID-19 and Asthma

Chen-Yuan Chiang, Luis García-Marcos, Philippa Ellwood, Eamon Ellwood, Refiloe Masekela, Neil Pearce

In December 2019, a cluster of pneumonia cases caused by an unknown pathogen was noticed in Wuhan, China. Deep sequencing analysis of samples from the lower respiratory tract revealed a novel coronavirus which was named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Coronavirus disease 2019 (COVID-19) caused by SARS-CoV-2 mainly affects adults. Children and adolescents are less likely to have severe COVID-19. The effects on asthma in children are not clear.



The use of inhaled corticosteroids (ICS) is not associated with greater severity of COVID-19, exacerbations of asthma, a change of asthma medicines or hospitalisation in children infected with SARS-CoV-2.

A summary of 44,672 confirmed COVID-19 cases reported in February 2020 by the Chinese Center for Disease Control and Prevention, revealed that 90% of these cases were 30 years or older and only 1% were 9 years or younger. The case-fatality rate was 2.3% overall: 8% in patients aged 70-79 years; and 14.8% in patients aged ≥ 80 years; but no deaths in those aged 9 years or younger.

During the pandemic of COVID-19, children with asthma experienced fewer upper respiratory tract infections, emergency visits, asthma attacks, and hospitalisations due to asthma, probably due to public health interventions leading to reduced exposure to asthma triggers. Clinical manifestations of COVID-19 among children with asthma have rarely been reported. It has been unclear whether SARS-CoV-2 is associated with exacerbations of asthma.

Global Asthma Network (GAN) survey on COVID-19 among children with asthma

To improve the global understanding of COVID-19 and childhood asthma, the GAN Steering Group conducted a survey among its worldwide network, on clinical manifestations and outcomes of infection with SARS-CoV-2 among children with asthma. A standardised questionnaire was developed and sent to 133 centres from 59 countries in November 2020. Data collection closed on 28th April 2021. The sampling frame included asthmatic children who had been tested in contact examination, in a clinical practice or in a hospital of each participating centre. All asthmatic children who tested positive for SARS-CoV-2 were included, regardless of symptoms.

Fourteen GAN centres from 10 countries (Argentina, Belarus, Brazil, Greece, Guatemala,

Iran, Kyrgyzstan, the Kingdom of Saudi Arabia, Spain, and Sudan) provided data on 169 asthmatic children infected with SARS-CoV-2 confirmed by reverse transcription polymerase chain reaction tests.

Findings of the GAN survey

Of the 169 participant children, 111 (65.7%) were symptomatic and 76 (45.0%) had a body temperature >37.5 °C. Common symptoms included cough, headache, rhinorrhoea, fatigue, and smell reduction. Thirty-eight (22.5%) patients had exacerbations of asthma associated with SARS-CoV-2 infection; 53 (31.4%) had a change of asthma medicines. COVID-19 was asymptomatic in 58 (34.3%), mild in 93 (55.0%), moderate in 14 (8.3%) and severe/critical in 4 (2.4%). Twenty-one (12.4%) patients had been hospitalised for a median of seven days.

Adolescents aged 14 years or older were significantly more likely to be symptomatic than children aged under 10 years. Patients from high-income countries were significantly less

likely to be symptomatic than patients from other countries. Use of ICS and other asthma medications were not significantly associated with being symptomatic. Patients from high-income countries were significantly less likely to have moderate or more severe COVID-19 than patients from other countries. Use of ICS and other asthma medications were not significantly associated with moderate or more severe COVID-19.

Those who had moderate or more severe COVID-19 were significantly more likely to have had an exacerbation of asthma as compared to those who were asymptomatic or had mild COVID-19. Use of ICS and other asthma medicines were not associated with asthma exacerbations.

Those who used inhaled bronchodilators were significantly more likely to have a change of asthma medications compared to those who did not. Those who had moderate or more severe COVID-19 were significantly more likely to be hospitalised as compared to those who were asymptomatic or mild COVID-19. Use of ICS and other asthma medications were not significantly associated with hospitalisation.

Other COVID-19 studies among children with asthma

Various studies have reported that the proportions of COVID-19 cases who were asymptomatic among children were 13% - 28%; moderate disease ranged from 19% to 64.9%; and 2% to 3% had severe/critical illness. The GAN COVID-19 survey revealed that children with asthma did not have high morbidity from COVID-19, although a small proportion had severe/critical disease.

A substantial proportion of asthmatic children had exacerbations of asthma and a considerable proportion had a change of asthma medicines associated with infection with SARS-CoV-2. However, the severity of COVID-19 was significantly associated with exacerbations of asthma and a change of asthma medicines. Whether symptoms leading to a change of asthma medicines were caused by COVID-19 or due to exacerbations of asthma was less clear.

Figure 1:
Medication changes (%) in asthmatic children infected with SARS-CoV-2

Source: Chiang C-Y et al. *Pediatr Allergy Immunol* 2022.

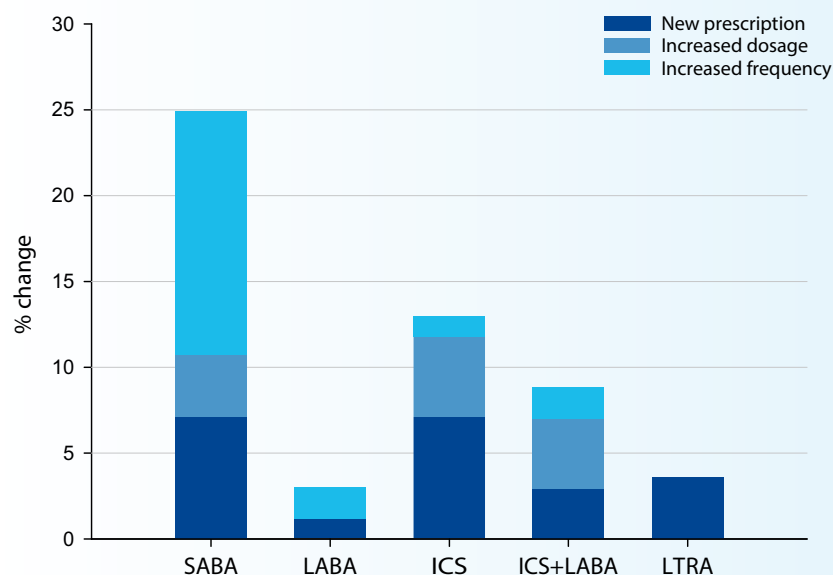
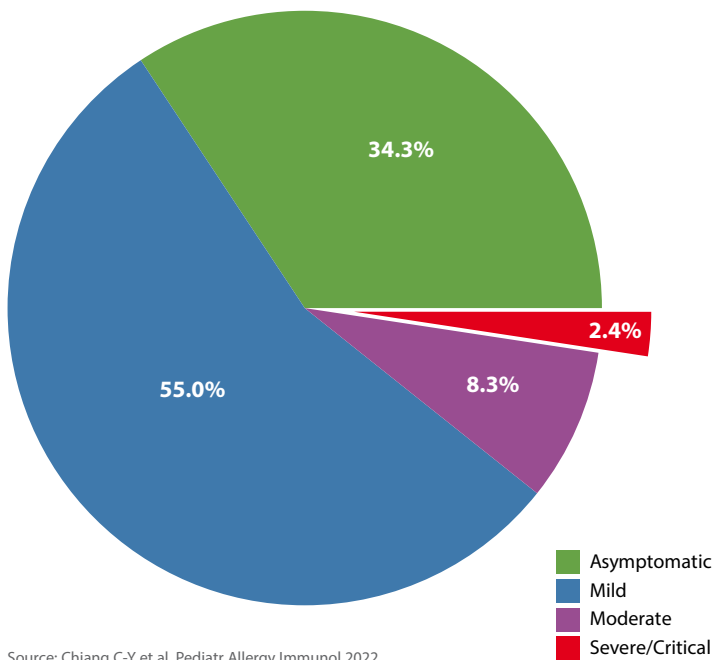




Figure 2:
Symptom severity (%) in asthmatic children infected with SARS-CoV-2



Source: Chiang C-Y et al. *Pediatr Allergy Immunol* 2022.

Conclusion

The GAN survey revealed that the use of an inhaled bronchodilator was associated with a change of asthma medications, likely indicating that their asthma was not appropriately controlled. However, the use of ICS was not associated with severity of COVID-19, exacerbations of asthma, a change of asthma medicines and hospitalisation in children infected with SARS-CoV-2. This finding clearly supports the recommendation of continuing the use of ICS among patients with asthma.

Key Recommendation

Children with asthma who are using ICS for asthma control should continue the use of ICS in the era of COVID-19.

Table:

Change of asthma medicines, severity, treatment and outcomes of COVID-19 in asthmatic children infected with SARS-CoV-2

	Number	Percentage		Number	Percentage
<i>Total</i>	169	100	Severity of COVID-19		
Treatment change	53	31.4	<i>Asymptomatic</i>	58	34.3
Short acting β_2-agonists (SABA)	41	24.3	<i>Mild</i>	93	55
<i>New prescription</i>	12	7.1	<i>Moderate</i>	14	8.3
<i>Increased dosage</i>	6	3.6	<i>Severe/Critical</i>	4	2.4
<i>Increased frequency</i>	24*	14.2	Treatment		
Long acting β_2-agonists (LABA)	5	3	<i>Hydroxychloroquine</i>	3	1.8
<i>New prescription</i>	2	1.2	<i>Immune globulin</i>	0	0
<i>Increased dosage</i>	0	0	<i>Interferon alfa</i>	3	1.8
<i>Increased frequency</i>	3	1.8	<i>Lopinavir–ritonavir</i>	0	0
Inhaled corticosteroid (ICS)	22	13	<i>Macrolides</i>	26	15.4
<i>New prescription</i>	12†	7.1	<i>Oseltamivir</i>	2	1.2
<i>Increased dosage</i>	8	4.7	<i>Oxygen inhalation</i>	21	12.4
<i>Increased frequency</i>	2	1.2	<i>Remdesivir</i>	1	0.6
Combination ICS and LABA	15	8.9	<i>Steroids, oral</i>	13	7.7
<i>New prescription</i>	5	2.9	<i>Steroids, systemic</i>	11	6.5
<i>Increased dosage</i>	7	4.1	<i>CPAP/BiPAP**</i>	2	1.2
<i>Increased frequency</i>	3	1.8	<i>Intubation ventilation</i>	1	0.6
Leukotriene receptor antagonist (LTRA)	6	3.6	Outcome of COVID-19		
<i>New prescription</i>	6	3.6	<i>Recovered, no sequelae</i>	158	93.5
<i>Increased dosage</i>	0	0	<i>Recovered, with sequelae</i>	10	5.9
<i>Increased frequency</i>	0	0	<i>Died</i>	1	0.6

* one patient had both increased dosage and increased frequency

† one patient was prescribed budesonide nebulization

** CPAP, continuous positive airways pressure; BiPAP, bilevel positive airways pressure.

Source: Chiang C-Y et al. *Pediatr Allergy Immunol* 2022.

Everyone should
have access to
good asthma
management.





PART TWO:

Asthma in WHO Regions

7. Asthma in the African Region

Refiloe Masekela

Introduction

Asthma remains the most common non-communicable disease (NCD) in children and adolescents in Africa. With NCDs set to overtake infectious diseases in Africa by 2030, there is a great need to address asthma in this youthful continent. Despite this, asthma remains largely undiagnosed and is associated with significant morbidity and mortality. Poverty, environmental exposures and stigma worsen outcomes for people with asthma.



Nigeria

Adegoke Falade



Out of pocket expenses still a barrier to asthma therapy

In Nigeria, the cost of asthma medicines is not subsidised. For people with asthma this results in catastrophic costs to purchase asthma medicines.

High prevalence and poor diagnosis

Asthma in Nigeria is an important NCD. One multi-centre study found a high prevalence of wheeze in over 20,000 children and adults. With a predicted population of over 13 million people with asthma in Nigeria, adults over 45 years carry the highest burden of the prevalence of wheeze in the past 12 months at 15%. Underdiagnosis of asthma remains a challenge with only 4% of people with asthma having been diagnosed by a physician.

Asthma management

There have been new developments in asthma treatment guidelines with the introduction of the use of low dose inhaled corticosteroid (ICS) to be taken whenever short acting β_2 -agonist is used at Step 1 (mild asthma).

Challenges

As the SARS-CoV-2 pandemic has affected all countries, patients' clinic attendance has been significantly impacted as, unlike in high-income countries, tele-consultations have not been feasible in most instances. Lack of affordable medicines, availability and disparities in healthcare remain a challenge. One study found that only 23% of publicly funded pharmacies, compared to 75% of private pharmacies, had recommended ICS containing inhalers on site (see chapter 15).

Patient Story

A 9-year-old boy was diagnosed with bronchial asthma in December 2020, after suffering from recurrent wheeze for 1 year. Treatment prescribed included salbutamol inhaler and ICS twice daily. He was lost to follow up but presented again after 8 months because of recurrence of symptoms during the rainy season. Further history indicated that he improved with the salbutamol inhaler, but did not purchase the ICS. The caregiver was counselled again, and ICS prescribed.

Cameroon

Achiri E Ndikum, Bertrand H Mbatchou Ngahane

Pollution and disease stigma still significant barriers to achieving asthma control



Guidelines but no programme

Asthma is a rampant respiratory disease that needs urgent attention, awareness and advocacy in Cameroon. The prevalence of self-reported asthma is 3.6% (n=2,648) respondents, with 1.8%, 5.3% and 3.0% in children, adolescents and adults, respectively.

There is a serious gap in asthma management with underdiagnoses, treatment and follow-up being inadequate, especially in adolescents. In addition to poor access to affordable, quality-assured, essential asthma medicines largely due

to the cost, lack of access to adequate information that patients need to protect their health, stigma and psychological trauma remain prevalent.

Cameroon has experienced a significant increase in ambient fine particle exposure over the past decades from waste burning and firewood burning, and this could be contributing to increasing asthma mortality and morbidity. According to the 2020 State of the Global Air Report, Cameroon is ranked 8th among the top 10 countries with the highest population weighted annual average PM2.5 concentration of 64.5µg/m³.

Patient testimonial adolescent asthma advocate

"All my life I have suffered from many health diseases and asthma was the most pathetic of all. The little commerce my parents did, and all they had saved, went on my treatment. My doctor helped me a lot, he advised my parents to stop cooking on firewood and charcoal because the smoke was harmful to my health."

South Africa

Refiloe Masekela, Heather J Zar

Despite availability of asthma medications lack of asthma diagnosis is a barrier to care

High asthma prevalence

South Africa remains one of the countries with the highest prevalence of childhood asthma in the African continent. Recent data from the Global Asthma Network (GAN) Phase I, has found a high prevalence of asthma and a striking increase in severe symptoms in adolescents in Cape Town (Table 1).

Risk factors for severe disease

Of concern is that in this study 8.8% of 13-14 year olds had self-reported smoking. Despite changes in access to basic services in South Africa, social support and attempts at re-engineering the health care system to a primary care-based model, a large proportion of children were largely undiagnosed (66%). They include those with severe symptoms, indicating substantial underdiagnosis and lack of appropriate care. Risk factors for severe disease remain linked to sociodemographic factors, including, smoking, pet exposure, pollution exposure and informal housing as well as poor access to care or to effective therapy.



Table: Prevalence of current symptoms of asthma (12-month prevalence rate of wheeze) by centre in South Africa 13 - 14 year age group as measured by the International Study of Asthma and Allergies in Childhood (ISAAC) Phases One, Three and the Global Asthma Network (GAN) Phase I

	13-14 Years
	N (% with asthma)
<i>Cape Town (ISAAC One)</i>	5178 (16%)
<i>Cape Town (ISAAC Three)</i>	5037 (20.3%)
<i>Polokwane (ISAAC Three)</i>	4660 (18%)
<i>Cape Town (GAN Phase One)</i>	3979 (21.7%)

Teachers Story

"I've got a friend with asthma and I don't walk with her anymore because it's very alarming when she starts breathing heavily. You can hear the wheeze when you're next to her. And then there are other issues too because she fears the medication, she puts on weight. So, it's very depressing sometimes for her also."

Sources: Asher MI, et al. Lancet 2021; Zar et al. Pedatric Allergy Immunol 2007.

Spirometry in Africa

Lindsay Zurba, Nqobile Ndimande, Refiloe Masekela

Improving access to spirometry and spirometry champions in Africa

Background

From 2017 to 2021 the Pan African Thoracic Society (PATS) has been building spirometry capacity through the training, mentorship and technical support of 482 healthcare professionals across 13 countries in Africa (Table).

Activities

A range of spirometry certificate training programmes were undertaken, including Foundational, Paediatric, Data Review and Quality Assurance, Refresher and Train-the-trainer courses. An ongoing equipment repository has also assisted researchers to conduct clinical work and undertake research. We have built capability for spirometry testing in asthma clinics in low- and middle-income country workplaces where specialised testing and equipment is limited. There is also inequity in terms of access to care. In 2020 we pivoted to the development of e-learning and online training due to the COVID-19 pandemic. Dissemination of spirometry training impacts both disease assessment and facilitates patient education with an objective measure of their asthma. Through spirometry screening in the community, early referral for treatment can improve health outcomes.

Future directions

Further development of an e-Learning platform and online training together with translation of learning materials into French, Portuguese, Spanish and Amharic are next priorities.



Table: PATS spirometry training course summary across Africa region in the past 5 years

	Courses held	Number of students	Number of countries
2017	3	60	3
2018	9	180	7
2019	12	188	10
2020	1	23	1
2021	4	31	4
Total	29	482	13*

*Countries: South Africa, Ethiopia, Uganda, Nigeria, Cameroon, Tanzania, Ghana, Kenya, Malawi, Zimbabwe, Mozambique, Gambia, Sudan.

Testimonials from spirometry students

"It has given us a new direction in practice. Now we can monitor and evaluate our treatment for asthmatic and chronic obstructive pulmonary disease (COPD) patients which we could not do before."

8.

Asthma in the Region of the Americas

Blanca E Del-Río-Navarro

Introduction

In Latin America, great efforts and many campaigns have been carried out to detect and manage asthma and other allergic diseases. Several studies have been undertaken throughout the region by the International Study of Asthma and Allergies in Childhood (ISAAC) and the Global Asthma Network (GAN). However, socio-economic and political factors are still barriers for medical care reaching the entire population. It is, therefore, necessary to reinforce and achieve access to affordable, quality-assured, essential asthma medicines, as well as to educate first-contact health personnel and parents, to improve the quality of life of schoolchildren and adolescents into adulthood.



Mexico

Blanca E Del-Río-Navarro, Nayely Reyes Noriega, Arturo Berber

Asthma remains a public health problem

Mexico is a middle-income country, with 127.8 million inhabitants, a third of which live in urban areas. Asthma in Mexican school children has been surveyed twice: the International Study of Asthma and Allergies in Childhood (ISAAC) Phase III in 2001-2003; and Global Asthma Network (GAN) Phase I in 2016-2019.

ISAAC Phase III was carried out in 10 centres in Mexico. The prevalence of "wheezing in the past 12 months" varied between 3.6-12.7% in 6-7 year olds (children) and 3.9-14.4% in 13-14 year olds (adolescents). GAN included 15 centres in Mexico with 35,780 children and 41,399 adolescents participating. The prevalence of "wheezing in the past 12 months" was 10.2% in children and 11.6% in adolescents. The prevalence of "asthma diagnosed by a doctor" was much lower, 5.4% and 6.6% in children and adolescents, respectively. Less than 5% of the participants in both age groups had a written asthma treatment plan.

According to these results, the prevalence of asthma symptoms has increased in the past 15 years. However, the prevalence of diagnosis and treatment was less than 10% in both groups. Also, a negative association was observed between asthma symptoms and altitude >1500 meters above sea level.

