



# *Impact of Environment on Health. What are the challenges?*

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# The impact of the environment on health by country: a meta-synthesis

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**Background:** Health gains that environmental interventions could achieve are main questions when choosing environmental health action to prevent disease. The World Health Organization has recently released profiles of environmental burden of disease for 192 countries.

**Methods:** These country profiles provide an estimate of the health impacts from the three major risk factors 'unsafe water, sanitation & hygiene', 'indoor air pollution from solid fuel use' and 'outdoor air pollution'. The profiles also provide an estimate of preventable health impacts by the environment as a whole. While the estimates for the three risk factors are based on country exposures, the estimates of health gains for total environmental improvements are based on a review of the literature supplemented by expert opinion and combined with country health statistics.

**Results:** Between 13% and 37% of the countries' disease burden could be prevented by environmental improvements, resulting globally in about 13 million deaths per year. It is estimated that about four million of these could be prevented by improving water, sanitation and hygiene, and indoor and outdoor air alone. The number of environmental DALYs per 1000 capita per year ranges between 14 and 316 according to the country. An analysis by disease group points to main preventions opportunities for each country.

**Conclusion:** Notwithstanding the uncertainties in their calculation, these estimates provide an overview of opportunities for prevention through healthier environments. The estimates show that for similar national incomes, the environmental burden of disease can typically vary by a factor five. This analysis also shows that safer water, sanitation and hygiene, and safer fuels for cooking could significantly reduce child mortality, namely by more than 25% in 20 of the lowest income countries.

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# Environmental burden of Disease

**Part 1**

**Environmental burden of disease for selected risk factors, per year**

Risk factor	Exposure	Deaths /year	DALYs/ 1000 cap /year
Water, sanitation and hygiene diarrhoea only	Improved water: 90%	15 000	3.6
	Improved sanitation: 75%		
Indoor air	SFU% households: 13%	4 100	0.6
Outdoor air	Mean urban PM10: 35 ug/m3	12 900	0.6
Main malaria vectors	<i>A. darlingi, A. nuneztovari, A. triannulatus</i>		
Main other vectors	<i>Lutzomyia intermedia, L. wellcomei, L. pessoai, Culex quinquefasciatus</i>		

Indicates the DALYs/1000 capita preventable through healthier environments could be used for inter-country comparison

**Part 2**

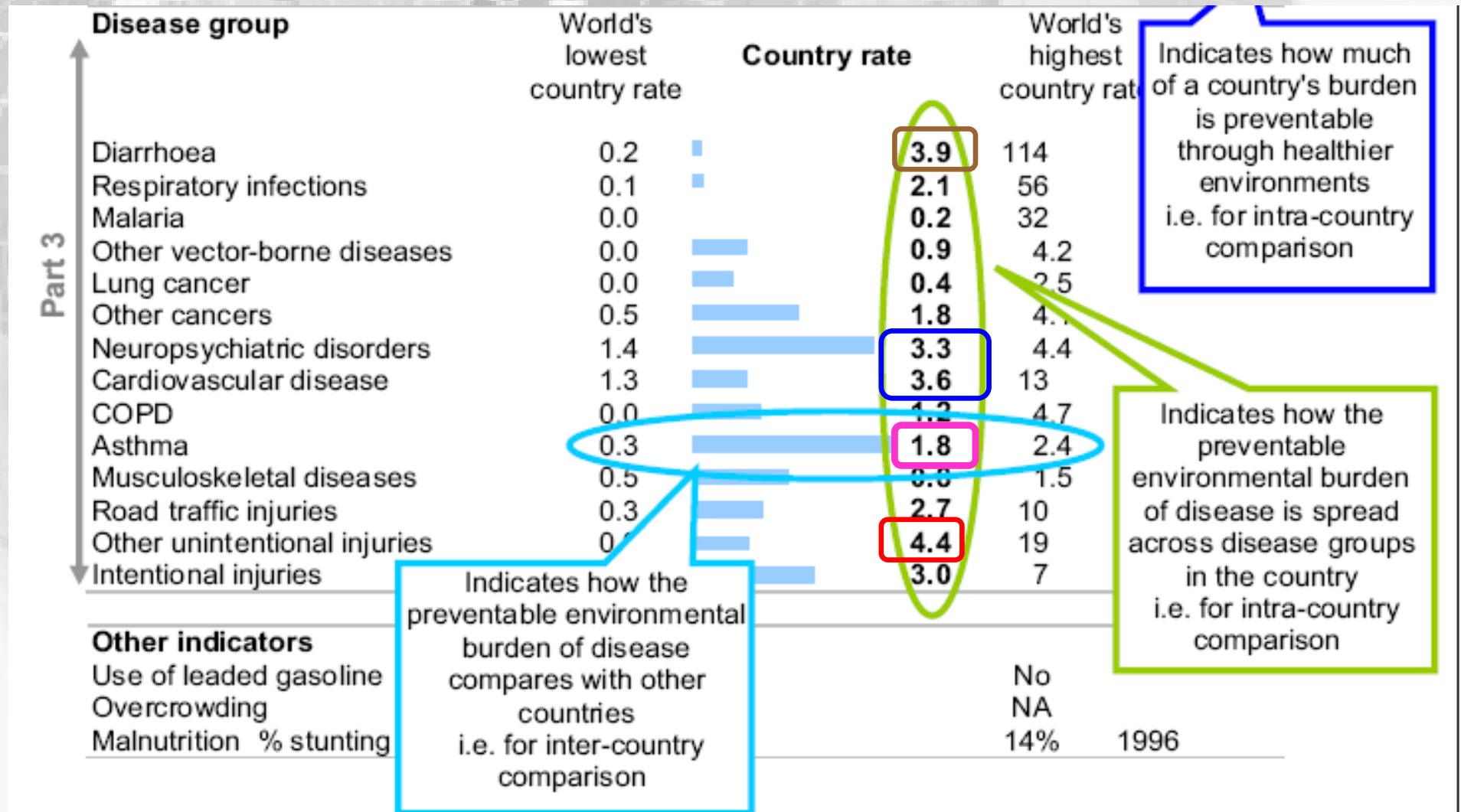
**Environmental burden of disease (preliminary), per year**