Access to medicines

Mexico has national asthma management guidelines for paediatric patients such as the clinical practice guidelines-CENETEC and the asthma management guide (Manejo Integral del Asma, MIA). Both of these documents mention important medicines for asthma rescue and control, such as: salbutamol, budesonide, montelukast, beclomethasone, tiotropium; drugs for combination therapy such as

salmeterol-fluticasone, budesonide-formoterol; and biological therapy such as omalizumab, accessible at public and private levels.

The Instituto Nacional para la Salud y el Bienestar (INSABI) was founded in 2020 to provide and guarantee the free provision of health services, medicines, and other associated supplies to people without social security. However, until this is fully implemented, free medicines are available only to those patients belonging to the Instituto Mexicano del Seguro Social (IMSS), Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado (ISSSTE), the Secretaría de la Defensa Nacional, and the Secretaría de la Marina. This represents a challenge for the management of asthmatic patients without insurance since these medicines will most of the time represent a significant expense for parents, limiting access to treatment and, therefore, symptom control. It is expected that in the course of 2022, all patients with asthma will have free access to medicines regardless of their insurance or the medicines they require.

National Challenges for Asthma Management

Asthma is a public health problem in our country, so continuous training of first contact for physicians and paediatricians is required for the proper diagnosis and management of patients with asthma. In January 2021 an expert session was held with the Senate of the Mexican Republic to publicise the increase in asthma in the paediatric population, the need to increase the number of asthma medicines available and stimulate the training of medical personnel.



Patient Story

Santiago, 7 years old, presented with 9 asthma attacks in the past 12 months and required hospital management on 6 of these occasions. The treating physician prescribed inhaled combination therapy; unfortunately, his parents could not consistently purchase the drug due to financial difficulties.

Training of health personnel an important strategy

The city of San Francisco (Córdoba Province), is in the centre of Argentina. It has 60,000 inhabitants and is an industrial city with a low level of atmospheric pollution, surrounded by a rural environment with a predominance of agricultural activity (planting cereals).

Increase in the prevalence of asthma

A study using the ISAAC questionnaire was undertaken in urban children in San Francisco city and the surrounding rural area in 2006. The prevalence of asthma symptoms in adolescents was 12.9%. As part of the GAN Phase I study, undertaken in the same sampling frame in 2019, the prevalence of asthma symptoms in adolescents significantly increased to 21.4%.

Reported asthma ever increased from 4.3% in 2006 to 15.7% in GAN in 2019. Additionally, in GAN, only 8.3% had a written asthma plan. This could be due to constraints in training strategies for the diagnosis and treatment of asthmatic patients.

Campaigns to improve diagnosis and treatment

A Ministry of Health campaign started in 2018 to reduce mortality from asthma in patients aged 5-39 years through the training of health personnel and to promote the use of spirometers in first contact centres. On the other hand, the dissemination of Global Initiative for Asthma (GINA) strategy, the availability of inhaled budesonide and salbutamol at no cost to the population when medically indicated, may have contributed to the increase in the prevalence of asthma diagnosis.

Patient Story

A 13-year-old male patient with moderate asthma reported the use of short-acting β_2 -agonist (SABA) on demand. Budesonide-formoterol was indicated for better control of his symptoms. The high price of this combination inhaler made it impossible for their parents to afford it, and the State only supplied inhaled budesonide and SABA.



Brazil

Marilyn Urrutia-Pereira, Dirceu Solé

Improvements in basic public health have lessened severe asthma

Uruguaiiana is a Brazilian municipality in the state of Rio Grande do Sul next to the river border with Argentina and Uruguay.



Patient Story

A 7-year-old female patient comes to the emergency room for her third asthma attack of the year, requiring oxygen, intravenous steroid, and nebulisations. The mother herself reports that her daughter has been using rescue salbutamol for a year, suggesting poor control. Therefore, she requests follow-up by the allergy subspecialty.

Asthma prevalence in the past 15 years

GAN Phase I was undertaken in Uruguaiiana and found the prevalence of wheezing in 13-14 year old adolescents was lower (15.8%) than that reported in ISAAC Phase II, conducted at the same centre in 2004 - 12 years ago in 8-13 year olds (25.6%). Prevalence of severe asthma was lower in GAN compared to ISAAC (6.2% vs. 7.6%). In GAN the prevalence of asthma diagnosed by a doctor was 7% and 4.1% of participants had a written asthma plan.

National strategies to address this problem

Between the ISAAC Phase II and GAN Phase I studies, there were improvements in basic

sanitation, from 16% to 81.2%, corroborated by the Human Development Index (HDI), which increased from 0.523 to the current 0.744. At the same time, there was a decrease in hospitalisations for severe asthma and in asthma mortality.

In 2012, the Children's Asthma Prevention Program (PIPA) was created, enacted by municipal decree (2016), which aims to improve the medical care of children and adolescents in the municipality. Patients are referred to the programme by primary care physicians and paediatricians, and receive specific treatment to control asthma for free.

Costa Rica

Manuel E Soto-Quirós, Manuel E Soto-Martínez

Asthma management has improved

Costa Rica is a small country located in Central America. It has a single National Children's Hospital, which is a third-level referral centre for all chronic diseases requiring evaluation by a sub-specialist in paediatric pneumology, such as moderate to severe asthma. In addition, Costa Rica has universal access to health care with the availability of asthma essential medicines.



Patient Story

Paula, aged 8, presented to the Emergency Department three times during the past year with an asthma attack. She has frequent daytime asthma symptoms especially with exercise, using daily inhaled steroid and salbutamol as reliever, and also long-standing allergic and reactive nasal symptoms. The paediatric pulmonologist consulted recommended treatment with inhaled steroid (beclomethasone), long-acting β_2 -agonist (formoterol) and nasal steroid, enabling follow-up at her local hospital who has an "Air/asthma clinic".

Asthma prevalence in the past 15 years

The prevalence of asthma in Costa Rica is among the highest in the world; and this has been confirmed in recent data from GAN Phase I. When comparing the current prevalence of asthma symptoms reported in ISAAC Phase III (2001-2) with the results obtained in GAN (2017-18), the prevalence decreased significantly from 37.6% to 23.3% in children and from 27.3% to 20.8% in adolescents.

Asthma management has improved

In 2003, a National Asthma Programme, which consisted of educational meetings at all major public health care centres was implemented in Costa Rica. This programme emphasised in asthma diagnosis, the use of ICS (Beclomethasone) as first-line therapy

for asthma control with early use of reliever medications (e.g. salbutamol) during asthma attacks, appropriate referral to asthma specialists for asthma care and the avoidance of common allergens (e.g. dust mite and cockroaches) and other risk factors (e.g. tobacco). Recent studies have shown a marked decrease in hospitalisations and mortality due to asthma in Costa Rica.

Challenges

As in many other LMICs, Costa Rica faces many obstacles in asthma control. Implementation of asthma treatment guidelines and other economic and social barriers must be confronted. Although asthma awareness and control has improved over the years, in the latest GAN report, written asthma management plans were available in just 35% of patients. Efforts in achieving disease control and preventing asthma attacks should be a priority to every health system.

Asthma in the Eastern Mediterranean Region

Asma El Sony, Yousser Mohammad

Introduction

The burden of asthma in the Eastern Mediterranean Region (EMRO) is substantial; rapidly changing lifestyles, war and conflict zones that encompass numerous countries are contributing to the increasing prevalence of asthma. The World Health Organization (WHO) estimates the prevalence of asthma in EMRO at 8% in adults. The International Study of Asthma and Allergies in Childhood (ISAAC) Phase III estimated asthma prevalence to be 10.6% in male and 7.9% in female adolescents (13-14 year olds); 10.3% in male and 8.5% in female children (6-7 year olds). Asthma remains underdiagnosed and undertreated. Essential asthma medicines such as inhaled corticosteroids (ICS) and long-acting β_2 -agonists (LABA) are not available or affordable for all. Health systems are weak and not multi-sectorial, national guidelines and patient education are rarely present, with the exception of the Gulf States. The Global Asthma Network (GAN) followed 13 to 18 years after ISAAC to measure trends in prevalence, risk factors and management. Five country profiles are presented, with a conclusion and recommendations.

Programmatic Management of Asthma

- *political commitment*
- *financing*
- *uninterrupted supply of medicines*
- *human resource development*
- *up to date curriculum*
- *up to date guidelines*
- *training*
- *diagnosis using simple tools*
- *standardised treatment using essential medicines*
- *analysis of treatment outcome*
- *monitoring*
- *supervision*
- *evaluation*

Kingdom of Saudi Arabia

Shaker A Alomary, Wael A Althagafi, Izzeldin F Adam, Omneya E Elsherif, Ahmed J Almadani, Aljoharah A Alabdullah

Safe, Quality Health System, based on Patient Centric Care guided by standards, enabled by eHealth

Saudi Vision 2030 sets out the directions, objectives, and commitments that the Kingdom of Saudi Arabia (KSA) seeks to increase citizens' well-being and quality of life. This can only be achieved through promoting physical, psychological and social well-being. KSA has made notable progress in improving the health of its population over recent decades, particularly in primary and secondary prevention of non-communicable diseases.

The National Global Asthma Network study

The National Asthma Control Program (NACP) conducted the first national study across 20 regions in the country as part of GAN Phase I to estimate the prevalence of asthma and allergies and their related risk factors.

The prevalence of asthma in KSA in the last national study as part of GAN Phase I was estimated to be 10.4%, 13.3%, and 14.2% in children 6-7, 13-14 years and adults.

Guidelines and training

The NACP in collaboration with experts in asthma and allergy have standardised asthma management through publishing national guidelines for health professionals regularly and updating them based on the Saudi Initiative for Asthma Guidelines (SINA) and Global Initiative for Asthma guidelines (GINA).

Moreover, to ensure standardised and best health services, NACP conducts continuous training activities for health workers including on-site and online training programmes based on updated national guidelines.

Health Services

Patient education is done at different levels like Public Health Centres (PHCs), hospitals and schools concerning symptoms and signs, common misconceptions, inhaler technique, treatment adherence, and preventive measures.

Alongside regular patient monitoring in clinics, KSA invests in digital health applications like an online asthma control test for public and telemedicine services.

With governmental support asthmatic patients have easy access to all health care levels and medications are freely available for dispensation at PHCs, hospitals and commercial pharmacies through an electronic system (Wasafaty service).



Patient Story

A 20 year old female known case of bronchial asthma started to have a cough and shortness of breath.

She decided to try the online video consultation service by Sehaty App. The doctor noticed she couldn't complete a sentence and asked her to seek urgent medical care. Thanks to digital health, the patient received healthcare and her life was saved.

Pakistan

Osman Yusuf

Pakistan is the world's fifth most populated country with 221 million inhabitants. Approximately 4.3% of these are suspected to suffer from asthma. While asthma profiles in Pakistan are identical to other countries in the region, seasonal asthma is very important in some selected parts of the country. Most seasonal asthma is triggered by various indoor and outdoor airborne allergens, however several factors like occupational asthma in poorly controlled work environments, environmental pollution, and lifestyle changes, also contribute significantly to the increasing asthma prevalence.



Public Health Plan

Seasonal pollen induced asthma caused by pollens from male paper mulberry trees are thought to be responsible for severe morbidity and, occasional mortality, in the spring season in the capital city Islamabad, and some other cities.

As far as treatment facilities are concerned, there are about 100,000 registered physicians in Pakistan. Most of them are trained in the management of asthma both through their educational curricula, as well as continued medical education (CME) activities and conference attendance.

The Global Initiative for Asthma (GINA) strategy is widely followed in Pakistan. Although, most of the GINA-recommended medicines for asthma, including inhaled corticosteroids, β_2 -agonists, muscarinic antagonists, leukotriene modifiers, and biologics, are available here, asthma still remains underdiagnosed and undertreated.

The Pakistan Chest Society produces updated

guidelines for asthma periodically, and focuses not only on physician's training, but also on patient education.

The Allergy and Asthma Institute Pakistan (AAIP), is involved in research and training for academics and clinical practice in this field. The AAIP is currently engaged in research on asthma, respiratory allergies and other chronic respiratory diseases (CRDs) in Pakistan, in collaboration with the National Institute of Health Research Global Health Research Unit on Respiratory Health (RESPIRE), based at the Usher Institute, University of Edinburgh, UK. In this regard, a physician and public education campaign was launched on social media, for educating the relevant stakeholders and public about these illnesses. Educational videos on various aspects of asthma management and pollen allergy can be viewed on their YouTube channel.

Many tertiary care institutions throughout the country have dedicated asthma clinics, and conduct trainings, seminar and educational activities in addition to providing state-of-the-art clinical services.

Syria

Gazal Dib, Ghroob Alkhayer, Louei D Nahas, Kusama Azhari, Mais Yassine, Jamal Allouch, Mostafa Ibrahim, Rafea Shaaban

While the prevalence of current wheeze in ISAAC III in Syria was 6.5%, for the 13-14 year age group (adolescents), in GAN Phase I, 17 years later it was surprisingly 19.8%. For the 6-7 year age group (children), it went from 4.7% to 10.8% over a period of 16 years. The Syrian war started in 2011 and brought new chemical pollutants, higher exposure to passive smoking, and stress. These factors were associated with higher prevalence and severity of wheezing, confirmed by answers to questions that we added to the GAN survey (see table p55).

In the GAN survey it was of concern to find that doctor diagnosed asthma in the adolescents of 8.9% was much lower than current wheeze (19.8%), which alludes to underdiagnosis of asthma in the adolescents.

In 2018, a survey was conducted to track underdiagnosed and uncontrolled asthma in shelters during the Syrian conflict. This was a collaborative survey between the Global Alliance

against Respiratory Disease (GARD) GARD-Syria and the Asthma Ontario Surveillance Information System. The results showed that asthma was doctor diagnosed in 8%, and was uncontrolled in all subjects. Only 4% used inhaled corticosteroids. While 40% of non-diagnosed asthmatics replied yes to the question "Do you wake up by attacks of cough, wheezing and breathlessness", this suggests underlying undiagnosed asthma that could have been concealed by poorer environmental and psychological conditions (36% suffered Post Traumatic Stress Disorder).

A national committee for asthma in collaboration between the Ministry of Health (MOH) and Tishreen University, the GARD-WHO collaborating centre for chronic respiratory diseases (CRD) and co-morbidities, edited a National technical guide for CRDs, which was based on GINA and WHO-package of essential non-communicable disease interventions for primary health care (PEN) algorithms in 2016. It was updated in 2021, adding chapters for

COVID-19 and air pollution interaction with CRD. The guide is uploaded on MOH website, Medical Syndicate website, Syrian Private University and the Tishreen University website. This guide was adopted by Syrian MOH for training and programs. The WHO country office is helping.

Medications

Short-acting β_2 -agonists, inhaled corticosteroids, and combined ICS-LABA, are offered for free in hospitals, and in primary care centres thanks to International help. They are also available in private pharmacies.

Curriculum of nursing

There is a lack of the essential information on how to educate for asthma. This is the same in the pharmacies. We are working to update the curriculum.

War homeless children, happy to receive research team for asthma in the shelter near Damascus-Syria 2019



- 40% of them replied yes to the question do you have attacks of wheezing, cough and breathless at night.
- While only 8% were diagnosed as having asthma. This highlights the underdiagnosis, and the role of exposure to war pollutants .
- According to our survey results, Health authorities gave ICS and SABA for all, thanks to international help

Sudan

Hana El Sadig, Sara A Hassanain, Sundos Hamza, Najlaa Mohamed Abass, Rana Ahmed

Asthma remains a neglected health problem in Sudan. In ISAAC Phase III, undertaken in 2003, the prevalence of wheeze in the past 12 months among adolescents was estimated to be 12.5%, and by GAN Phase I, fourteen years later in 2017 at 5.7%. Nonetheless the prevalence of having asthma ever were reported at 15.5% and 18.2% by the Sudanese respondents of ISAAC Phase III and GAN Phase I respectively. A health system survey reflected a readiness range of health facilities ranging from 36.4 to 86.4%.

Additionally, in Sudan between 2009 and 2021, a Standard Case Management asthma pilot project resulted in significant reductions in hospital and related emergency-room admissions. Hospitalisation was reduced, 73.5% had no hospitalisation in the previous 12 months at enrolment and this increased to 98.2% at 1-year follow-up. Patients improved and shifted from Severe and Moderate to Mild and Intermittent with reasonable rates of loss to follow-up demonstrating that asthma can be managed effectively in rural, resource-limited settings (Figure 1).

A more recent study in Gezira - Sudan showed that 59% out of the overall identified presumed CRD patients were referred to a health facility and a diagnosis was made. Asthma constituted 44% of overall cases (Figures 2 & 3). Expansion of standardised CRD management and investment in health system strengthening including human resource capacity building and sustainability of diagnostics and treatment supply to tackle CRDs including asthma is imperative for universal health coverage.

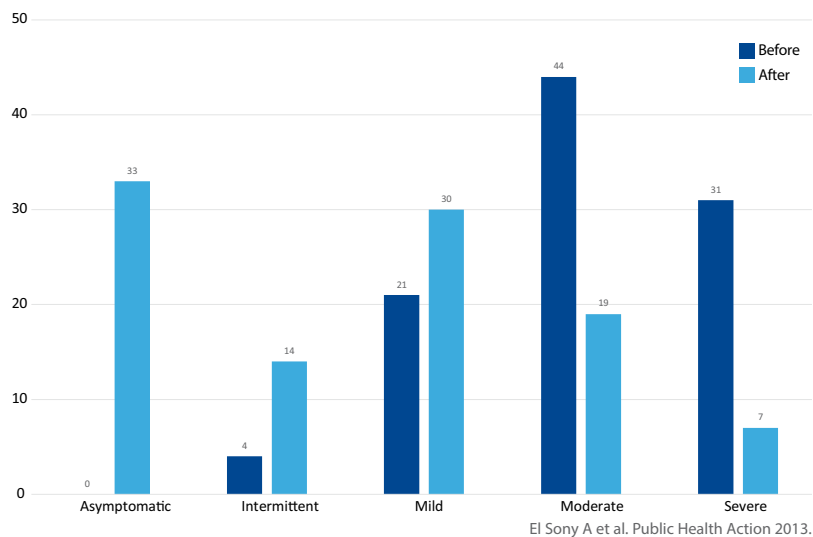


Figure 1:
Standard Case Management
asthma pilot project symptoms
before and after follow up

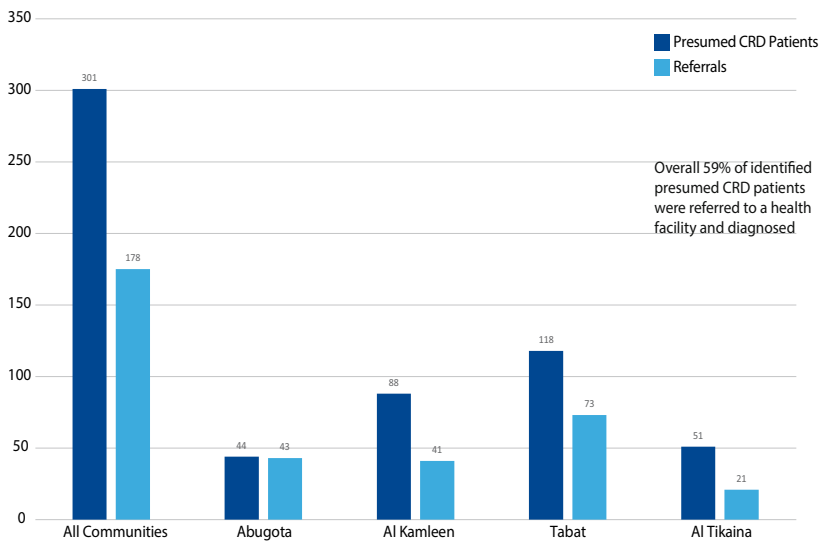


Figure 2:
Number of presumed CRD patients vs number of referrals to a health care facility by area Gezira State - Sudan December 2020 - June 2021

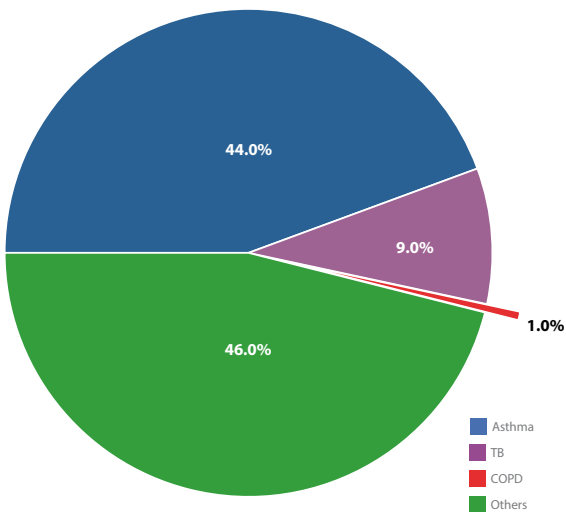


Figure 3:
Categorisation of referred cases Gezira State - Sudan Dec 2020 - June 2021

Figs 2 & 3 Source: El Sony A et al. The International Multidisciplinary Programme to Address Lung Health and TB in Africa "IMPALA" unpublished.

Improving management and asthma education programs in Iran

Public Health Plan

Like many other countries in the world, Iran is facing an increasingly growing number of asthmatic patients. The prevalence of asthma in Iran, using core questions from ISAAC, between November 2015 and February 2016 was estimated to be 12.4% in 13-14 year old adolescents (N=16,850). However, some are still underdiagnosed or undertreated since there is a social stigma attached to asthma in Iran. Not only do many patients deny that they suffer from asthma, but also some physicians dissuade them from using their inhalers. This problem finds its roots in the people's steroid phobia as well as being worried about cardiac side effects of bronchodilators and addiction to inhaled steroids.

In regard to asthma triggers, Iranian people, particularly in large cities face air pollution as a serious challenge. Smoking is also a problem, particularly for asthmatic children and women as passive smokers. The health care system in the MOH gathers data every two years about tobacco and there are some clinics throughout the country which offer services for tobacco cessation to smokers; however, it does not seem to be effective enough. Although not affordable for many, almost all essential asthma medicines and leukotriene receptor antagonists are available, either produced in or imported to Iran.

The educational curriculum is based on the most updated GINA and expert panel reports. Iranian Society of Asthma and Allergy (ISAA) follows regular educational programmes not only for physicians but also for asthmatic patients and their family members too, which is held at least annually under the pretext of celebrating world asthma day. Continuous educational programmes are held by ISAA and more than 130 allergists are now working in the medical universities throughout the country. The focus of these meetings is on asthma diagnosis and management to keep physicians updated. Although mobile-based education

is not widespread, patients and caregivers, in the context of educational programmes, are instructed on self-management and the right technique of how to use inhalers and spacers. This instruction can also be undertaken at the physicians' offices. Thanks to having close cooperation with the MOH and the National Asthma Council, ISAA has the privilege of using the facilities of these organisations to increase people's knowledge and improve their attitude and performance in controlling the burden of asthma.

The Persian version of GINA strategy and a regularly updated national guideline of asthma are available on <http://ginasthma.ir>. There is a national asthma committee, whose members are some officials. These include the manager of non-communicable diseases centre in the MOH; some allergists and pulmonologists as the representative of Iranian society of asthma and allergy; Iranian society of pulmonology or medical universities; and some invited partners. These organisations, none of which are international, are working under the supervision of the MOH and supervise any measures which have been taken concerning asthma throughout the country.

In summary, asthma is a growing issue in Iran. However, thanks to the availability of relatively affordable medicines and regular educational programs, it is reasonably under control.



Patient Story

A 10-year-old boy with a history of recurrent colds usually going to his chest, presented with prolonged cough, dyspnea and wheeze since he was 6 months old. He had atopic dermatitis during infancy, rhinorrhea, itchy nose and gastro-esophageal reflux, all of which were pharmacologically treated. He had been frequently admitted to the hospital before starting asthma treatment. However, his parents discontinued his inhalers owing to steroid phobia, which is the most common reason of not-well-controlled asthma in our community.

Table:

Prevalences of asthma symptoms in adolescents in the Eastern Mediterranean Region: ISAAC Phase III (1996-2002); GAN Phase I (2016-2020)

EMRO country	Current Wheeze in the past 12 months (%)			Ever had asthma prevalence (%)			Severe wheeze prevalence in the past 12 months (%)			Severe wheeze prevalence in those with current wheeze (%)		
	ISAAC III	GAN	ISAAC III to GAN*	ISAAC III	GAN	ISAAC III to GAN*	ISAAC III	GAN	ISAAC III to GAN*	ISAAC III	GAN	ISAAC III to GAN*
Syria	5.2	19.8	8.4	5.1	12.1	4.0	2.2	12.0	5.6	41.9	60.4	10.7
KSA		13.3			15.7			5.6			41.8	
Sudan	12.5	5.7	-4.8	15.5	18.2	1.9	7.3	3.5	-2.7	58.2	61.4	2.3
Iran	10.8	9.4	-0.1	3.4	5.9	0.1	4.7	2.2	-0.2	43.5	23.1	-1.0
Pakistan	10.7			6.6			5.7			53.4		
Kuwait	7.6			14			4.8			63.8		
Egypt	7			5.2			2.7			38		
Jordan	12.3			7.6			7.7			62.6		
Palestine	8.6			6			4.0			46.6		
Sultanate of Oman	8.4			19.9			5.3			62.3		

* Absolute change in prevalence per year

Sources: Asher MI, et al. Lancet 2021; Lai CKW, et al. Thorax 2009; ISAAC. Eur Respir J 1998.

Conclusion

The high prevalence of severe asthma is of concern in EMRO. Asthma and inhalers are stigmatised in society. However the readiness and capacity of countries to address asthma varies substantially. Barriers to the implementation of successful asthma programmes include lack of regional, standardised packages of care, low rates of dissemination and implementation of national and international treatment guidelines, and under-recognition and undertreatment of asthma.

Other barriers include weak health systems and low levels of patient education and training of primary health care professionals, limited access and distribution of ICS except in KSA and the Gulf States, and instability inflicted by conflict and war zones. To improve asthma service delivery, health authorities, academics and organisations working in asthma, should collaborate to develop programmatic management of asthma, taking in consideration GAN results, COVID-19, war impact and regional features as recommended by GARD

Key Recommendation

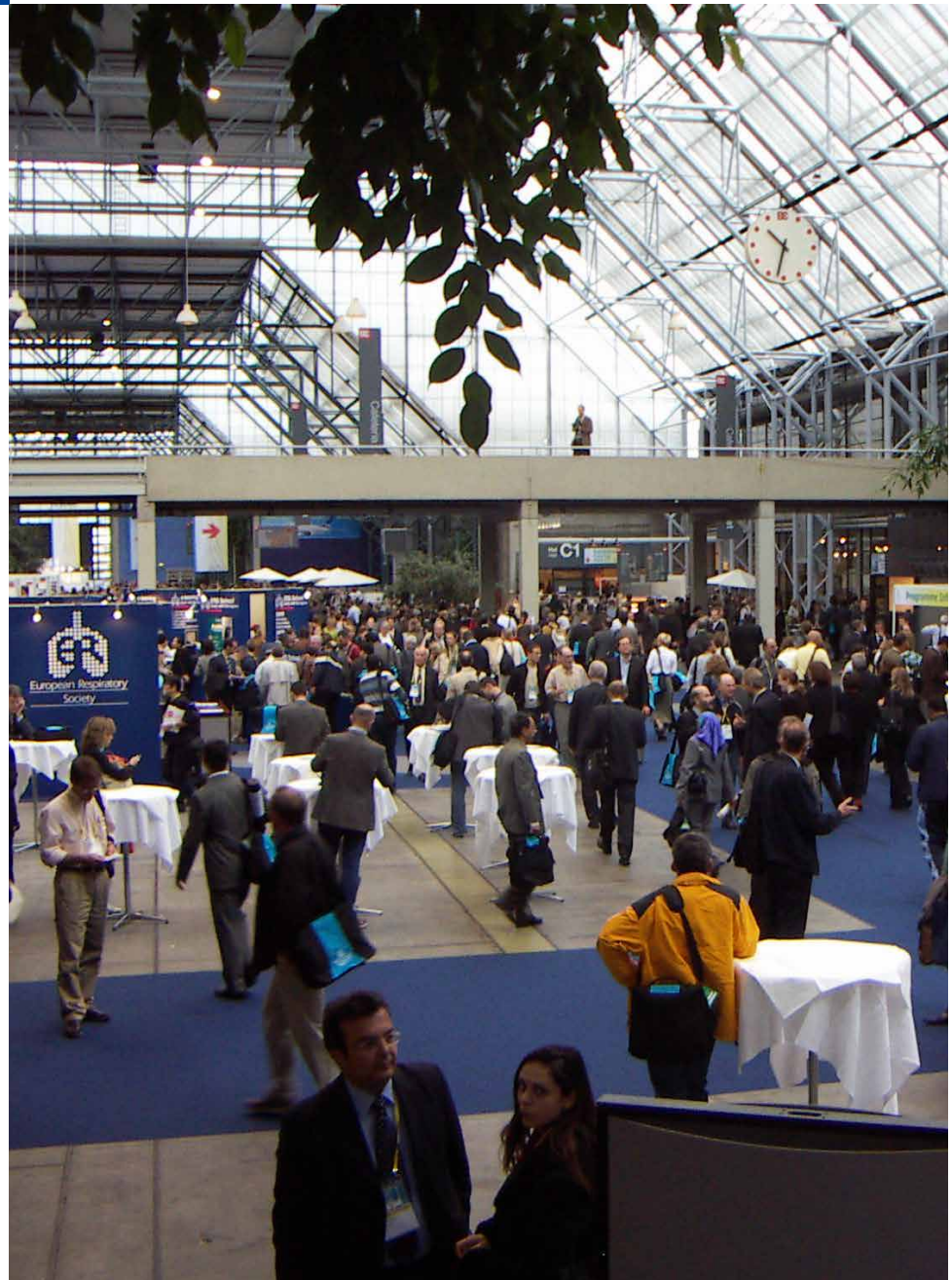
We urge health authorities and academics, at country level, WHO/EMRO and The Union's Regional Office to enhance political commitment and promote programmatic management, to improve asthma service delivery.

10. Asthma in the European region

Luis García-Marcos

Introduction

Asthma in the European region has different scenarios which are dependent on the peculiarities of each country and on how health authorities prioritise this condition. Here we have some examples of this diversity. All four countries included in this chapter participated in the Global Asthma Network (GAN) Phase I survey, thus their authors have very recent information: from the low prevalence in Kosovo either real or an effect of stigmatisation, or both, according to the investigators, to the problems derived from the immigrant population in Greece; and from the impact of environmental factors in Russia pushing asthma prevalence up, to the avoidable excess of deaths in Spain where 17 different regional health authorities look like the Tower of Babel.



Satisfactory asthma care although some problems exist with refugee and immigrant children

Trends in the prevalence of asthma and hospital admissions

Greece is a country with a low prevalence of childhood asthma estimated at 7% in adolescents, according to the recent results of the GAN Phase I study. This fact should be at least partly attributed to the Mediterranean climate and the sunny weather that prevails most of the year. As in other westernised societies, there was initially a rapid increase in the prevalence of asthma in the 1980s and 1990s, followed by a plateau in the 2000s and a slight decline thereafter.

In addition, there has been a significant

decline in paediatric asthma admissions since the early 1990s, as a result of increased disease awareness, the introduction of treatment guidelines and the release of new medicines.

Medical care of patients with asthma

Medical care for asthma patients has improved significantly during the last decades in Greece. The training of primary care paediatricians in asthma management, combined with the establishment of treatment guidelines has led to a significant reduction in the number of children with poorly controlled asthma. Today, most children with asthma have access to

respiratory specialists and even those with severe, uncontrolled asthma have the opportunity to receive costly but effective treatments such as omalizumab and immunotherapy.

However, in recent years there has been an increasing influx of refugee and immigrant arrivals. Despite the state's policy of providing access to public healthcare services, the barrier of language and the lengthy bureaucratic procedures may sometimes result in a delayed and suboptimal quality of medical care. As a consequence, it is not unusual for many refugee and immigrant children to visit repeatedly the Emergency Departments (ED) due to asthma exacerbations.



Patient Story

Hiba is a 6-year-old girl from Syria who suffers from severe asthma. She has not received anti-asthmatic therapy since she came to Greece and during the last year, she visited the ED with asthma attacks on several occasions. Six months ago, she was referred to a paediatric respiratory specialist. Inhaled corticosteroids were prescribed, and a written asthma attack plan was given. Eventually, she managed to get her medicine through the National Health Insurance System and she has had no asthma exacerbation since then.

No national asthma management programme, no specific immunotherapy reimbursement, no biological treatments

The GAN Phase I study found that Kosovo is one of the countries with the lowest prevalence of asthma as compared to other countries in the world. However, is this real, or an effect of the avoidance of stigmatisation, both by the family even and by the doctors themselves?

Public Health Plan

We suspect that the problem is probably bigger and is growing, in part due to the increase of air pollution in recent years, especially in the biggest cities. For example, Pristina experiences some of the worst air pollution found in Europe. According to Inside IQ Air, this is largely due to air pollution emissions coming from two coal-fired power plants located close to the capital, on which the country relies for a substantial amount of their power supply and in addition, high rates of indoor solid fuel burning, such as wood and coal. According to the World Bank: "The air pollution in the capital city of Pristina rivals that of big cities like Beijing, Mumbai, and New Delhi. Especially in winter, urban areas face severe smog episodes, caused by the increased demand for heat from the residential and commercial sector, which is mainly provided by burning solid fuels. Such levels of air pollution are unsafe for Kosovo's population of 1.9 million and cause significant deleterious health impacts".

Unfortunately, Kosovo does not have a national programme which may help to improve awareness and information about asthma among health care professionals to achieve better treatment adherence. The treatment of patients with asthma in Kosovo was previously carried out only by paediatricians and pulmonologists. But, with the development of the specialisation of allerge-immunology, a greater number of allergists are currently more involved in treatment of asthmatic patients. Their contribution is especially noticeable in preventing the development of allergic asthma, because of administering specific immunotherapy to children and patients diagnosed with allergic rhinoconjunctivitis.

Since 2005, as a member of Global Initiative for Asthma (GINA) assembly, Prof Luljeta Ahmetaj has worked hard to implement the GINA strategy for the management of asthma. In this regard, every year we have organised a national conference, with international participation, around the World Asthma Day in different cities of Kosovo.



Although allergists are doing a good job in treating allergic asthma with specific immunotherapy, very unfortunately this treatment is not reimbursed by our Ministry of Health. Even more dramatically, there is no availability of biological treatments in Kosovo.

Patient Story

A young man born in 2002 in Ferizaj, presents with a history of asthma attacks since the age of 7 years. He has had two operations for nasal polyps. He had visited several times the ED due to asthma, the last one after taking an ibuprofen tablet. Laboratory evidence indicated treatment with Omalizumab, but this treatment is not available in our country.

Russia

Kseniia Kuzmicheva, Olga Richkova

Prevalence of asthma is growing not only due to the negative impact of environmental factors, but also due to better detection



The prevalence of asthma has increased due to national diagnosis and treatment programmes, but mild asthma is still less commonly diagnosed.

The highest values of the chronicity index in children 0-14 years old were found for the diagnosis "asthma, status asthmaticus" (8.7%), higher than other common conditions such as "insulin-dependent diabetes mellitus" (6.2%), renal failure (4.9%) and "ulcerative stomach ulcer and duodenal disease" (4.1%).

The work of the national programme "Bronchial asthma in childhood. Strategy for treatment and prevention" in recent years has improved the outcomes for severe forms of asthma. There remains one additional unsolved problem: early diagnosis of mild forms of asthma, which would improve the situation further. Many generic medicines of high quality are available. However there is still considerable steroid phobia among patients, which interferes with the good patient-doctor interaction. Unfortunately, too many patients believe that inhaled corticosteroids affect growth and cause obesity.

Patient Story

A 5 year-old boy who suffered from asthma, received inhaled corticosteroids in high doses and salbutamol as needed, without effect. From the age of 6 he began to receive combined inhaled drugs, but his asthma was still not controlled. Finally, omalizumab was prescribed and control was achieved. He has been receiving this drug for four years and is doing well.

Asthma deaths: an avoidable toll

Although health care in Spain could be considered among those in the highest standards of the world, and access to asthma medicines is virtually free, this condition still kills many more people than it should. According to Eurostat, asthma has been causing around one thousand deaths each year, from 2011 to 2019. This figure is higher than in France and much higher than in Italy (both countries with considerably more numerous populations). Most of those deaths could have probably been avoided. In fact, in the UK, an audit performed by the Royal College of Physicians and summarised in the National Review of Asthma Deaths (NRAD) in 2014, found that two-thirds of asthma deaths could have been prevented by better basic care (Chapter 4).

Apart from the general health care system, including family doctors and paediatricians in primary health care centres and specialists based in hospitals; scientific societies dealing with asthma, both in children and in adults, have been joined together for more than two decades, to provide the best possible and updated information on how to manage asthma. This effort is summarised in "Guía Española para el Manejo del Asma" (GEMA) (<https://www.gemasma.com>). Additionally, several isolated local initiatives to implement specific asthma plans have been launched in the past.

What might be the problem?

So, if all the necessary instruments are there, what might be the problem? Probably coordination and awareness of the importance of the disease are the main problems. Having 16 different regional authorities does not help the coordination. Awareness should be easy to achieve as, according to the last GAN survey, the prevalence of asthma-related symptoms in children 6-7 and 13-14 years of age and adults are, respectively, 10.4%, 15.3% and 13.7%. If more than 10% of the population (more than five million people in the country) has asthma,



Asthma kills as many people as traffic accidents in Spain

how can this be ignored by health authorities? Probably because the death rate among asthmatics is low: as low as the number of deaths from traffic accidents.

How this can be improved?

Improving awareness and information about asthma among health care professionals and patients to achieve better treatment adherence is crucial: a national asthma programme, like that of Finland, would be a great advance not only to decrease the death toll but also to reduce the cost of the disease.

Patient Story

Otasowie, a 14-year-old from Nigeria, suffered from "difficult-to-control asthma" which was probably worsened by his obesity. Asthma control improved dramatically when adherence to treatment was increased through a more frequent follow up and a detailed asthma management plan.

11. Asthma in the South-East Asian Region

Virendra Singh

Introduction

Asthma prevalence has shown no increase in the South-East Asian Region in repeated cross-sectional studies undertaken by the International Study of Asthma and Allergies in Childhood (ISAAC) and the Global Asthma Network (GAN). In Thailand asthma prevalence is stable while it is showing a decreasing trend in India and Sri Lanka. However air pollution, biomass fuel and inadequate treatment are important challenges in this region. Public education, regular supply of affordable inhalers and proper implementation of asthma treatment guidelines are required to achieve improvements.



India

Nishtha Singh, Mohammed Sabir, Shally Awasthi, Sushil K Kabra, Sundeep Salvi, Meenu Singh, Padukudru A Mahesh, Thevaruparambil U Sukumaran, Alope G Ghoshal

Government initiatives have been helpful

Amongst India's 1.36 billion people, about 35 million suffer from asthma. In the GAN Phase I study asthma prevalence was lower than Phase III of ISAAC. Exposure to some causal environmental factors have also reduced over this time. Underdiagnosis and inadequate treatment are important challenges in India. Most people do not have health insurance and there is a wide gap in healthcare facilities across different economic strata. Although most types of inhaled corticosteroids (ICS), β_2 -agonist and combination inhalers are available at pharmacies these are expensive in comparison to oral formulations. Asthma treatment guidelines of national societies are available but need updating.

Clean environment

There has been a decline in exposure to factors such as biomass fuel, truck traffic and maternal tobacco smoking. The Government has distributed almost 80 million liquid petroleum gas connections at concessional rates to poor families to reduce exposure to biomass fuel cooking. Strict emission norms for vehicle engines have helped in cleaning the city environment. These are pleasing steps towards a cleaner environment both at home and on roads.