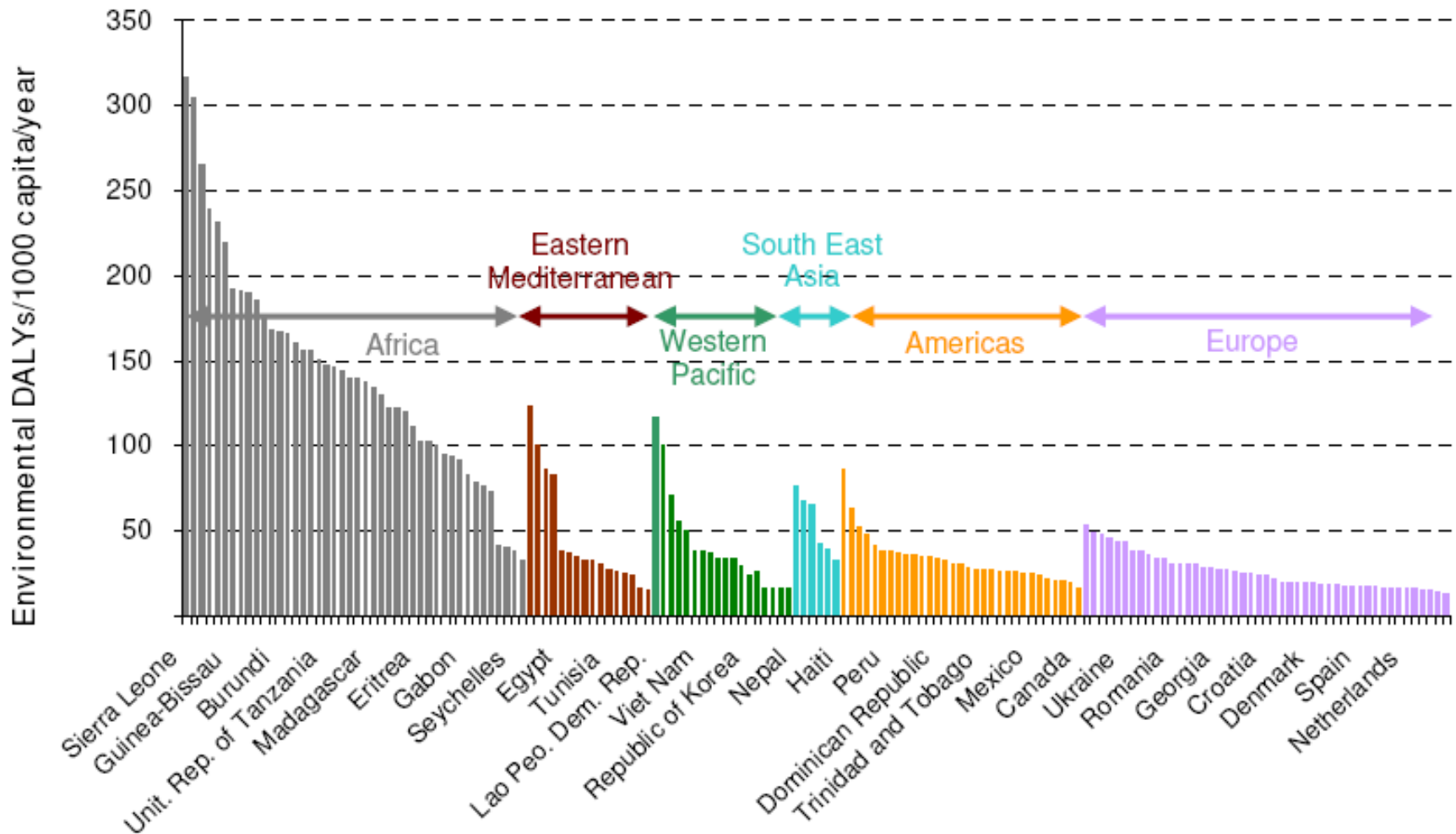
Estimate based on regional exposure and national health statistics 2004		
DALYs/1000 cap	World - best: 14 worst: 316	37
Deaths	Deaths preventable through the environment each year	233 000
% of total burden		18%