Barriers in treatment

GAN Phase I found that in fewer than 30% of people with current wheeze, the diagnosis of asthma was confirmed by a doctor. Even in these diagnosed patients, the daily use of ICS was less than 10%. More than 25% of patients are hospitalised at least once a year probably due to inadequate treatment. A large number of patients in India still consider asthma as a stigma and therefore conceal the disease. Asthma also has different deceptive symptomatic names, such as cough, saans and dama. Many patients take treatment only when they are unable to tolerate the agony of symptoms. A large number of people with asthma still use oral treatment instead of inhalers. Despite these barriers, with frequent and regular patient education programmes, the acceptability of inhaler treatment for asthma is gradually increasing.



Availability of medicines

A low-income person sick with asthma may spend 80% of personal savings buying medicine. However essential asthma medicines are available now for poor patients because the Government of India launched Ayushman Bharat Yojana in 2018. This provides free treatment to hospitalised patients at government and selected private hospitals.

Rajasthan initiatives

In India the maximum deaths and Disability Adjusted Life Years (DALYs) due to asthma occur in the state of Rajasthan (Western India) according to the Global Burden of Disease study in 2016. Since 2011 the most important medicines are provided free to all outdoor and indoor patients at government hospitals. The state has undertaken pooled procurement of medicines for Rajasthan's 75 million people, leading to a large reduction in procurement cost. The state provides asthma patients with free metered-dose inhalers, dry powder inhaler capsules and nebuliser solutions. Thus, asthmatic patients are accessing treatment more easily, but adherence issues still persist.

Patient Story

14-year old Sonu was prescribed a combination of long-acting β_2 -agonists (LABA) and ICS inhaler twice a day. He did not come for the one month follow-up visit. After 2 months when he consulted the doctor for some other problem he told the doctor, "Now asthma does not bother me much, except a slight cough while running, therefore I stopped the inhaler".

Sri Lanka

Jagath C Ranasinghe, Sanath T Kudagammana

Poor air quality contributes to asthma burden

The prevalence of asthma and other allergic diseases in Sri Lanka is relatively higher compared to the other countries of the South East Asia region according to the GAN Phase I study. Sri Lanka follows the latest Global Initiative for Asthma (GINA) strategy in managing adult and childhood asthma across the country. Asthma deaths contribute by nearly 5% to total deaths in the country.

Poor air quality index

Indoor and outdoor air pollution is a huge problem in Sri Lanka as in many countries in the region. High fuel prices have compelled the poor to rely on cheaper energy sources, such as biomass fuel and kerosene oil that produce high concentrations of harmful indoor air pollutants. There is domestic overcrowding, especially in the tea estate labour population, exacerbating the risk of exposure affecting younger and older people. Although people in Sri Lanka are exposed to more than double the air pollution levels recommended by the World Health Organization (WHO), there are no national interventions to reduce indoor air pollution or to minimize the exposure of vulnerable groups to indoor air pollutants.

Asthma burden in Sri Lanka

After the ISAAC Phase III whole island study undertaken in January 2001 and an ISAAC based study in 2013, there was no country-wide data regarding asthma prevalence, although several studies were conducted in isolated parts of Sri Lanka using the ISAAC tools. Different prevalence rates are seen in different geographical regions. GAN Phase I showed prevalences of current wheeze ranging from 10 to 15% in both age groups of school children (2018), but in ISAAC, current wheeze prevalence was 23.0% (2001) and in 2013 17.5% in the 13-14 age group. In order to reduce the asthma burden in Sri Lanka, the government is providing inhaler medicines free of charge to all patients; and has appointed consultant respiratory physicians to almost all district general hospitals across the country.

Conclusion

The prevalence of childhood asthma in Sri Lanka remains high though there is a small variation across the country. Indoor air quality needs to be addressed as a priority with reliable data and analysis of determinants. Country-wide asthma and allergic diseases prevalence data is also needed.



Patient Story

A two-year-old boy from the country's tea estate sector presents with recurrent wheezing. The 8 family members live in a single line room. Exposures to biomass fuel and paternal smoking are the likely causes for recurrence of symptoms and poor asthma control. Difficult access to specialist medical care, poor socio-economic status and recurrent exposure to indoor pollution has made management very challenging.

Thailand

Sasawan Chinratapisit, Pakit Vichyanond

Despite progressive asthma guidelines and increased access to medicine, asthma prevalence remains high

Asthma has been a common chronic illness in Thailand. The result of GAN Phase I in Bangkok showed that the prevalence of asthma has stabilised in both age groups, 6-7 year olds and 13-14 year olds. The increase availability of asthma controllers throughout Thailand might have helped lower the national rate of people with severe asthma attacks presenting to emergency rooms as well as the number of asthma hospital admissions. ICS are very popular choices. Lower cost generic versions of ICS are included in the Essential Medicines List subsidised by the Government for those eligible for medical support (governmental employees, those under the social security program and universal health coverage).

Global Asthma Network survey

The GAN Phase I study in Thailand found that the asthma prevalence was 14.6% and 12.5% in 6-7 and 13-14 years old, respectively. The prevalence of severe wheeze was 6.8% and 5.8% respectively. There is an urgent need for an in-depth study to define epidemiological factors responsible for this increase.

Air pollution measures

Thailand has enforced stricter regulation to reduce outdoor air pollution, namely cleaner air emissions and vehicle fuels. Despite this, air quality in Bangkok and Chiang Mai continues to be at a critical level, especially in cooler months. Effective advocacy by non-governmental organisations are quite successful. Smoking at homes and in public places are now rare events.

Guidelines

The Chest and Allergy Society in Thailand regularly update asthma guidelines for adults and children. Social media has made it easier for parents and patients to find appropriate professional care.

Allergy

Thailand has been noted to have increased numbers of patients with food allergy and atopic dermatitis. The reason for this worrisome, unusual increase is uncertain at this point. Similarly, GAN Phase I substantiated the increasing prevalence of asthma in children and adolescents. If a phenomenon of allergic march operates in this country, one might expect an increase in the number of asthmatic patients rather than a decrease in the next decade.

COVID-19

There is no doubt that paediatric asthma clinics are among health care services significantly affected by the COVID-19 pandemic. The number of new

patients evaluated is restricted, and the frequency and/or the total number of patients monitored has reduced. In addition, diagnostic modalities, including lung function testing, fractional exhaled nitric oxide, or methacholine tests, are limited as are nebulised treatments. However, many asthma services have actively responded to these challenges, especially using tele-health, which have flourished in all medical specialties during the COVID-19 epidemic. Clinicians considered such clinics suboptimal, but adequate for the short period under the lockdown. Standardised tools, such as the Asthma Control Test or the Asthma Control Questionnaire were also used.



Patient Story

A 12 year old boy, on budesonide treatment, was admitted to hospital for asthma. The physician recommended switching to ICS with long-acting β_2 -agonist treatment. The mother could not afford to buy it. For those eligible for medical support, the Government subsidisation allows cheaper cost of asthma drugs in the Essential Medicines List to reach those needing them.

12. Asthma in the Western Pacific Region

Innes Asher

Introduction

The Western Pacific Region is home to almost 1.9 billion people across 37 countries and areas, many being islands in the Pacific Ocean; the remainder live in Australia and continental Asia, the largest country being China where about 75% of the region's people live. Unsurprisingly the rates of asthma and approach to management vary over such disparate geographical, cultural, economic and political situations.



China

Gary Wong, Yuhan Xing

Economic development raises asthma concerns

China has undergone rapid and massive economic development and urbanisation over the past three decades, along with development of severe air pollution. In parallel the prevalence of asthma and allergic diseases has escalated. Even a slight increase in the prevalence rate will translate into millions of people with asthma due to China's large population. Thus there is urgency to address environmental factors and improve asthma management.

Patient Story

A mother of a 5-year-old boy was reluctant to let the physician label her child as "asthma" and preferred to have the diagnosis such as "wheezing illness" or "bronchiolitis" instead. When her boy was prescribed inhaled corticosteroids, she was quite worried. She thought non-steroid medications were much safer and asked for alternatives such as traditional Chinese medicine.

Increasing prevalence

Based on the national epidemiological survey from 2012 to 2015, the overall prevalence of asthma was estimated to be 4.2% in China. There has been an increase in asthma prevalence, especially in the paediatric population, over the past three decades. Using the standardised International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, the prevalence of current wheeze in 13-14 year old children was documented to rise from 3.4% in 1994 to 4.8% in 2001, and rose further to 6.1% in 2009 in Guangzhou, southern China.

Rapid urbanisation

China is a country with marked regional differences in socioeconomic development and environmental exposures. The prevalence of asthma and related atopic disorders varies substantially within the country, with much lower prevalence in rural areas compared with urban regions. For example, Conghua is an agricultural area located only 130 kilometres away from the highly urbanised city of Guangzhou. The prevalence of ever having asthma among secondary schoolchildren in rural Conghua was only half of that in urban Guangzhou (3.4% vs. 6.9%). Exposures related to a traditional rural lifestyle have been recognised as one of the most potent protective factors for asthma.

In contrast growing numbers of motor vehicles in parallel with rapid urbanisation aggravate the problem of traffic related air pollution (TRAP). The largest percentage of paediatric asthma incidence (from the Global Burden of Disease Study 2015) attributable to exposure to nitrogen dioxide (NO₂), one of the major components of diesel exhausts, was found in Shanghai, China. Nearly half of the new cases were attributable to NO₂ exposure. Driving restrictions in Beijing, with stringent pollution control policy, have shown to improve lung function and reduce asthma-related physician visits.



Paediatric asthma clinic in Nanjing Children Hospital

Challenges create opportunities

Asthma prevention and control remains a significant challenge in China, where under-reporting, underdiagnoses and undertreatment constitute major obstacles to effective delivery of care. A real-world survey has revealed that many of the people with mild asthma in China received only non-steroidal and short-acting medicines and may benefit from treatment intensification. Education programmes and dissemination of control tools such as Asthma Control Test and action plans are critical steps to raise patients' awareness, to monitor daily control, and to improve treatment adherence. The national health insurance policy was adjusted in 2019, covering most of the important medicines for asthma. Targeted therapies for difficult asthma such as omalizumab which used to be expensive now are becoming affordable as a large part of the cost is covered for eligible patients. At the same time improvements in air pollution need to be prioritised.

Asthma prevalence increases as the economy develops

Along with the rapid economic development in Taiwan, asthma prevalence is increasing in the past three decades. In the 1970s, only 1.3% of 7-15 year-old students had asthma. In 1994 the prevalence of current wheeze increased to 5.2% and to 7.1% in 2002. In 2017, the Global Asthma Network (GAN) Phase I survey found that the prevalence of current wheeze was 9.2%. The change in asthma prevalence is demonstrated in Figure 1.

Asthma is a great burden to patients, their families, and the whole society. The annual cost of each asthmatic patient was more than 7000 USD in Taiwan, equaling 215 million USD as a total expenditure per year. Unscheduled clinic or emergency department visits all result in school or work absenteeism, leading to more indirect costs.

Joint intervention to provide better asthma care

Because of the increasing prevalence of asthma, in 2001 Taiwan's National Health Insurance launched an Asthma Quality Enhancement Project. Subsequently Emergency Department visit and hospital admission rates decreased gradually. Paediatric and adult medical

societies were devoted to formulating guidelines and training physicians to provide better asthma care. Physicians and nurses went to every corner in Taiwan to educate patients and their families about asthma. All of the measures attempted to alleviate the burden of asthma in Taiwan. The photo below shows the group asthma education provided by Chang Gung Memorial Hospital.

In recent years new biologics for asthma are being rapidly developed. Taiwan's National Health Insurance covers these biologics for severe asthmatic patients, providing better and affordable treatment options for them. The measurement of exhaled nitric oxide is also covered by Taiwan's National Health Insurance for 6-12 year-old children. A new generation of inhalation medications and devices are available in Taiwan as well. General practitioners, asthma specialists, and certified asthma education nurses cooperate efficiently to provide holistic care for asthmatic patients in Taiwan.

Air pollution and secondhand smoking are associated with the increase of asthma in Taiwan. In 2009, the Taiwan government passed the Renewable Energy Development Act, aiming to reduce the utility of fossil fuel and increase the renewable share to 20% by 2025. Electric vehicles are promoted by giving tax exemptions

and subsidies in Taiwan. Cigarette smoking is prohibited in the most public areas in Taiwan. High tobacco tax and education at schools and in the media intend to decrease the smoking population. All these measures are hopefully decelerating the increasing trend of asthma in Taiwan.

The prospect of asthma control in Taiwan

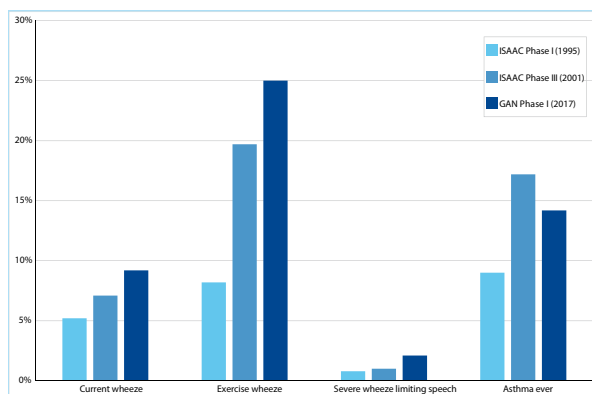
Through the joint effort to decelerate asthma prevalence and provide better asthma control, physicians, asthmatic patients, and their families look forward to a bright future in Taiwan. We hope "no one suffers from asthma" in Taiwan, the same as the vision of GAN.



Group asthma education provided by Chang Gung Memorial Hospital

Figure 1:

Change in asthma prevalence in Taiwan 1995 - 2001



Source: Asher MI, et al. Lancet 2021.

Patient Story

A 7 year-old girl was diagnosed with asthma at 2 years old with poor drug adherence. At 7 she had a life-threatening acute asthma exacerbation requiring extracorporeal membrane oxygenation support. After discharge, she received a regular inhaled corticosteroid with long-acting β_2 -agonist and monthly omalizumab injections. The frequency of asthma acute exacerbations decreased and her lung function improved slowly.

New Zealand

Innes Asher

Asthma has been of high interest in New Zealand (NZ) since the asthma mortality epidemics of 1960's and 1970's which resulted in a lot of research and focus on better management. Subsequently NZ asthma management guidelines were published in 2002, 2016 and 2020 (adults) and 2005, 2017 and 2020 (children). Although there is no national asthma strategy, the Asthma and Respiratory Foundation NZ provides education and resources on asthma for the public and health professionals. These may have contributed to the fall of asthma prevalence and severity as shown in the Table.

ISAAC Phase Three was completed in 2003, a mean of 7 years after ISAAC Phase One in 5 NZ centres (Auckland, Bay of Plenty, Christchurch, Nelson and Wellington). Reported asthma ever significantly increased from 24.6% to 30.2% in children and from 24.1% to 32.4% in adolescents. Current wheeze (written questionnaire) significantly decreased in children from 23.6% to 22.2% and in adolescents from 29.7% to 26.7%, and for the video asthma questionnaire from 18.1% to 11.1%. There was a significant reduction in wheezing limiting speech from 5.0% to 3.7% in children, and 7.9% to 6.2% in adolescents. Little

regional variation was found. In 2003 a higher proportion of children with asthma symptoms reported having ever had asthma.

Subsequently, in 2018, the GAN Phase I study was completed in one NZ centre (Auckland). The prevalence of current wheeze showed a decrease in both age groups, however the proportion reporting asthma ever showed a decrease in the 6-7 year old children but little difference for the adolescents.

Although the prevalence of asthma symptoms in Auckland is showing a decrease the explanation for this decrease is unknown. It could be due to a combination of factors, including changes in unknown environmental causes of current asthma symptoms, changes in asthma awareness (the development of NZ asthma guidelines) or improved asthma treatment.

If this trend of decreasing prevalence of asthma symptoms, is maintained, it has positive implications for lessened burden of disease among asthmatics and lowered cost of treatment.



Table: Repeated cross-sectional studies of asthma prevalence in children and adolescents in Auckland

	Children (6-7 yr)			Adolescents (13-14 yr)		
	Current wheeze	Severe asthma symptoms	Asthma ever	Current wheeze	Severe asthma symptoms	Asthma ever
ISAAC Phase I 1995	22.5%	11.5%	23.8%	26.5%	12.9%	22.9%
ISAAC Phase III 2003	22.4%	10.3%	28.3%	22.5%	10.0%	27.9%
GAN Phase I 2018	17.4%	6.7%	19.2%	14.9%	5.1%	22.6%

Source: Asher MI, et al. Lancet 2021.

Pacific Islands

Sunia Foliaki, George 'Aho

Asthma Burden

The considerable variation in asthma prevalence in the Pacific Islands, as determined in the ISAAC Phase III studies in the Pacific two decades ago, appears to have not changed much. At that time, childhood asthma ranked among the top 10 leading causes of childhood morbidity in some countries. In the past 10-15 years in Tonga, for example, it accounts for less than 2% of annual respiratory admissions with severe or life-threatening asthma admissions occurring only once every few years.

The need to improve asthma management

The inhabitants of the islands in the Pacific Ocean are geographically scattered, with contrasting political systems and varying stages of economic development which has a direct bearing on asthma management. This determines affordability of medicines and tools for asthma management regardless of human resources. Some countries rely on a single medicine for asthma prevention, such as inhaled beclomethasone, in the country's essential medicines list, and sharing spacers and peak flow meters in hospital wards also occurs. In contrast, other Pacific Islands such as Niue, a self-governing state in free association with New Zealand, can afford free access to the above tools, long-acting β_2 -agonists (LABA) and various metered dose inhaler (MDI) steroids provided by the state. Written asthma self-management plans, a given in developed countries, has not been part of asthma management in most if not all Pacific Islands. The existence of some asthma management guidelines for outpatient and inpatient asthma management does not necessarily translate to national practice with some of the children managed in the private clinics.

Challenges

The ISAAC findings further documented that the asthma prevalences among Pacific Island children in their traditional homelands were considerably lower than have been observed among Pacific children living in New Zealand.



Admittedly, there have not been any studies or follow up studies in the Pacific Islands involved in ISAAC using a standardised methodology and instruments to determine asthma prevalence and trends. There is a need for such a study. A repeat study is of particular interest because many Pacific Island countries that retained their traditional diets, lifestyle and management processes during ISAAC Phase III have become increasingly 'westernised' as well as in their exposure status to a changing environment. The arrival of COVID-19 adds to the impact, as well as dramatic environmental changes such as the devastating atmospheric pollution from Tonga's recent volcanic eruption. A repeat study would inform further on the role of environmental factors on asthma prevalence, and that children who migrate can experience an altered risk of asthma as a result of exposure to a new environment during childhood. Additionally this information

would provide further information that would be of value for assessing trends in global asthma burden, causes and control.

Patient Story

A morbidly obese 10-year-old patient had one admission with severe asthma and one with life-threatening asthma. His well-educated parents were hesitant about their child taking preventers regularly until they witnessed how they almost lost him with his life-threatening asthma attack. Powerful evidence-based health education is necessary for families of all socioeconomic levels.