**Environmental burden by disease category [DALYs/ 1000 capita], per year**

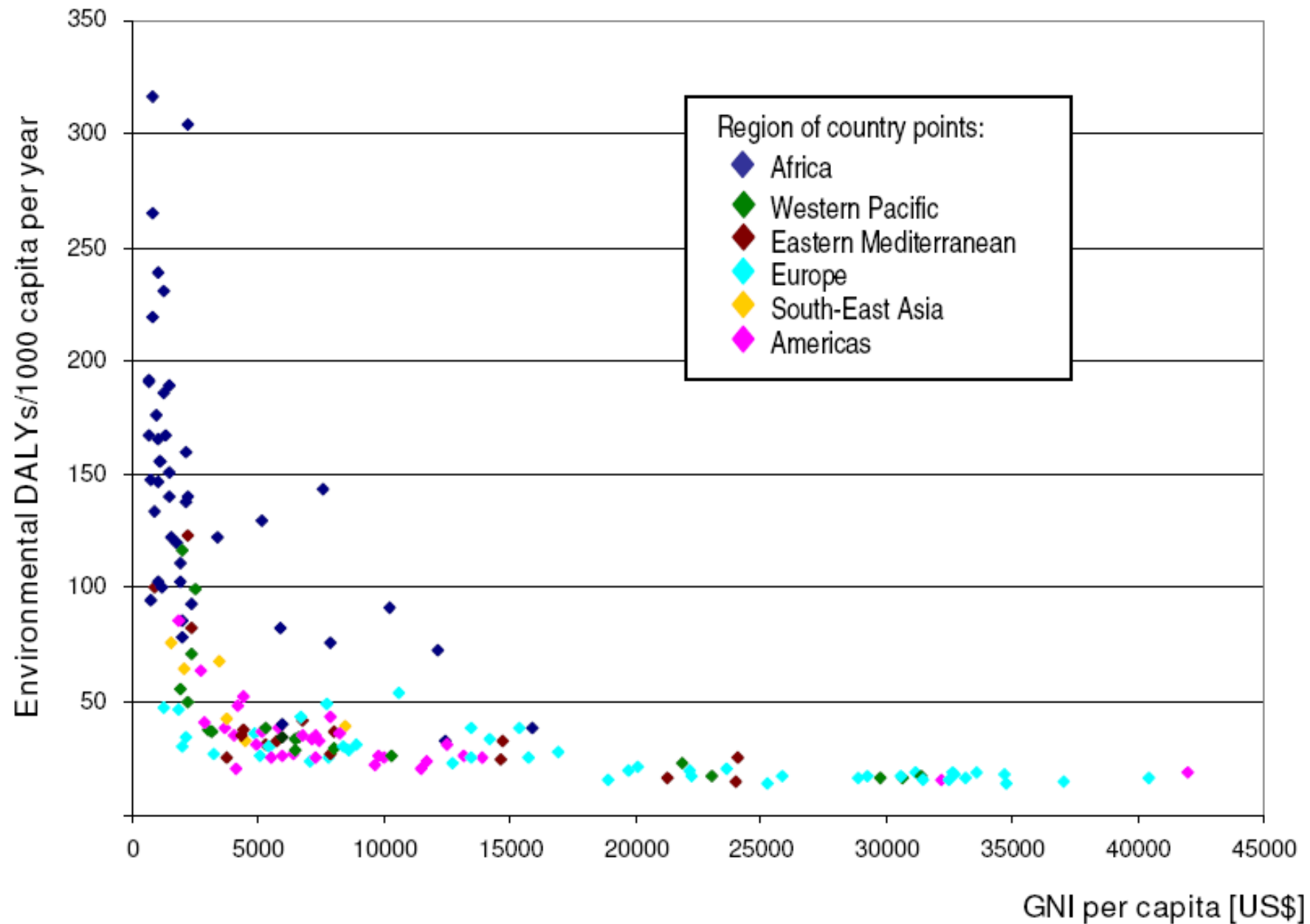
# Environmental burden of Disease

## - Disease group wise