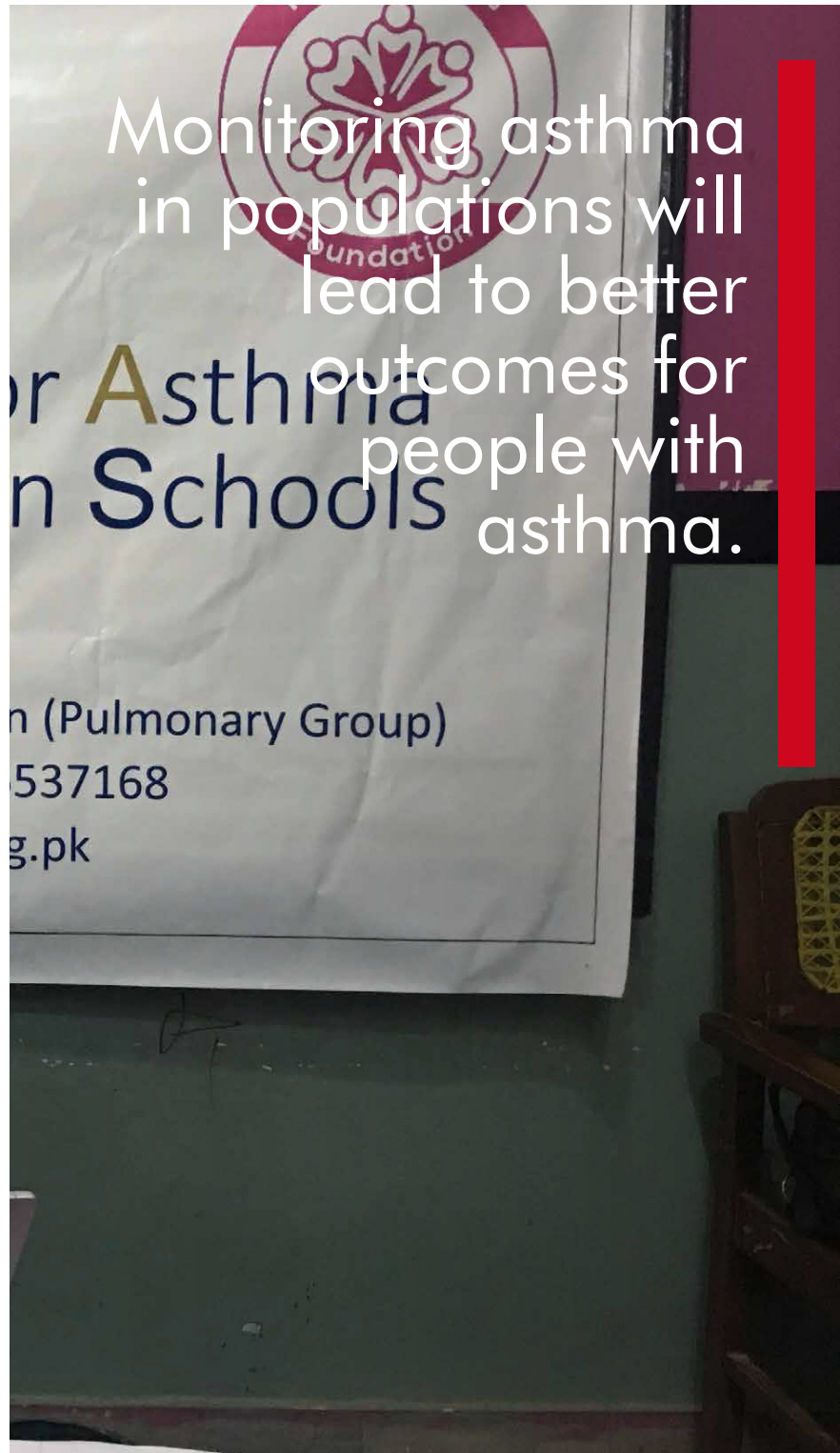


PASS Program for Screening

Under auspices:
Pediatric Association (PLA)

Pakistan Pediatric Association
Online: 061- 6
hhf.org





Monitoring asthma
in populations will
lead to better
outcomes for
people with
asthma.

n (Pulmonary Group)
537168
g.pk

PART THREE:

IMPROVING ASTHMA MANAGEMENT

New Approaches with Asthma Medicines

Chen-Yuan Chiang, Iain Crossingham, Asma El Sony, Rebecca Fortescue, Luis García-Marcos, Guy Marks, Refiloe Masekela, Helen Reddel

There are two key types of essential asthma medicines: short-acting bronchodilator inhalers which provide only short-term symptom relief and inhaled corticosteroid (ICS)-containing medicines, which treat the underlying airway inflammation. Unfortunately, many patients with asthma are managed without ICS, as shown by the recent Global Asthma Network (GAN) Phase I study (Chapter 5). For many patients, this is because they lack access to affordable quality-assured ICS. In addition, even after ICS became widely available, the sole use of short acting bronchodilators for initial treatment was recommended for decades, contributing to over-reliance and/or overuse of them, and failing to provide any protection against exacerbations.

Compared with as-needed SABA alone, as-needed ICS-formoterol in adults and children ≥ 12 years with mild asthma reduced exacerbations requiring systemic corticosteroids.



In 2015, The International Union Against Tuberculosis and Lung Disease (The Union) proposed that the use of both ICS and rapid acting β_2 -agonist together, as needed for symptom relief, might be a better option than rapid acting β_2 -agonist alone. This was, in part, because the Asthma Drug Facility (ADF) pilot project implemented in Benin, China, El Salvador, and Sudan revealed that many people with asthma who had frequent emergency visits or hospitalisations were prescribed only inhaled bronchodilators for symptom relief. Furthermore, several clinical trials in patients with mild or moderate-severe asthma had demonstrated that those people who used both ICS and rapid acting β_2 -agonist as needed for symptom relief, with or without a maintenance ICS-containing inhaler, had a lower risk of asthma exacerbations

compared to those who used rapid acting β_2 -agonist as their reliever. However, at the time, combination ICS-rapid acting bronchodilator inhalers were not affordable for disadvantaged populations. Therefore, The Union looked for quality-assured affordable generic products of combination inhalers through ADF. In the interim, The Union proposed concomitant use of separate inhalers of ICS and short acting β_2 -agonist (SABA) for rescue therapy, pending the availability of affordable combination inhalers containing both ICS and a bronchodilator.

The Global Initiative for Asthma

In their 2019 Strategy, the Global Initiative for Asthma (GINA), prompted by concerns about the

risks and consequences of commencing asthma treatment with SABA alone, and based on new evidence about a safe and effective alternative, made a historic change in recommendations for asthma management. This resulted from a comprehensive review of evidence on the adverse outcomes of SABA-only treatment and the impact of ICS on asthma exacerbations and deaths in mild asthma. This review included two large clinical trials of as-needed use of ICS in combination with formoterol (a long-acting β_2 -agonist with rapid onset of action) in patients with mild asthma. GINA concluded that adults and adolescents with asthma should not be treated with SABA alone. Instead, GINA recommended that all adults and adolescents with asthma should receive either symptom-driven (in mild asthma) or daily ICS-containing treatment, to reduce their risk of serious exacerbations. These recommendations were supported by a further two open-label studies in mild asthma, in which as-needed ICS-formoterol was used as it would be in real life.

In mild asthma, the preferred option is now as-needed combination inhaled ICS-formoterol, taken whenever symptom relief is needed. Fortunately, this formulation is now included in the Essential Medicine List of the World Health Organization (WHO) after a working group of The Union successfully applied for its addition in 2016. Pragmatic studies are needed to assess the feasibility, effectiveness, safety and cost-effectiveness of this intervention in low-and middle-income country (LMIC) settings.

ICS and β_2 -agonist inhalers for children with asthma

Although the evidence is clear for the use of as-needed combination ICS-formoterol for adults and adolescents with mild asthma, there are no such studies in children aged <12 years. For children 6–11 years with mild asthma, the current GINA recommendation is regular low dose ICS plus as-needed SABA or, for those with very infrequent symptoms, taking ICS whenever SABA is taken. For children 6–11 years with moderate-severe asthma, as-needed ICS-formoterol is an option as part of maintenance and reliever therapy in Steps three and four. There is currently a lack of evidence for use of any of these combination therapies for children aged ≤ 5 years with mild asthma, with regular low dose ICS still the preferred choice. Evidence is urgently needed as it is likely that children ≤ 5 years with established asthma might also benefit from as-needed combination ICS-formoterol or ICS-SABA, as many do with regular ICS.

Cochrane review

Recently, a systematic review and meta-analysis concluded that as-needed use of combination ICS-formoterol inhalers was clinically effective in adults and adolescents with mild asthma. Compared with as-needed SABA alone, as-needed ICS-formoterol in adults and children ≥ 12 years reduced exacerbations requiring systemic corticosteroids (e.g. 109 individuals

per 1000 will experience an exacerbation over 52 weeks with SABA alone vs 52 per 1000 with ICS-formoterol). As needed ICS-formoterol may also reduce the risk of asthma-related hospital admissions or Emergency Department visits and exposure to systemic corticosteroids, without increasing adverse events.

Access to affordable, quality-assured, essential asthma medicines

One of the main barriers in the management of asthma has been the lack of affordable quality-assured, essential asthma medicines, especially in resource-limited settings. ICS is frequently not available and they and combination inhalers are prohibitively expensive for patients in LMICs, or may be poor quality. To ensure that the new recommendation of using combination inhalers as needed for symptom relief will be beneficial for all asthma patients, it is critical to ensure that quality-assured combination inhalers are also accessible and affordable in resource limited settings.

Key Recommendation

Children, adolescents and adults with asthma should receive ICS-containing medicine, either symptom-driven in mild asthma, or daily.



Asthma in the Context of Other Chronic Respiratory Diseases in LMICs

Non-communicable diseases (NCDs) cause considerable morbidity and mortality in people globally (approximately 70% of all deaths). The United Nations' Sustainable Development Goals (SDGs) aim for the risk of premature mortality from NCDs including chronic respiratory diseases (CRDs) to be reduced by a third by 2030. There is a long way to go to achieving this goal for CRDs particularly as they are common, frequently neglected and disproportionately affect people living in poverty around the world.

The CRDs - including asthma - represent one of the four major groups of NCDs. The CRDs share underlying drivers of morbidity and mortality that are often poverty related.

Kevin Mortimer, Karen Bissell, Alvaro Cruz, Luis García-Marcos, Asma El Sony

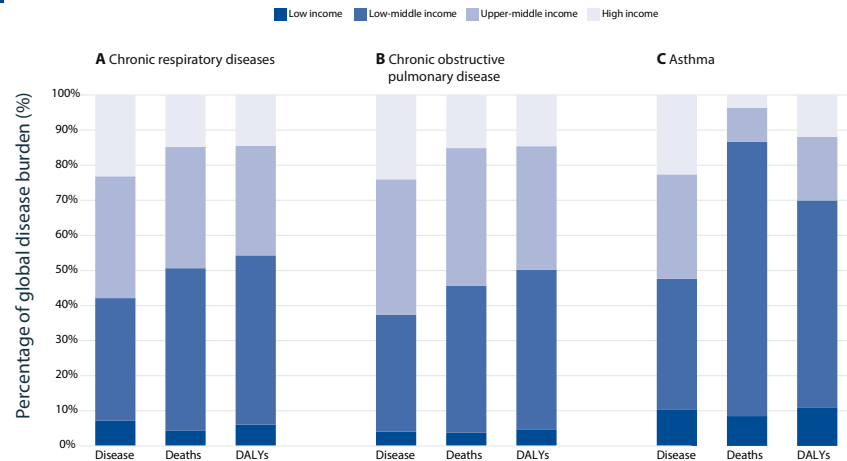


Figure 1:

Source: Adapted with permission from Meghji J et al. Lancet 2021.

Distribution of the global burden of disease, deaths, and disability adjusted life years (DALYs) from (A) chronic respiratory diseases, (B) chronic obstructive pulmonary disease, and (C) asthma, by World Bank-defined country income per capita strata, using Global Burden of Disease 2019 estimates

CRDs – mainly represented by asthma, chronic obstructive pulmonary disease (COPD), bronchiectasis and post-tuberculosis lung disease (PTLD) – are one of the major groups of NCDs. The most common CRDs, asthma and COPD, are diseases affecting predominantly the airways and therefore overlap in how people present to health services, including wheeze, cough and breathlessness, and other CRDs, too, may cause these symptoms. These diseases also overlap in other ways including how they are diagnosed, the medicines used for treatment, non-pharmacological management, health professional training and health systems needs. It is therefore logical to consider CRDs together in clinical practice where syndromic approaches to management can be effective. From a public health (programmatic) perspective health systems for people with CRDs need to be strengthened. There are several useful resources that set out pragmatic approaches to the management of CRDs in low- and middle-income

countries (LMICs) including the World Health Organization's (WHO) package of essential non-communicable disease Interventions for primary health care (PEN) and the Package of Care Kit (PACK) for children, adolescents and adults. There is a balance to be struck between pragmatic programmatic approaches aiming to deliver standardised package of care and more individualised approaches.

There is a need for greater recognition and investment in CRD care pathways in LMICs. Given the overlap in needs to improve the care of people with CRDs there would be merit in initiatives focused on asthma and COPD (perhaps tuberculosis, PTLT, and bronchiectasis) as well being expanded to unite public and private efforts and advocacy behind this cause. It is likely that post-COVID-19 lung disease will become another cause of CRD.

There is also the need to address underlying drivers of morbidity and mortality from CRDs

which are often poverty related; ending poverty is another SDG goal. Improving maternal nutrition and health, reducing exposure to air pollution (including tobacco, household, ambient and occupational) and improving the prevention and treatment of respiratory tract infections throughout the life course including tuberculosis and COVID-19 are also key priorities.

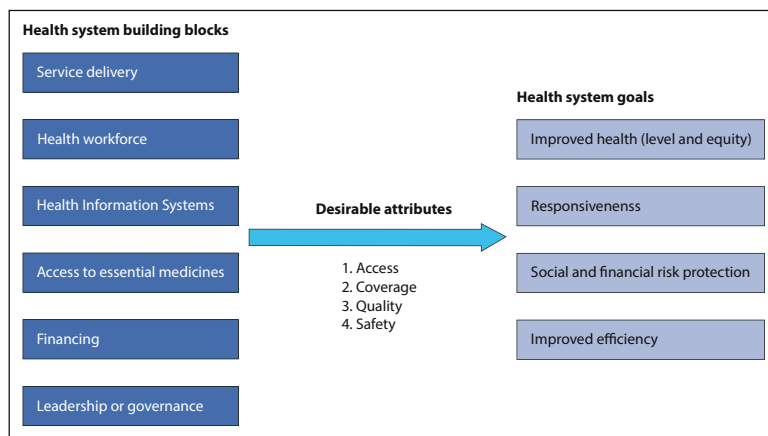
Conclusion

CRDs represent a major burden of disease in LMICs. The SDGs have targets requiring that this large burden should be addressed through improved prevention and control of these diseases. Investment in health systems including human resources, training and capacity strengthening are needed. It is important that CRD care pathways are prioritised adequately as part of Universal Health Coverage. The recently acquired knowledge and technology on teletraining may help to scale up the capacity strengthening required.



Figure 2:

WHO six building blocks of health systems, together with aims and desirable attributes



Source: Adapted with permission from Meghji J et al. Lancet 2021.

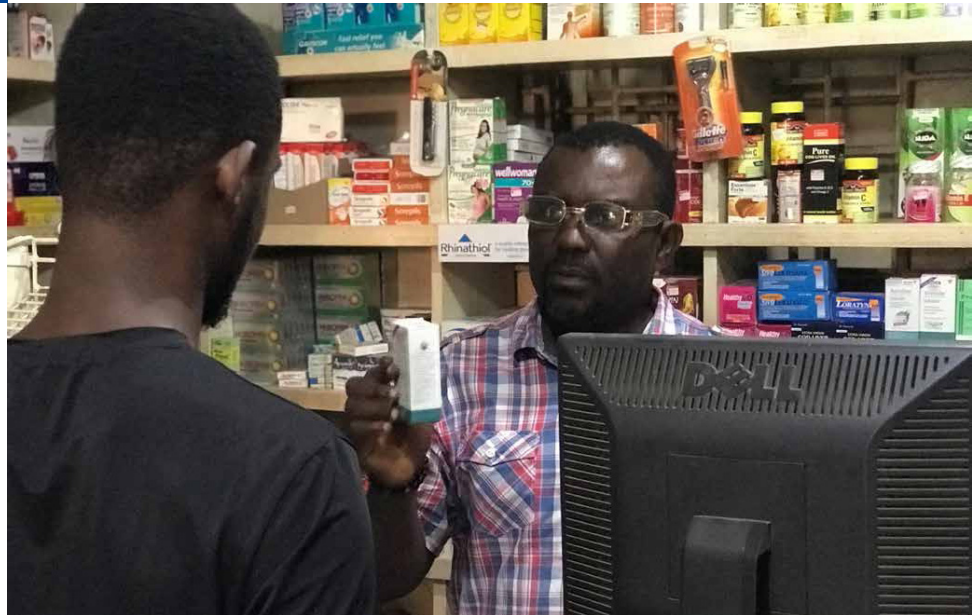
Key Recommendation

The needs of patients with asthma in LMICs have much in common with those of patients with other CRDs and would benefit from joined-up approaches.

15. Improving Access to Essential Asthma Medicines

Karen Bissell, Catherine Plum, Kevin Mortimer, Zaheer-Ud-Din Babar, Obianuju Ozoh

One-third of the world's population does not have access to essential medicines and every year out-of-pocket expenditures for medicines force approximately 100 million people into poverty. The causes for poor access to medicines are known and can be addressed.



A health systems perspective on essential asthma medicines

To fully understand access to essential asthma medicines we must take a health systems perspective. Poor access can be caused by many health systems issues, such as: high prices; resistance to supplying generic medicines; poor procurement procedures; health and pharmacy system problems; interrupted medicine supplies; slow registration of new medicines; outdated regulations and policies; and undue influence by pharmaceutical companies.

Robust medicine policies are key

Pharmaceutical pricing and reimbursement policies are key to achieving equitable and affordable access to medicines. Affordability and access are better in countries where prices are controlled. To improve access to essential

asthma medicines, countries should seriously consider the following policy interventions recommended by the World Health Organization's (WHO's) 'Guideline on country pharmaceutical pricing policies': regulating the application of mark-ups across the pharmaceutical supply chain; exempting essential medicines and active pharmaceutical ingredients from taxes; using reference pricing to reduce price variability among comparable products; tendering; pooled procurement; and the use of quality-assured generic medicines. WHO's Global Action Plan for non-communicable diseases (NCDs), extended from 2020 to 2030, has an 80% availability target for NCD essential medicines.

How easy is it to access essential asthma medicines in Africa?

Recent surveys in selected African countries reflect ongoing problems of access to essential asthma medicines.

Sustainable Development Goal 3.8 highlights "access to safe, effective, quality and affordable essential medicines and vaccines for all" as central to achieving Universal Health Coverage.

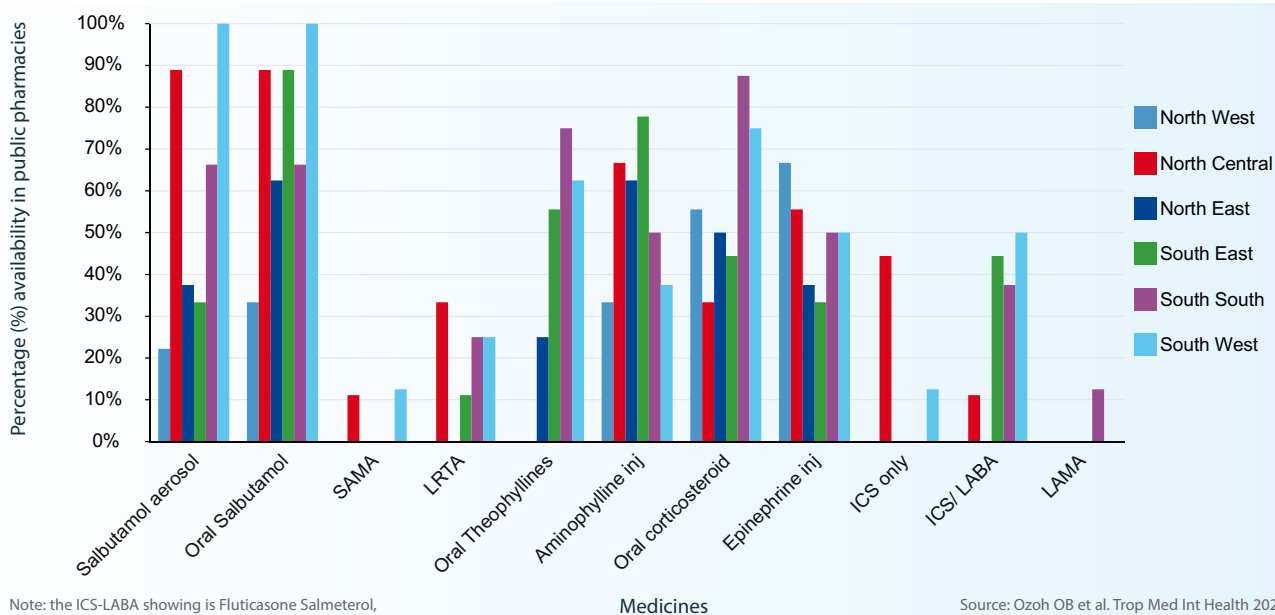


Figure 1: Availability of asthma and COPD medicines in public pharmacies across the 6 geopolitical zones of Nigeria

The Gambia

A questionnaire in the Gambia gathered responses from the central medical stores (CMSs) that supply public health facilities and 8 registered private pharmacists who supply 19 of the 26 registered private pharmacies in the country. Most reported little availability of essential asthma medicines, and if one was available it was unaffordable. The only inhaled corticosteroid (ICS) available at the CMSs was beclometasone 50 mcg. Only 1 of 8 private pharmacists had a WHO-recommended ICS. Although inhaled salbutamol was available in the CMSs and through 6 private pharmacists, 7 of the 8 private pharmacists did not have high dose ICS inhalers or the WHO-recommended ICS-long-acting β_2 -agonist (ICS-LABA) combination inhaler

of budesonide and formoterol (Chapter 13). The 8th pharmacist had beclometasone 50 mcg at a cost equivalent to 15 days' wages and budesonide 100 mcg at a cost equivalent to 28 days' wages.

Nigeria

In Nigeria (Chapter 7), an onsite study in 128 public and private pharmacies found that availability of the WHO-recommended asthma medicines was far below the WHO voluntary target of 80% (Figure 1). ICS were available in only 16% of public pharmacies. One ICS-LABA was available in 48% of public pharmacies. The most available and affordable medicines were oral corticosteroids (in 73% of pharmacies) and oral salbutamol (in 72%), yet these products are not recommended for long-term asthma

management. More expensive originator brands dominated more affordable generics. Private pharmacies, where costs are higher, had much higher availability than public pharmacies.

Multi-country survey in the African Region

A survey of 37 respiratory specialists representing 13 countries in Africa reported on the availability in their health facility of WHO-recommended asthma and chronic obstructive pulmonary disease (COPD) medicines (Figure 2). The least available was the ICS-LABA combination inhaler, which was also the medicine most often paid out-of-pocket (Figure 3). About half reported that an ICS was available, however in half of those availability was often interrupted. Only

oral corticosteroids and oral salbutamol reached the 80% availability target set out in WHO's Global Action Plan for NCDs.

Action for improved access

Across these three studies, the reasons reported by the survey respondents and researchers for such poor availability and affordability included: prohibitive cost; WHO-recommended asthma medicines not being on the country's essential medicines list (EML); outdated national treatment guidelines; lack of knowledge by prescribers about WHO-recommended asthma medicines and long-term asthma management; and pharmacies not stocking ICS medicines, partly because they are rarely prescribed.

It is unfortunate that people have not been benefitting from access to essential medicines such as the ICS-LABA combination inhaler. The ICS-LABA (budesonide-formoterol) serves as both a reliever and controller, which can enhance adherence (Chapter 13). However, this product has not yet made it onto the EML of Nigeria, Gambia or most of the other African countries in the above study. These three surveys reflect the same poor availability of essential asthma medicines reported in earlier surveys by the International Union Against Tuberculosis and Lung Disease (2004-2011) and

the Global Asthma Network (2014). Global and country-level action and advocacy needs to be revitalised (see Table). An important step for WHO would be updating the asthma treatment recommendations in its package of essential non-communicable disease interventions for primary health care (PEN) to reflect the combination inhalers (ICS-LABA) included in the WHO Essential Medicines List.

Conclusion

Many countries still do not have the WHO-recommended essential asthma medicines on their EML, and many are not providing the medicines free or subsidised for patients, especially in low- and middle-income countries. This situation creates barriers for patient access to medicines and is likely to be perpetuating the under-prescription and underuse of ICSs and the combination inhaler. Regular international monitoring may prompt countries to work harder towards WHO's 80% availability target for NCD essential medicines and the overarching aim of Universal Health Coverage. Monitoring should include not only the availability, pricing and affordability of essential asthma medicines. It should also report on the inclusion, or not, of essential asthma medicines in policies that are fundamental for improving access: for example,

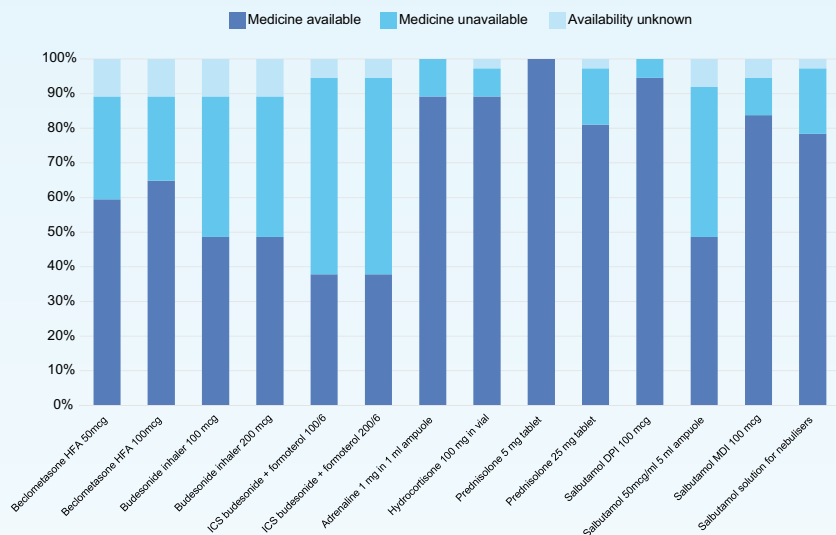
each country's EML, asthma management guidelines and medicine reimbursement lists.

Key Recommendation

All countries should implement robust pharmaceutical pricing policies and ensure their national asthma management guidelines, Essential Medicines List, reimbursement lists and asthma training materials are up-to-date with WHO-recommended essential asthma medicines.

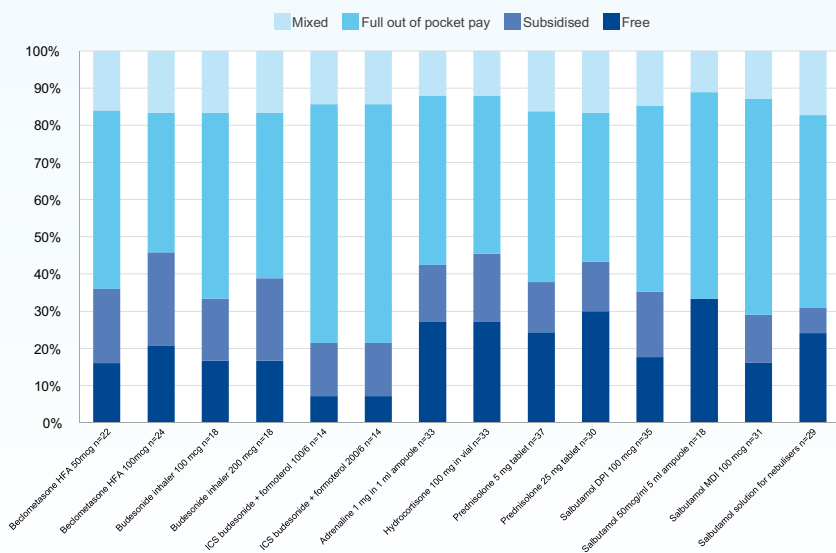


Figure 2:
Availability of WHO essential medicines in African countries



Source: Plum C et al. Int J Tuberc Lung Dis 2021.

Figure 3:
Patient payment method of essential medicines for chronic respiratory diseases



Source: Plum C et al. Int J Tuberc Lung Dis 2021.



Table 1a:

Actions within countries

- *stimulate in-country demand for essential medicines by supporting the establishment of national asthma programmes (standard case management with essential medicines)*
- *use asthma programme data to track improvements in diagnosis and reductions in emergency admissions, and to quantify the effectiveness of and need for essential medicines (cohort evaluation)*
- *engage with their professional societies, civil society, asthma patient organisations, health services to increase demand for medicines and care*
- *check healthcare workforce trainers include essential medicines in curricula and training*

Table 1b:

Actions for WHO and its influencers

- *call for WHO and partners to re-energise the piloting of national asthma programmes in LMICs with a clear systems-strengthening strategy based on essential asthma medicines*
- *engage in coordinated international advocacy for access to essential medicines*
- *advocate for WHO to be funded to add asthma essential medicines to the WHO Prequalification Programme*
- *advocate for WHO to receive adequate funding to help countries strengthen their procurement systems and practices*
- *call for their countries to apply WHO pricing policy recommendations to increase access to essential medicines*

16.

Asthma Management in LMICs

Asma El Sony, Arzu Yorgancıoğlu, Karen Bissell, Refiloe Masekela, Sarah Rylance, Guy Marks, Chen-Yuan Chiang

Although asthma is a common problem in both high-income and low- and middle-income countries (LMICs), the management of asthma is often inadequate, especially in resource-limited settings.

This chapter provides a summary of the current challenges facing asthma diagnosis and management in LMICs, and recommends forging strategic collaborations and a generic framework and guidelines for asthma in LMICs.



Management of asthma is often inadequate, especially in resource-limited settings, with a substantial proportion of individuals with uncontrolled asthma.

The recent Global Asthma Network (GAN) Phase I study revealed that among those who had asthma confirmed by doctors, the proportion of individuals with uncontrolled asthma was substantial (see Chapter 5). Among those with severe asthma symptoms, a very high proportion of children, adolescents and adults used short-acting β_2 -agonist (SABA) for symptom relief. Unfortunately, the proportion of children, adolescents and adults with severe asthma symptoms who used either inhaled corticosteroid (ICS), or ICS and long-acting β_2 -agonist in a combined inhaler was much lower than the proportion of individuals using SABA, and many of them did not use ICS for asthma management (see Chapter 5).

This is likely to be related to a number of factors including neglect of asthma, underutilisation of guidelines which include systematic strategies and effective treatments, and international leadership. To fundamentally transform the fight against asthma and to meet the United Nations' Sustainable Development Goal (SDG) Goal 3 "ensure healthy lives and promote well-being for all at all ages", there is a long way to go.

This chapter provides a summary of the current challenges facing asthma diagnosis and management in LMICs, and recommends forging strategic collaborations and a generic framework and guidelines for asthma in LMICs.

Gaps in management of asthma and chronic respiratory diseases (CRDs) in LMICs are the same as for tuberculosis (TB) initiated some decades ago. These are: lack of political commitment; delay in implementing all the currently available interventions; scarcity of funding; leadership and governance; weaknesses in health systems which are incapable

of providing effective and efficient services across the care continuum; lack of guidelines and information systems; poor or no availability and affordability of essential diagnostic tools and; most importantly, lack of availability of affordable, quality-assured, essential asthma medicines.

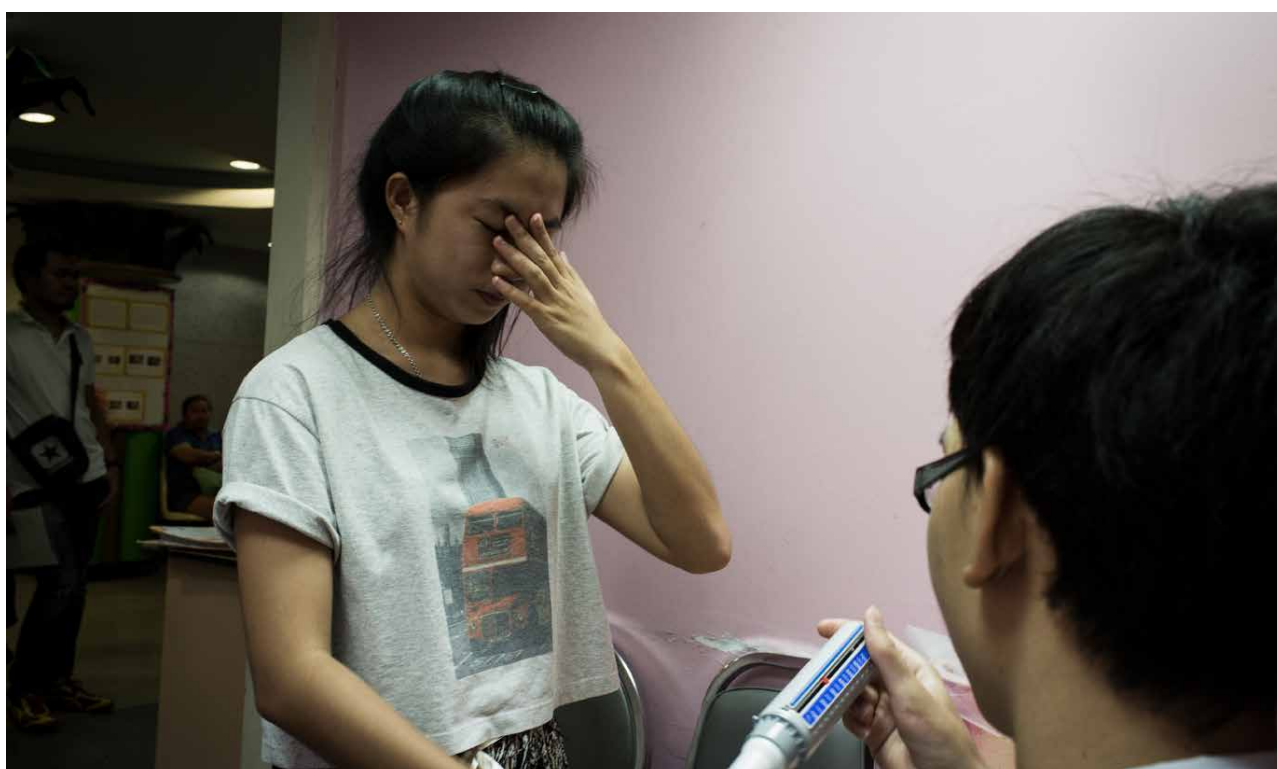
For asthma the TB programmatic management model could be implemented. This model was developed by The International Union Against Tuberculosis and Lung Disease to improve case finding and treatment for TB known as the Directly Observed Therapy Strategy (DOTS) “a cohort monitoring approach”. Both the World Health Organization (WHO) with its Practical Approach to Lung Disease (PAL) and the Global Initiative for Asthma (GINA) suggest a syndromic approach for asthma diagnosis in LMICs. The Global Alliance Against Respiratory Diseases (GARD), which is supported by WHO, advocates that the goals and action plans of CRD control

need to be tailored according to the income level of the country and approaches will be developed from available management plans and international guidelines, according to specific country needs. All stress the importance of measuring variability in airflow for confirmation, using peak flow monitoring or spirometry with reversibility testing. However, access to these tools remains limited in LMICs, such that diagnostic capacity is severely constrained. The GINA strategy is widely used in LMICs, and in 2019, GINA recommended a fundamental change in asthma management which simplifies the use of essential asthma medicines.

To fundamentally transform the fight against asthma and CRDs management in LMICs, it will strategically be essential to:

- i. achieve a high-level of political commitment and a greater investment in asthma services in LMICs

- ii. achieve rapid progress towards universal health coverage through health systems strengthening, while also ensuring universal access to quality people-centred asthma prevention and care, and other respiratory tract diseases including COVID-19
- iii. advance research and development, to address underlying drivers of morbidity and mortality as well as rapid uptake of uninterrupted supply of new and more effective tools for diagnosis, and affordable, quality-assured, essential asthma medicines
- iv. promote an up to date curriculum, programmatic management with skilled health workers, proactive utilisation of guidelines and systematic strategies with sound information system of recording and reporting for cohort evaluation



- v. promote partnership and commit stakeholders by actively engaging people and communities of those affected by asthma, and their families

In conclusion an effective asthma response requires a global, regional, and country specific approach with multi-sectorial and multi-stakeholder actions, with recognition of differences among and within countries, needs of the affected individuals, and communities. The achievement of the SDGs calls for action to address this through improved prevention and control, until a cure for asthma is found. There is an immediate need to strengthen partnership with and within international organisations working on asthma including WHO (PAL, GARD), The Union, GINA, GAN, Forum of International Respiratory Societies (FIRS) and patient organisations. These organisations need to forge strategic collaborations and recommend a generic framework and guidelines for asthma in LMICs, to ensure that quality-assured combination inhalers (Chapter 13) are also accessible and affordable in resource limited settings, safeguarding that no one is left behind.

Key Recommendation

To fundamentally transform asthma-management in LMICs, the first step is to achieve a high-level of political commitment and a greater investment in asthma services in LMICs.



17. The Role of Patient Advocacy

Tonya A Winders

The definition of advocacy found in the World Health Organization (WHO) Roll Back Malaria (RBM) Advocacy Guide (2000) is “winning the support of key constituencies in order to influence policies and spending to bring about social change.” While this definition is helpful, it is even more important to focus on the questions of “why”, “what”, “to whom” and “how”. Here we highlight answers to these questions and provide specific examples in asthma.



Why is advocacy important?

Two main reasons for engaging in advocacy exist:

1. A compelling health problem or situation that needs analysis and action. Asthma directly impacts millions of people across the world. Over half of these are living with uncontrolled disease which clearly warrants analysis and action.
2. The solution to this situation requires understanding and action by a variety of stakeholders. Asthma burden and impact cannot be mitigated by patients or healthcare providers alone. It is imperative all stakeholders come together to effect change.

Some examples of key changes sought include policy change, programme change, practice change, a change in investment or a change in awareness. An example of policy change is evidenced in USA by Allergy & Asthma Network which has worked to ensure every school in the country has access to emergency medicines for allergy and asthma. Federal and state laws have been adopted to ensure schools are prepared and protected to respond to emergency medical situations with stock medications and liability measures. An example of practice change and investment change is found across Europe where there is advancement of quality standards and reimbursement of biologics for the treatment of severe asthma.

Patient advocacy can ensure integration of patient viewpoints into planning and policy decisions.

What are the objectives of patient advocacy?

Defining the advocacy objective is the first step. This is an incremental and realistic step toward a larger goal or mission. It should focus on a specific and measurable action that an institution can take. For asthma, advocacy is deeply rooted in the concept of patient empowerment whereby asthma patients must own their needs and actively participate in managing their disease. Patient advocacy can raise awareness, educate on the prevention and management and work to improve access to appropriate treatments for patients.

One such advocacy objective is to curb the overuse of quick-relief/rescue medication in uncontrolled asthma and increase the use of maintenance/controller medication. Asthma Canada leveraged a public awareness campaign in Toronto to highlight the issue and garner the attention of the public and policymakers to evoke systems change.

To whom do patient advocates communicate?

The audience of advocacy efforts is highly dependent on the goal to be achieved in any given advocacy objective or project. Different types of audiences one may engage include politicians (local, city, state, national,

international, etc.), donors, journalists, healthcare providers, industry, the general public and non-governmental organisations.

Politicians listen and respond to voters. Several asthma patient advocacy organisations host annual advocacy days at the local, regional, national and international levels. By equipping patients to share their story in a compelling way, advocacy organisations are empowering social change.

How do patient advocacy organisations impact asthma globally?

The history and impact of asthma advocacy still varies globally; however, progress has been made in recent years. For example, The Global Initiative for Asthma (GINA) Advocates Program, now includes patient reviewers who share equal representation and voice with health professionals in providing input to GINA about report updates and dissemination. In high-income countries, especially in North America, asthma advocacy groups have significant influence over policymakers, researchers and healthcare providers. Throughout Europe and Asia Pacific, asthma advocacy organisations continue to advance clinical and translational research. For example, Asthma UK/British Lung Foundation has partnered with Allergy & Asthma Network in the USA to harmonise data across severe

asthma clinical trials. In low- and middle-income countries (LMICs) patient advocacy efforts are emerging with greater structure and resourcing. For example, in Kenya patient advocates led an effort to improve air quality by meeting with government officials and encouraging the planting of trees in urban areas near childcare centres. Advocacy is essential in these countries to ensure the local context and patient voice is not lost while improving outcomes.