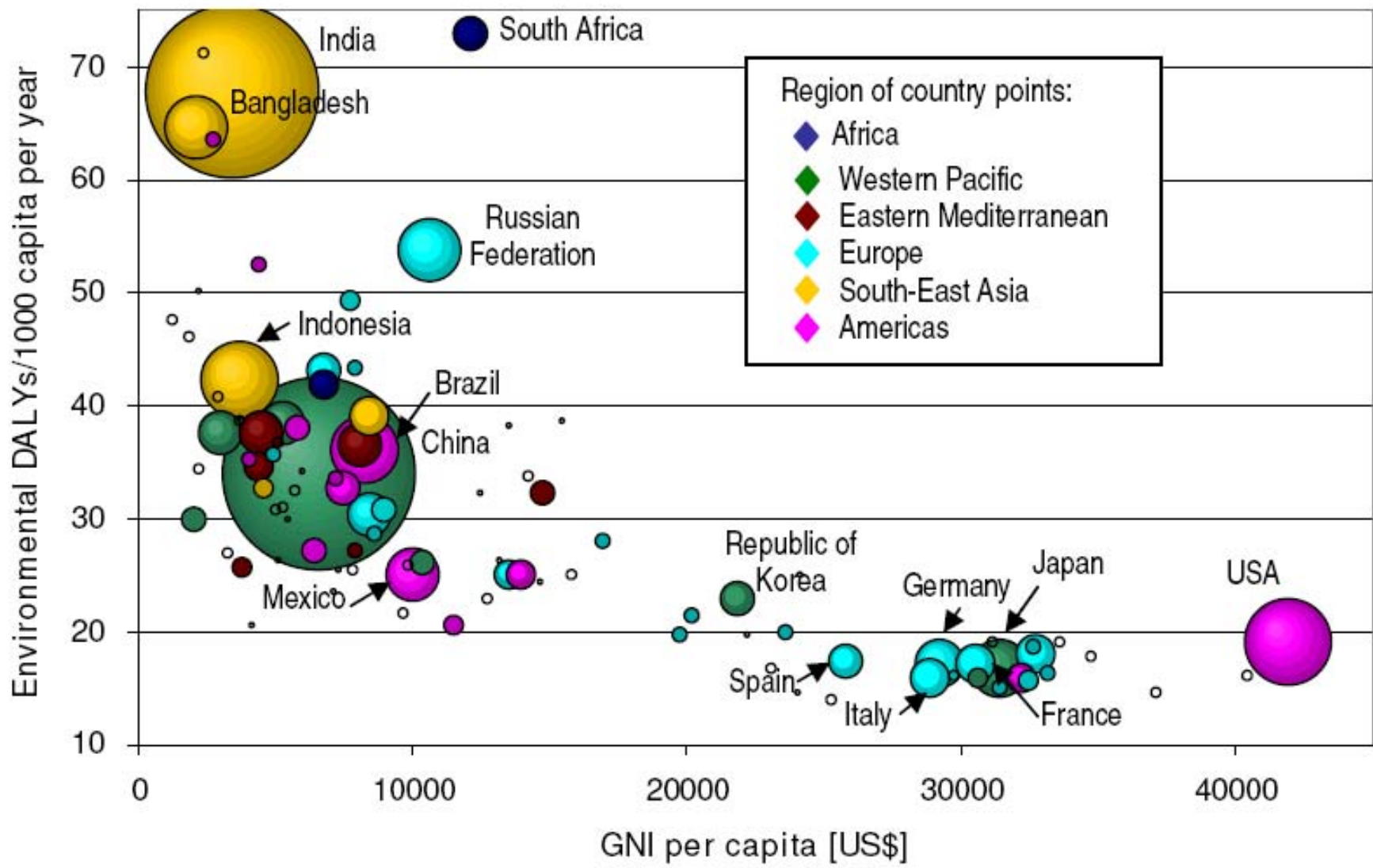




**Figure 2**  
**Environmental DALYs per capita, by country, year 2002.** Country grouping corresponds to WHO Regions (WHO 2002).