Over the past twelve years, the Global Allergy & Airways Patient Platform (GAAPP) has existed to act as a global umbrella advocacy organization to better represent the collective respiratory patient voice in forums like Global Alliance Against Respiratory Diseases (GARD)/WHO, GINA, Global Initiative for Obstructive Lung Diseases (GOLD) and professional medical societies like the World Allergy Organization (WAO). By working collaboratively with these groups GAAPP raises awareness of unmet patient needs, educates on quality standards and evidence-based care pathways, and improves access to diagnostics, treatments and self-management skill development. In fact, over the past five years GAAPP has co-authored over thirty peer-reviewed articles in the medical literature to elevate the patient perspective. By working together, patients, healthcare providers, policymakers, industry and the general public can ensure the right treatment to the right patient at the right time with the fewest barriers.



Key Recommendation

Health professionals and policy makers should encourage patient advocacy to improve asthma outcomes.

Asthma, Climate Change and Planetary Health

Arzu Yorgancıoğlu, Zorana J Andersen, Kjeld Hansen, Omar Usmani, Neil Pearce, Kevin Mortimer and Achiri E Ndikum

Asthma is a common non-communicable disease with a large global burden. There is urgency and severity in the threat of climate change and planetary risk factors and it is important to understand the immediate and long term consequences of these on the burden of asthma. There are many aspects of climate change that directly impact on the health of people with asthma, including air pollutants, allergens, and high temperatures. The ecological impacts of climate change affect the planet unequally and disproportionately fall on people who already have fewer resources, increasing local, regional and planetary inequities, further reducing their resources.

Prioritising healthy air for all is essential for both human and planetary health.



Frequently, climate change is attributed to temperature increases, more extreme weather events, hot weather and heat. Excessively hot air can increase exacerbations of asthma that can result in asthma emergency hospitalisations. Warmer temperatures favour exposure to ozone, a major pollutant especially in the cities, leading to irritation of the airways that renders asthma severe. The burning of fossil fuels, waste burning, and suspension particles or sulphur dioxide (including all forms of PM_{2.5}) are important contributors. It is vital to understand how pollutants and allergens are being altered by climate change and how these affects people, especially those with asthma.

As the climate changes, natural disasters, rising temperatures, changes in rainfall patterns, photochemical reactions from heat waves creating ozone and more, are already making life challenging and more dangerous for millions of people living with asthma. Climate change can affect mental health, which in turns worsens asthma, as extreme weather events cause stress, fear, anxiety and depression. In addition, increase

in pollen and other allergens related to increase in temperatures occurs with climate change. Longer pollen seasons as well as transmission of allergens to areas that have not experienced pollen exposure in the past is a problem, especially to asthma patients who are allergic.

There is evidence around an increased risk of asthma due to indoor air pollutants (e.g cooking on an indoor open fire) or outdoor air pollutants (e.g waste burning, suspension particles or sulphur dioxide) but this is less clear and consistent than for tobacco smoke. The burning of fossil fuels is a contributor to air pollution and climate change. The mechanism of air pollution on asthma is well known with continuous inhalation of particles leading to oxidative stress, inflammation and sensitisation that can lead to increased risk of developing asthma. Air pollution also worsens the life of patients especially during short exposures, such as walking in dense traffic, which can lead to emergency hospitalisation and death. According to the World Health Organization, through birth, adolescence and beyond, air pollution principally driven by



fossil fuels, and exacerbated by climate change damages the lungs and every other vital organ.

The disruption caused by climate change to our current lives, lifestyles, economies, societies and policies could have a serious effect on access to affordable, quality-assured, essential asthma medicines which currently do not reach many people with asthma (Chapter 15). The aspects which may be adversely affected include national procurement systems, supply chains and their continuity, and affordability (costs of medicine related to income of person with asthma). As the COVID-19 pandemic has illustrated, major crises can also disrupt health systems and the availability of healthcare.

Human contributions to climate change by producing excessive greenhouse gases harm the planet and health of asthmatics. Every day billions of people are breathing polluted air and raising their risk of succumbing to a pollution-caused illness such as asthma. The Global Asthma Report demonstrates that asthma already has an impact on the lives of large numbers of people. In addition, climate extreme events and rise in

temperature will threaten food production. Also, elimination of forest in favor of farmland has contributed to the expansion of desert areas and worsening droughts that will worsen life for all people. Climate change is a crisis threatening the very existence of people around the world.

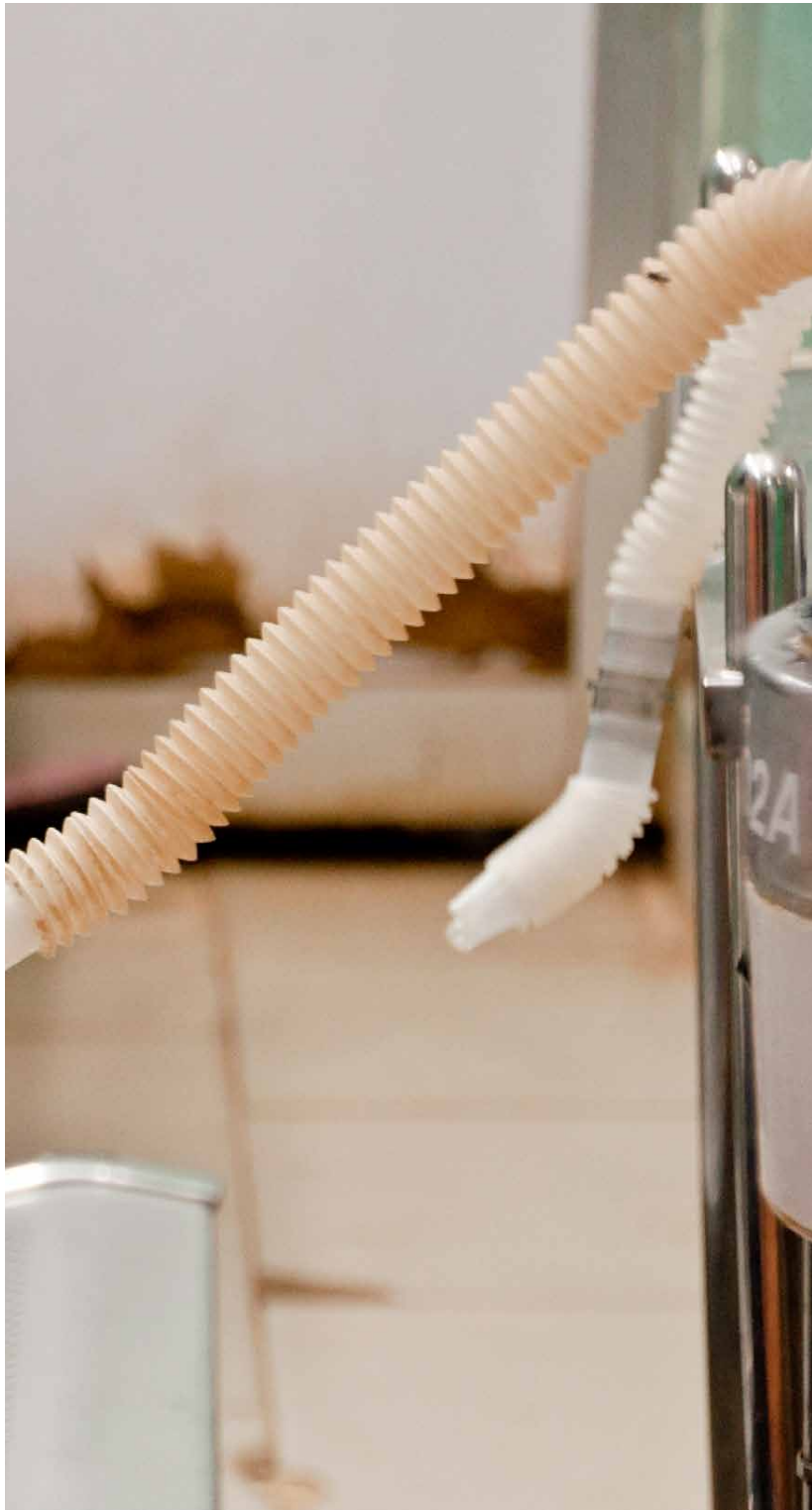
Conclusion

There is an urgent need for mitigation, adaptation and advocacy actions to curb these numerous climatic and planetary risk factors causing or worsening asthma or threatening access to asthma management. Health professionals are often recognised as being amongst the most trusted professionals in society. Their role in speaking about asthma care in relation to climate change and planetary health to the public, and decision makers can be extremely influential in support of policies that promote planetary health. Patients suffering from asthma need to be involved to support the wider transformation needed towards ending stigma from asthma and a 'net carbon-zero' economy and future planetary health.

Key Recommendation

Consider people with asthma in climate change strategies.





Appendices

Glossary	90
Appendix A : References	92
Appendix B : Authors	96
Appendix C : GAN Phase I Study Group	99
Appendix D : Acknowledgements	101

GLOSSARY

Glossary of Abbreviations

AAIP	<i>Allergy and Asthma Institute Pakistan</i>
ADF	<i>Asthma Drug Facility</i>
BiPAP	<i>Bilevel positive airways pressure</i>
CME	<i>Continued medical education</i>
CMSs	<i>Central medical stores</i>
COPD	<i>Chronic obstructive pulmonary disease</i>
COVID-19	<i>Coronavirus disease 2019</i>
CPAP	<i>Continuous positive airways pressure</i>
CRD	<i>Chronic respiratory diseases</i>
DALYs	<i>Disability adjusted life years</i>
DOTS	<i>Directly observed treatment, short-course</i>
ED	<i>Emergency Department</i>
EML	<i>Essential Medicines List</i>
EMRO	<i>Eastern Mediterranean Region</i>
FIRS	<i>Forum of International Respiratory Societies</i>
GAAPP	<i>Global Allergy and Airways Patient Platform</i>
GAN	<i>Global Asthma Network</i>
GAR	<i>Global Asthma Report</i>
GARD	<i>Global Alliance against Chronic Respiratory Diseases</i>
GBD	<i>Global Burden of Disease</i>
GEMA	<i>Guía Española para el Manejo del Asma</i>
GINA	<i>Global Initiative for Asthma</i>
GOLD	<i>Global Initiative for Obstructive Lung Diseases</i>
HCC	<i>Healthy Caribbean Coalition</i>
HDI	<i>Human Development Index</i>
ICS	<i>Inhaled corticosteroids</i>
ICS+LABA	<i>Combinations of ICS and LABA</i>
IMSS	<i>Instituto Mexicano de Seguro Social</i>
INSABI	<i>National Instituto de Salud para el Bienestar</i>
ISAA	<i>Iranian Society of Asthma and Allergy</i>
ISAAC	<i>International Study of Asthma and Allergies in Childhood</i>
ISSSTE	<i>Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado</i>
KSA	<i>Kingdom of Saudi Arabia</i>
LABA	<i>Long-acting β_2-agonist</i>
LMICs	<i>Low- and middle-income countries</i>
LTRA	<i>Leukotriene receptor antagonists</i>

MDI	<i>Metered dose inhaler</i>
MHE	<i>Ministry of Higher Education</i>
MIA	<i>Manejo Integral del Asma</i>
MOH	<i>Ministry of Health</i>
NACP	<i>National Asthma Control Program</i>
NCD	<i>Non-communicable disease</i>
NGOs	<i>Non-governmental organisations</i>
NO ₂	<i>Nitrogen dioxide</i>
NRAD	<i>National Review of Asthma Deaths</i>
NZ	<i>New Zealand</i>
OCS	<i>Oral corticosteroids</i>
OR	<i>Odds ratios</i>
oSABA	<i>Oral SABA</i>
PACK	<i>Package of Care Kit</i>
PAL	<i>Practical Approach to Lung Disease</i>
PATS	<i>Pan African Thoracic Society</i>
PEN	<i>Package of essential non-communicable disease Interventions for primary health care</i>
PHCs	<i>Public Health Centres</i>
PIPA	<i>Children's Asthma Prevention Program</i>
PM _{2.5}	<i>Particulate matter 2.5 microns</i>
PTLD	<i>Post-tuberculosis lung disease</i>
<i>r</i>	<i>Rank correlation</i>
RBM	<i>Roll Back Malaria</i>
SABA	<i>Short-acting β₂-agonists</i>
SARS-CoV-2	<i>Severe acute respiratory syndrome coronavirus 2</i>
SDG	<i>Sustainable Development Goals</i>
SINA	<i>Saudi Initiative for Asthma</i>
TB	<i>Tuberculosis</i>
<i>The Union</i>	<i>International Union against Tuberculosis and Lung Disease</i>
TRAP	<i>Traffic related air pollution</i>
WAO	<i>World Allergy Organization</i>
WHO	<i>World Health Organization</i>
YLD	<i>Years lived with disability</i>
YLL	<i>Years of life lost</i>

APPENDIX A: REFERENCES

REFERENCES FOR TEXT, TABLES AND FIGURES

1. Global Asthma Network

Ellwood P, Asher I, Billo N, et al. The Global Asthma Network rationale and methods for Phase I global surveillance: prevalence, severity, management and risk factors. *Eur Resp J* 2017;49:1601605.

Global Asthma Network Steering Group. Global Asthma Network Website: Global Asthma Network; 2012. Available from: <http://www.globalasthmanetwork.org>.

Global Asthma Reports. Available from <http://globalasthmareport.org/>.

Figure source: Global Asthma Network. March 2022.

2. Asthma and Factors Affecting it

Global Initiative for Asthma. Global strategy for asthma management and prevention, 2021. Available from www.ginasthma.org.

Holgate ST. A brief history of asthma and its mechanisms to modern concepts of disease and pathogenesis. *Allergy Asthma Immunol Res* 2010 July;2:165-171.

Pavord ID, Beasley R, Agusti A, et al. After asthma: redefining airways diseases. *Lancet*. 2018;391:350-400.

Silverwood R, Rutter C, Mitchell E, et al. Are environmental risk factors for current wheeze in the International Study of Asthma and Allergies in Childhood (ISAAC) Phase Three due to reverse causation? *Clin Exp Allergy* 2019;49:430-441.

Weinmayr G, Weiland SK, Björkstén B, et al. Atopic sensitization and the international variation of asthma symptom prevalence in children. *Am J Respir Crit Care Med* 2007;176:565-574.

Figure source: Weinmayr G, Weiland SK, Björkstén B, et al. Atopic sensitization and the international variation of asthma symptom prevalence in children. *Am J Respir Crit Care Med* 2007; 176: 565-74.

3. The Global Burden of Asthma

Asher I, Pearce N. Global burden of asthma among children. *Int J Tuberc Lung Dis* 2014;18:1269-78.

Asher MI, Rutter CE, Bissell K, et al. Is the worldwide burden of asthma symptoms in school children changing? Global Asthma Network Phase I: repeated cross-sectional studies. *Lancet* 2021;398:1569-80.

García-Marcos L, Asher MI, Pearce N, et al. The burden of asthma, hay fever and eczema in children in 25 countries. *GAN Phase I study*. *Eur Respir J* 2022 Feb 10;2102866. doi: 10.1183/13993003.02866-2021. Online ahead of print.

GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020;396:1204-1222 and S108-S109.

Mortimer K, Lesosky M, García-Marcos L, et al. The

burden of asthma, hay fever and eczema in adults in 17 countries: *GAN Phase I study*. *Eur Respir J* 2022 Feb 24;2102865. doi: 10.1183/13993003.02865-2021. Epub ahead of print.

Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. *Lancet* 2012;380:2129–2143.

Figures 1 and 2 sources: García-Marcos L, Asher MI, Pearce N, et al. The burden of asthma, hay fever and eczema in children in 25 countries. *GAN Phase I study*. *Eur Respir J* 2022; 2102866. doi: 10.1183/13993003.02866-2021. Online ahead of print; Lai CKW, Beasley R, Crane J, et al. Global variation in the prevalence and severity of asthma symptoms: Phase Three of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* 2009; 64: 476–483; The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *Eur Respir J* 1998; 12: 315-335.

Figure 3 source: Mortimer K, Lesosky M, García-Marcos L, et al. The burden of asthma, hay fever and eczema in adults in 17 countries: *GAN Phase I study*. *Eur Respir J* 2022; 2102865. doi: 10.1183/13993003.02865-2021. Epub ahead of print.

Figure 4 sources: García-Marcos L, Asher MI, Pearce N, et al. The burden of asthma, hay fever and eczema in children in 25 countries. *GAN Phase I study*. *Eur Respir J* 2022; 2102866. doi: 10.1183/13993003.02866-2021. Online ahead of print; Mortimer K, Lesosky M, García-Marcos L, et al. The burden of asthma, hay fever and eczema in adults in 17 countries: *GAN Phase I study*. *Eur Respir J* 2022; 2102865. doi: 10.1183/13993003.02865-2021. Epub ahead of print.

4. Asthma Deaths

Anderson HR, Gupta R, Kapetanakis, et al. International correlations between indicators of prevalence, hospital admissions and mortality for asthma in children. *Int J Epidemiol* 2008;37:573-582.

Asher I, Bissell K, Chiang CY, et al. Calling time on asthma deaths in tropical regions - how much longer must people wait for essential medicines? *Lancet Respir Med* 2019;7:13-15.

Chatenoud L, Malvezzi M, Pitrelli A, et al. Asthma mortality and long-acting beta2-agonists in five major European countries, 1994-2004. *J Asthma* 2009;46:546-551.

Ebmeier S, Thayabaran D, Braithwaite I, et al. Trends in international asthma mortality: analysis of data from the WHO Mortality Database from 46 countries (1993-2012). *Lancet* 2017;390:935-945.

GBD 2019 Diseases and Injuries Collaborators. Global

burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020;396:1204-1222 and S108-S109.

Royal College of Physicians (UK). Why asthma still kills. The National Review of Asthma Deaths Confidential Enquiry Report, May 2014. London: RCP, 2014.

Figure 1 source: WHO Mortality Database updated from http://www.who.int/healthinfo/statistics/mortality_rawdata/en/ [version dated 1 October 2017]. Population denominators from UN World Population Prospects, June 2017 revision <http://data.un.org/Data.aspx?d=POP&f=tableCode%3A22> [Accessed 8 January 2018]. Income groups based on the World Bank 2014 definitions <https://blogs.worldbank.org/opendata/new-country-classifications> [Accessed 11 January 2018].

Figure 2 sources: WHO Mortality Database updated from http://www.who.int/healthinfo/statistics/mortality_rawdata/en/ [version dated 1 October 2017]. Eurostat: <http://ec.europa.eu/eurostat/web/health/health-care/data/database> [version dated 16 November 2017].

Figure 3 sources: Anderson HR, Gupta R, Kapetanakis V, et al. International correlations between indicators of prevalence, hospital admissions and mortality for asthma in children. *Int J Epidemiol* 2008;37:573-82.; Pearce N, Ait-Khaled N, Beasley R, et al. Worldwide trends in the prevalence of asthma symptoms: Phase III of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* 2007;62:758-66.

Figure 4 source: Asher MI, Rutter CE, Bissell K, et al. Is the worldwide burden of asthma symptoms in school children changing? Global Asthma Network Phase I: repeated cross-sectional studies. *Lancet* 2021;398:1569-80.

5. Global Asthma Management and Asthma Control

Akinbami LJ, Salo PM, Cloutier MM, et al. Primary care clinician adherence with asthma guidelines: the National Asthma Survey of Physicians. *J Asthma* 2020;57:543-55.

Asher I, Bissell K, Chiang CY, et al. Calling time on asthma deaths in tropical regions - how much longer must people wait for essential medicines? *Lancet Respir Med* 2019;7:13-5.

Bissell K, Ellwood P, Ellwood E, et al. Essential Medicines at the National Level: The Global Asthma Network's Essential Asthma Medicines Survey 2014. *Int J Environ Res Public Health* 2019;16:605.

Bush A. Management of asthma in children. *Minerva Pediatr* 2018; 70: 444-57.

Knibb RC, Alviani C, Garriga-Baraut T, et al. The effectiveness of interventions to improve self-

management for adolescents and young adults with allergic conditions: A systematic review. *Allergy* 2020;75:1881-98.

Figures 1 and 2 source: García-Marcos L, Chiang C-Y, Asher MI, et al. Asthma management and control in children, adolescents and adults: the Global Asthma Network (GAN) Phase I cross sectional study. 2022; Submitted.

6. COVID-19 and Asthma

Abrams EM, Sinha I, Fernandes RM, Hawcutt DB. Pediatric asthma and COVID-19: The known, the unknown, and the controversial. *Pediatr Pulm* 2020;55:3573-3578.

Chiang C-Y, Ellwood P, Ellwood E, et al. Infection with SARS-CoV-2 among children with asthma: evidence from Global Asthma Network. *Pediatr Allergy Immunol*. 2022;33:e13709. doi:10.1111/pai.13709.

Papadopoulos NG, Mathioudakis AG, Custovic A, et al. Childhood asthma outcomes during the COVID-19 pandemic: Findings from the PeARL multinational cohort. *Allergy* 2021;76:1765-1775.

Viner RM, Mytton OT, Bonell C, et al. Susceptibility to SARS-CoV-2 Infection Among Children and Adolescents Compared With Adults: A Systematic Review and Meta-analysis. *JAMA Pediatrics* 2021;175:143-156.

Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA* 2020; 323:1239-1242.

Figures 1, 2 and table source: Chiang C-Y, Ellwood P, Ellwood E, et al. Infection with SARS-CoV-2 among children with asthma: evidence from Global Asthma Network. *Pediatr Allergy Immunol*. 2022; 33:e13709 doi: 10.1111/pai.13709.

7. Asthma in the African region

Baard CB, Franckling-Smith Z, Munro J, et al. Asthma in South African adolescents: a time trend and risk factor analysis over two decades. *ERJ Open Res*. 2021;7:00576-2020.

Ozoh OB, Aderibigbe SA, Ayuk AC, et al. The prevalence of asthma and allergic rhinitis in Nigeria: A nationwide survey among children, adolescents and adults. *PLoS One*. 2019;14:e0222281.

Ozoh OB, Eze JN, Garba BI, et al. Nationwide survey of the availability and affordability of asthma and COPD medicines in Nigeria. *Trop Med Int Health*. 2021;26:54-65.

State of Global Air Report 2020: <https://fundacionio.com/wp-content/uploads/2020/10/soga-2020-report.pdf>.

South Africa Table sources: Asher MI, Rutter CE, Bissell K, et al. Is the worldwide burden of asthma

symptoms in school children changing? Global Asthma Network Phase I: repeated cross-sectional studies. *Lancet* 2021;398:1569-80; Zar HJ, Ehrlich RI, Workman L, Weinberg EG. The changing prevalence of asthma from 1995 to 2002. *Pediatr Allergy Immunol* 2007;18:560-565.

8. Asthma in the Region of the Americas

Del-Río-Navarro BE, Berber A, Reyes-Noriega N, et al. Global Asthma Network Phase I study in Mexico: prevalence of asthma symptoms, risk factors and altitude associations—a cross-sectional study. *BMJ Open Respir Res*. 2020 Dec;7:e000658. doi: 10.1136/bmjresp-2020-000658.

Estela DB, Arturo B, Nayely RN, et al. Have asthma symptoms in Mexico changed in the past 15 years? Time trends from the International Study of Asthma and Allergies in Childhood to the Global Asthma Network. *Allergol Immunopathol (Madr)*. 2021 Jan 2;49:1-10. doi: 10.15586/aei.v49i1.35.

<http://isaac.auckland.ac.nz/phases/phasethree/results/results.php>, 14th December 2021.

<https://www.inegi.org.mx/>, 14th December 2021.

Larenas-Linnemann D, Salas-Hernández J, Del-Río-Navarro BE et al. MIA 2021, Manejo Integral del Asma. Lineamientos para México [MIA 2021, Comprehensive Asthma Management. Guidelines for Mexico]. *Rev Alerg Mex*. 2021;68 Suppl 1:s1-s122. Spanish. doi: 10.29262/ram.v68i5.880.

Soto Martínez M, Yock Corrales A, Aglietti F, et al. Change in the prevalence of asthma and rhinitis related symptoms in school-aged children and adolescents in Costa Rica. *Eur Respir J* 2020 56:3119; DOI 10.1183/13993003.congress-2020.3119.

Tratamiento del asma en edad pediátrica. Guía de Práctica Clínica: Evidencias y Recomendaciones. México, CENETEC; 2020 [fecha de consulta]. Disponible en: <http://www.cenetecdifusion.com/CMGPC/GPC-SS-009-20/ER.pdf>.

Urrutia-Pereira M, Chong-Neto H, Mocellin LP, et al. Prevalence of asthma symptoms and associated factors in adolescents and adults in southern Brazil: A Global Asthma Network Phase I study. *World Allergy Organ J*. 2021 Mar 17;14:100529. doi: 10.1016/j.waojou.2021.100529.

9. Asthma in the Eastern Mediterranean Region

Asthma-webpage at KSA MOH-website: <https://www.moh.gov.sa/en/awarenessplatform/VariousTopics/Pages/Asthma.aspx>.

Chiang C-Y, Ait-Khaled N, Bissell K, Enarson DA. Management of asthma in resource-limited settings: role of low cost corticosteroid/ β -agonist combination inhaler. *Int J Tuberc Lung Dis* 2015;19:129-136.

El Sony A, Chiang C-Y, Malik E, et al. Standard case management of asthma in Sudan: a pilot project. *Public Health Action*. 2013 Sep 21;3:247-252.

Fazlollahi MR, Najmi M, Fallah Nezhad M, et al. Paediatric asthma prevalence: The first national population-based survey in Iran. *Clinical Respiratory J* 2019;13:14-22.

Global Initiative for Asthma. Global Strategy for Asthma management and prevention, 2021. Available from: www.ginasthma.org.

<http://www.pakistanchestociety.pk/asthma-guidelines/>.

Mallol J, Crane J, Von Mutius E et al. The International Study for Asthma and Allergies in Childhood. (ISAAC phase III) a global synthesis. *Allergol Immunopathol (Madr)*. 2013;41:73-85.

Mohammad Y, Brough G. The impact of conflict on asthma. *J Thorac Dis* 2019;11:3202-3206. doi: 10.21037/jtd.2019.07.1.

Mohammad Y, Shaaban R, Salman HA, Shabraq BN, Dubaybo B. Improving the quality of hospital care provided for asthma out-patients in a country in turmoil: a report from Syria. *J Thorac Dis*. 2019;11:1047-1055. doi: 10. jtd.2019.02.76.21037/ .

Mohammad Y, Waked M, Hamzaoui A. (2019) Chronic Respiratory Diseases in the Arab World. In: Laher I (eds) *Handbook of Healthcare in the Arab World*. Springer, Cham.

To T, Viegi G, Cruz A, et al. A global respiratory perspective on the COVID-19 pandemic: commentary and action proposals. *Eur Respir J*. 2020;56:2001704.

Sudan Figure 1 source: El Sony A, Chiang C-Y, Malik E, et al. Standard case management of asthma in Sudan: a pilot project. *Public Health Action*. 2013 Sep 21;3:247-252.

Figures 2 and 3 source: El Sony A et al. The International Multidisciplinary Programme to Address Lung Health and TB in Africa "IMPALA" unpublished.

Table sources: Asher MI, Rutter CE, Bissell K, et al. Is the worldwide burden of asthma symptoms in school children changing? Global Asthma Network Phase I: repeated cross-sectional studies. *Lancet* 2021;398:1569-80; Lai CKW, Beasley R, Crane J, et al. Global variation in the prevalence and severity of asthma symptoms: Phase Three of the International Study of Asthma and Allergies in Childhood (ISAAC). *Thorax* 2009;64:476-483; The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Worldwide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *Eur Respir J* 1998; 12: 315-335.

10. Asthma in the European Region

Banteva MN, Manoshkina EM, Sokolovskaya TA, Matveev EN. Trends in incidence and dynamics of chronic pathology in children aged 0-14 in the Russian Federation. *Social'nye aspekty zdorov'a*

APPENDIX A: REFERENCES (cont.)

- naselenia / Social aspects of population health [serial online] 2019; 65(5):10. Available from: <http://vestnik.mednet.ru/content/view/1105/30/lang.ru/>. (In Rus).
- Haahela T, Herse F, Karjalainen J, et al. The Finnish experience to save asthma costs by improving care in 1987-2013. *J Allergy Clin Immunol*. 2017;139:408-414.
- Ntzounas A, Giannakopoulos I, Lampropoulos P, et al. Changing trends in the prevalence of childhood asthma over 40 years in Greece. *Pediatr Pulmonol* 2021;56:3242-3249.
- World Bank. 2019. Air Pollution Management in Kosovo. World Bank, Washington, DC. © World Bank. <https://openknowledge.worldbank.org/handle/10986/33041> (accessed 10/15/2021).
- 11. Asthma in the South-East Asian Region**
- Danansuriya MN, Rajapaksa LC, Weerasinghe A. Genetic, familial and environmental correlates of asthma among early adolescents in Sri Lanka: a case control study. *World Allergy Organization Journal* 2015; 8:19.
- GBD compare, Viz hub. (2021, June 30). Retrieved from <https://vizhub.healthdata.org/gbd-compare/>.
- Gunasekera KD, Amarasinghe DL, Fernando A, Wickramasinghe R, The prevalence of asthma and related atopic diseases in Sri Lankan children from 2001 to 2013 utilizing the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire. *Eur Resp J* 2018 52:PA4609; doi: 10.1183/13993003.congress-2018.PA4609.
- Nandasena S, Wickremasinghe AR, Sathikumar N. Respiratory health status of children from two different air pollution exposure settings of Sri Lanka: a cross-sectional study. *Am J Ind Med*. 2012;55:1137-45.
- Senaratne R & Mendis S (Editors). (2018). Prevention and Control of Noncommunicable Diseases: Think Globally - Act Locally; Lessons from Sri Lanka. Ministry of Health, Nutrition and Indigenous Medicine, Sri Lanka. ISBN 978- 955 -3666-20 - 8.
- Singh V, Gupta R. Influence of a Clinic-Based Group Intervention on Asthma Perception and Management in India. *J Asthma & Allergy Educators* 2011;2:71-74.
- Singh V, Sinha HV, Gupta R. Barriers in the management of asthma and attitudes towards complementary medicine. *Respiratory Medicine* 2002; 96:835-840.
- 12. Asthma in the Western Pacific Region**
- Asher MI, Rutter CE, Bissell K, et al. Worldwide trends in the burden of asthma symptoms in school-aged children: Global Asthma Network Phase I cross-sectional study. *Lancet* 2021;398:1569-1580.
- Asher MI, Stewart AW, Clayton T, et al. Has the prevalence and severity of symptoms of asthma changed among children in New Zealand? ISAAC Phase Three. *NZ Medical J* 2008; 121, 52-63.
- Ding B, Small M. Disease burden of mild asthma in China. *Respirology* 2018;23:369-77.
- Feng ML, Yang ZW, Pan LY, et al. Associations of Early Life Exposures and Environmental Factors With Asthma Among Children in Rural and Urban Areas of Guangdong, China. *Chest* 2016;149:1030-41.
- Foliaki S. Epidemiology of Asthma in Selected Pacific countries. May 2007. https://mro.massey.ac.nz/bitstream/handle/10179/1565/02_whole.pdf?sequence=1&isAllowed=y.
- Huang K, Yang T, Xu J, et al. Prevalence, risk factors, and management of asthma in China: a national cross-sectional study. *Lancet* 2019;394:407-18.
- Hsieh KH, Shen JJ. Prevalence of childhood asthma in Taipei, Taiwan, and other Asian Pacific countries. *J Asthma* 1988;25:73-82.
- Li J, Wang H, Chen Y, et al. House dust mite sensitization is the main risk factor for the increase in prevalence of wheeze in 13-to-14-year-old schoolchildren in Guangzhou city, China. *Clin Exp Allergy* 2013;43:1171-79.
- Yan DC, Ou LS, Tsai TL, et al. Prevalence and severity of symptoms of asthma, rhinitis, and eczema in 13- to 14-year-old children in Taipei, Taiwan. *Ann Allergy Asthma Immunol* 2005;95:579-85.
- Yeh KW, Chiang LC, Huang JL. Epidemiology and current status of asthma and associated allergic diseases in Taiwan- ARIA Asia-Pacific Workshop report. *Asian Pac J Allergy Immunol* 2008;26:257-64.
- Taiwan Figure 1 source: Asher MI, Rutter CE, Bissell K, et al. Is the worldwide burden of asthma symptoms in school children changing? Global Asthma Network Phase I: repeated cross-sectional studies. *Lancet* 2021;398:1569-80.
- New Zealand Table source: Asher MI, Rutter CE, Bissell K, et al. Is the worldwide burden of asthma symptoms in school children changing? Global Asthma Network Phase I: repeated cross-sectional studies. *Lancet* 2021; 398:1569-80.
- 13. New Approaches with Asthma Medicines**
- Chiang C-Y, Ait-Khaled N, Bissell K, Enarson DA. Management of asthma in resource-limited settings: role of low cost corticosteroid/ β -agonist combination inhaler. *Int J Tuberc Lung Dis* 2015;19:129-136.
- Crossingham I, Turner S, Ramakrishnan S, et al. Combination fixed-dose beta agonist and steroid inhaler as required for adults or children with mild asthma. *Cochrane Database of Systematic Reviews* 2021; 5(5):CD013518. doi: 10.1002/14651858.CD013518.pub2.
- Global Initiative for Asthma. Global Strategy for Asthma management and prevention, 2021. Available from: www.ginasthma.org.
- O'Byrne PM, FitzGerald JM, Bateman ED, et al. Inhaled Combined Budesonide-Formoterol as Needed in Mild Asthma. *New Engl J Med* 2018; 378: 1865-76.
- Reddel HK, FitzGerald JM, Bateman ED, et al. GINA 2019: a fundamental change in asthma management. *Eur Respir J* 2019; 53: 1901046.
- 14. Asthma in the Context of other Chronic Respiratory Diseases in LMICs.**
- Allwood BW, van der Zalm MM, Amaral AFS, et al. Post-tuberculosis lung health: perspectives from the First International Symposium. *Int J Tuberc Lung Dis* 2020 Aug 1;24:820-828.
- Knowledge Translation Unit, University of Cape Town. Practical Approach to Care Kit (PACK): PACK overview. <https://knowledge.translation.co.za/pack/>.
- Meghji J, Mortimer K, Agusti A, et al. Improving lung health in low-income and middle-income countries: from challenges to solutions. *Lancet* 2021; 397: 928-40.
- van Gassel RJJ, Bels J, Remij L, et al. Functional Outcomes and Their Association With Physical Performance in Mechanically Ventilated Coronavirus Disease 2019 Survivors at 3 Months Following Hospital Discharge: A Cohort Study. *Crit Care Med* 2021;49:1726-1738.
- World Health Organization. Package of essential noncommunicable (PEN) disease interventions for primary health care in low-resource settings. *World Health Organization* 2010 https://www.who.int/ncds/management/pen_tools/en/.
- Figures 1 and 2 source: Meghji J, Mortimer K, Agusti A, et al. Improving lung health in low-income and middle-income countries: from challenges to solutions. *Lancet* 2021; 397: 928-40.
- 15. Improving Access to Essential Asthma Medicines**
- Ozoh OB, Eze JN, Garba BI, et al. Nationwide survey of the availability and affordability of asthma and COPD medicines in Nigeria. *Trop Med Int Health* 2021;26:54-65.
- Plum C, Stolbrink M, Zurba L, et al. Availability of diagnostic services and essential medicines for non-communicable respiratory diseases in African countries. *Int J Tuberc Lung Dis* 2021;25:120-125.
- Sanyang B, Jagne E, Sefa N, Touray S. Availability, cost, and affordability of asthma and chronic obstructive pulmonary disease medications in The Gambia. *J Pan Afr Thorac Soc* 2021;2:33-41.
- World Health Organization. WHO guideline on country pharmaceutical pricing policies. 2nd ed. World Health Organization, 2020.
- World Health Organization. Selection of essential medicines at country level: using the WHO model list of essential medicines to update a national essential medicines list. World Health Organization, 2020.

Figure 1 source: Ozoh OB, Eze JN, Garba BI, Ojo OO, Okorie EM, Yiltok E et al. Nationwide survey of the availability and affordability of asthma and COPD medicines in Nigeria. *Trop Med Int Health* 2021;26:54-65. Doi:10.1111/tmi.13497.

Figures 2 and 3 source: Plum C, Stolbrink M, Zurba L, Bissell K, Ozoh BO, Mortimer K. Availability of diagnostic services and essential medicines for non-communicable respiratory diseases in African countries. *Int J Tuberc Lung Dis* 2021;25:120-125.

16. Asthma Management in Low- and Middle-Income Countries

Ait-Khaled N, Enarson DA. Management of Asthma: the essentials of good clinical practice. *Int J Tuberc Lung Dis*. 2006;10:133-7.

Chiang C-Y, Ait-Khaled N, Bissell K, Enarson DA. Management of asthma in resource-limited settings: role of low cost corticosteroid/ β -agonist combination inhaler. *Int J Tuberc Lung Dis* 2015;19:129-136.

Global Initiative for Asthma. Global Strategy for Asthma management and prevention, 2021. Available from: www.ginasthma.org.

Reddel HK, FitzGerald JM, Bateman ED, et al. GINA 2019: a fundamental change in asthma

management. *Eur Respir J*. 2019; 53:1901046.

WHO Guidelines Approved by the Guidelines Review Committee. Practical Approach to Lung Health: Manual on Initiating PAL Implementation. Geneva: World Health Organization 2008.

17. The Role of Patient Advocacy

Global Partnership to Roll Back Malaria. (2000). RBM advocacy guide. World Health Organization. <https://apps.who.int/iris/handle/10665/66634>.

Haughney J, Winders TA, Holmes S, et al. Global Quality Standard for Identification and Management of Severe Asthma. *Advances in Therapy* 2020;37: 3645-3659.

Mathioudakis AG, Custovic A, Deschildre A, et al. Research Priorities in Pediatric Asthma: Results of a Global Survey of Multiple Stakeholder Groups by the Pediatric Asthma in Real Life (PeARL) Think Tank. *J Allergy Clin Immunol Pract* 2020; 8:1953-1960.

Os-Medendorf H, Deprez E, Maes N, et al. The Role of the Nurse in the Care and Management of Patients with Atopic Dermatitis. *BMC Nursing* 2020;19:102.

Winders T, Maspero J, Callan L, Al-Ahmad M. Perspectives on Decisions for Treatment and Care in Severe Asthma. *World Allergy Organization Journal* 2021;14:100500.

Winders TA, Wilson AM, Fletcher MJ, et al. A patient-centered description of severe asthma: Patient understanding leading to assessment for a severe asthma referral (PULSAR). *Patient* 2019;12:539-549.

18. Asthma, Climate Change and Planetary Health

Clean air statement-International Day of Clean Air for Blue Skies <https://www.cleanairblueskies.org/statement/message-international-day-clean-air-blue-skies-un-secretary-general-antonio-guterres>. <https://www.ersnet.org/news-and-features/news/ers-publishes-position-statement-asthma-environment/>.

Sanson A, Van Hoorn J, Burke S. Responding to the Impacts of the Climate Crisis on Children and Youth. *Child Development Perspectives* 2019;13:201-207. United Nations Children's Fund (UNICEF). Clear the air for children. The impact of air pollution on children. UNICEF October 2016 ISBN: 978-92-806-4854.

World Bank; Institute for Health Metrics and Evaluation. The Cost of Air Pollution: Strengthening the Economic Case for Action. World Bank, Washington, 2016. DC.



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