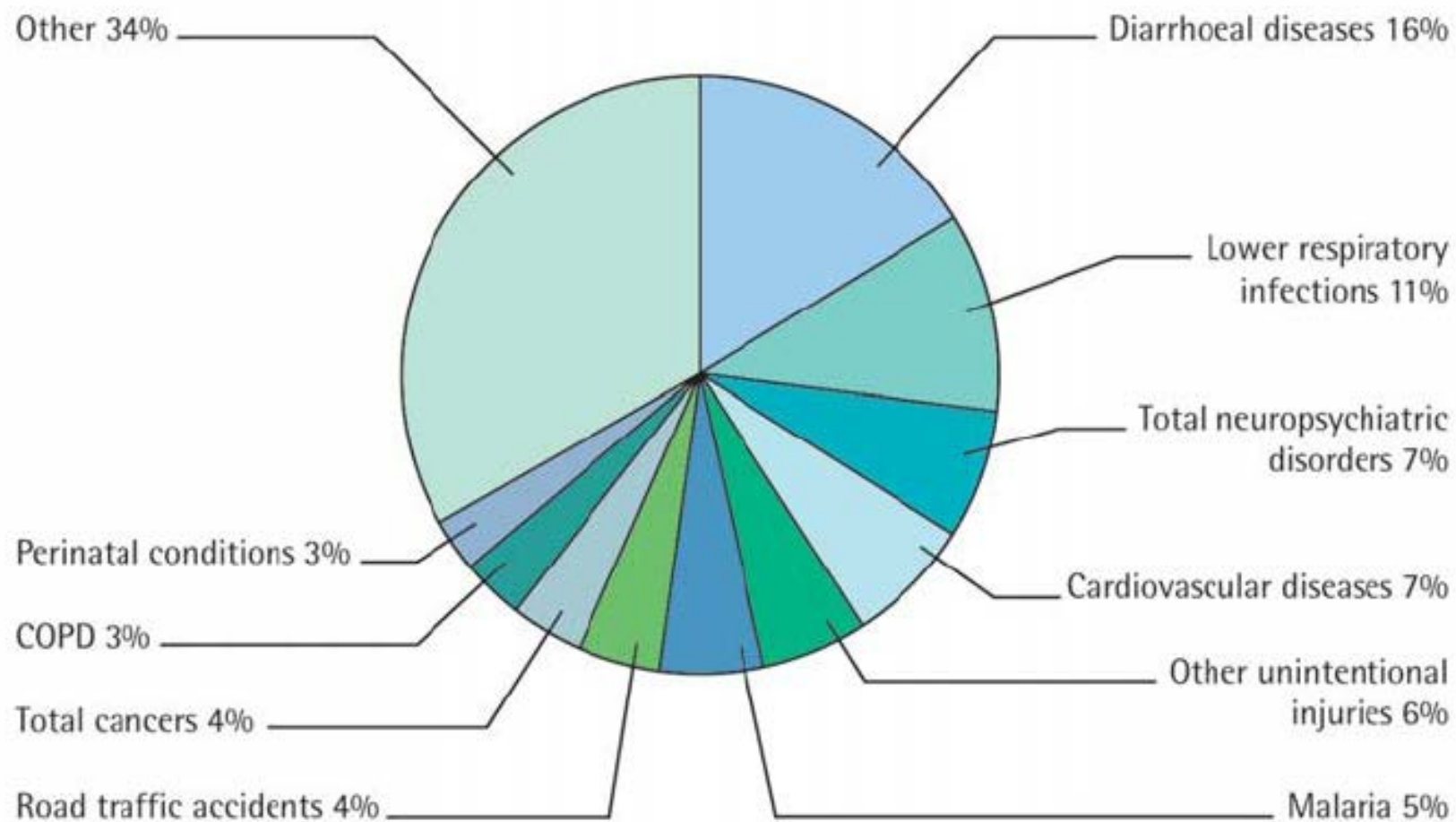
**Figure 3**  
**Environmental burden (DALYs/capita) versus GNI (Gross National Income).** Country grouping corresponds to WHO Regions (WHO 2002).



**Figure 4**

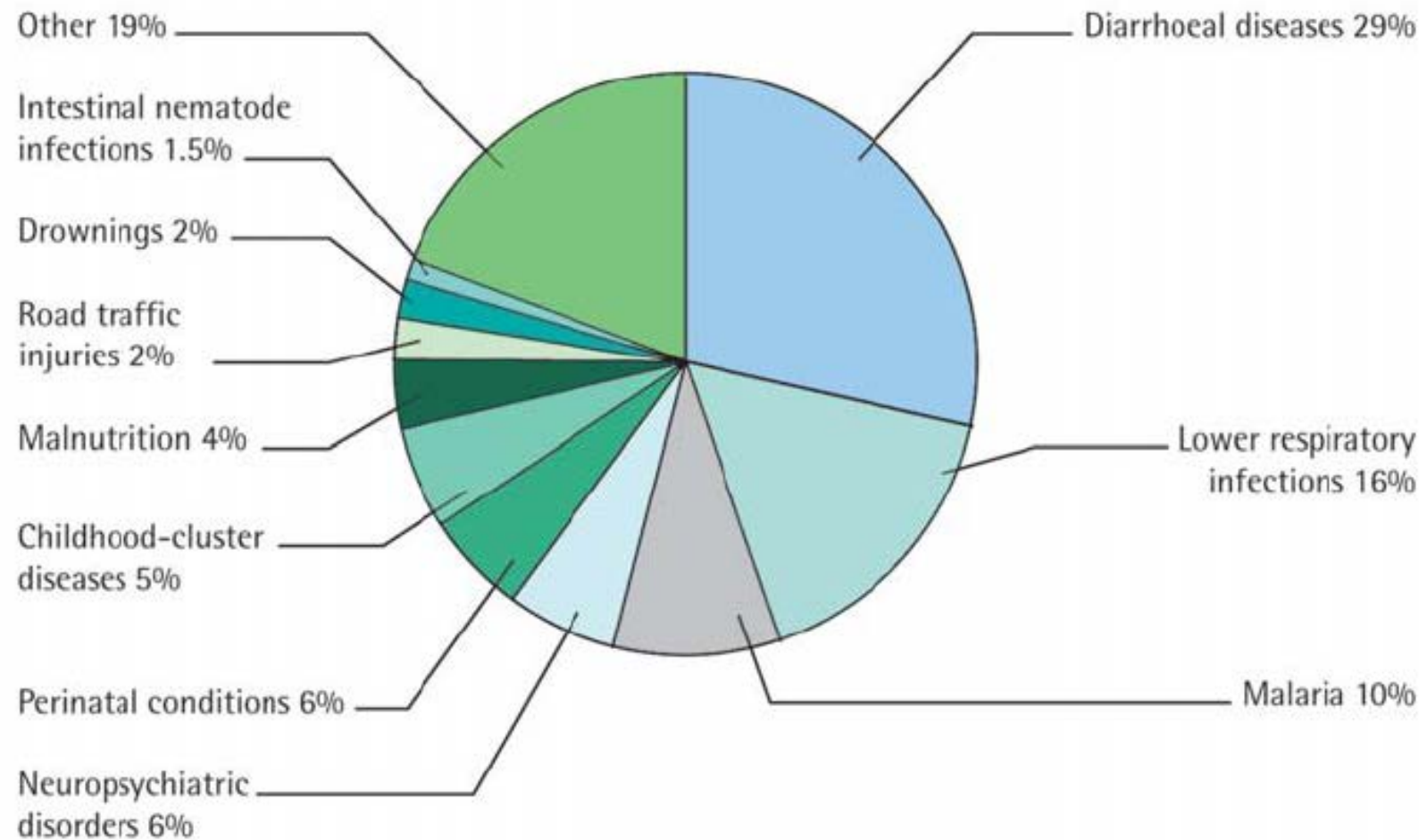
**Variability of environmental burden (DALY/capita) by GNI (Gross National Income).** Countries of EBD below 75 DALYs/1000 capita. Country grouping corresponds to WHO Regions (WHO 2002). Note: The surface of data points within the graph represents the country's population size; when considering trends, larger countries therefore appear more prominently.

**FIGURE 8** MAIN DISEASES CONTRIBUTING TO THE ENVIRONMENTAL BURDEN OF DISEASE, FOR THE TOTAL POPULATION <sup>a</sup>





**FIGURE 9** MAIN DISEASES CONTRIBUTING TO THE ENVIRONMENTAL BURDEN OF DISEASE, AMONG CHILDREN 0-14 YEARS <sup>a</sup>



<sup>a</sup> The environmental disease burden is measured in disability-adjusted life years, a weighted measure of death, illness and disability (DALYs).

***The "modifiable environment" includes***

- **pollution of air, water and soil**
- **radiations**
- **noise**
- **occupational risks**
- **the built environment, incl housing and road design**
- **land use patterns**
- **agricultural methods and irrigation schemes**
- **manmade changes to the climate and ecosystems**
- **behaviour related to the environment (such as hand-washing or personal protection).**

***Excluded from the definition are individual choices:***

- **alcohol and tobacco consumption**
- **drug abuse**
- **diet**
- **natural environments or ecosystems**
- **unemployment**
- **natural biological agents (e.g. pollen)**
- **person-to-person transmission**

# Impact of environment on health

These results show that in 23 countries, the disease burden from the two risk factors 'unsafe water, sanitation & hygiene' and 'indoor air pollution from solid fuel use' alone accounts for more than 1/10<sup>th</sup> of the country's total disease burden, amounting together to 3 million deaths globally.

Outdoor air pollution adds another 860,000 death annually.

# The Rising Global Burden of Allergic Diseases and Asthma

- Allergies are escalating to epidemic proportion and becoming more severe and complex, and the heaviest burden is on children and young adults.
- Allergy interacts with many other environmental factors such as pollutants, infections, lifestyle and diet that increase the impact on chronic disease.
- The socioeconomic burden of allergic diseases is also rising in countries worldwide regardless of their economic status.
- Increased disease awareness, improved patient care, better healthcare delivery, and a focus on preventative strategies are greatly needed.

# International Study of Asthma & Allergies in Childhood (ISAAC III)

## Asthma

## Allergic Rhinoconjunctivitis

6-7 year age-group



13-14 year age-group

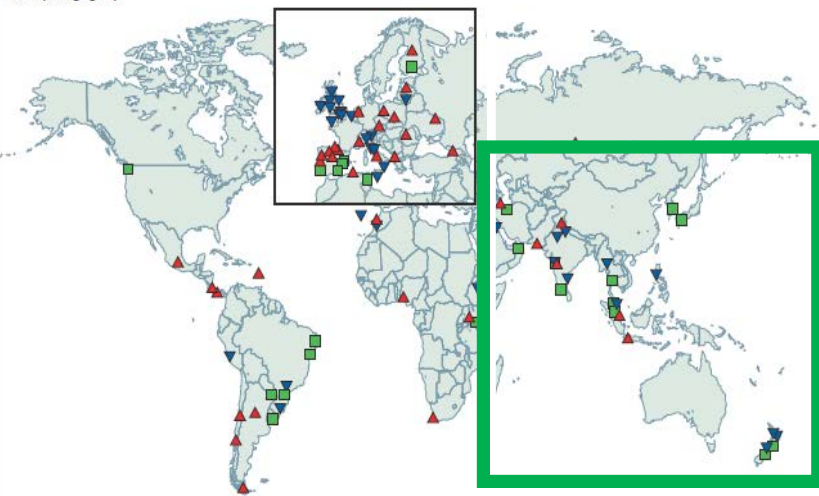


Figure 2: World map showing direction of change in prevalence of asthma symptoms for 6-7 year age-group and 13-14 year age-group

6-7 year age-group



13-14 year age-group



Figure 3: World map showing direction of change in prevalence of allergic rhinoconjunctivitis symptoms for 6-7 year age-group and 13-14 year age-group

# The prevalence of allergic diseases and asthma is escalating.

- Approximately 30 to 40 percent of the world's population suffers from allergic diseases.
- An estimated 300 million individuals worldwide have asthma, and this is likely to increase to 400 million by the year 2025.\*
- Allergic rhinitis, a risk factor for asthma, affects 400 million people annually, and food allergies affect 200 to 250 million.
- The number of avoidable deaths from asthma occurring every year is estimated at 250,000.\*

# Allergies are becoming more severe and complex.

- The increase in multiple allergies occurring in a single patient is making the global burden even more complex.
- Rhinitis (“allergies”), conjunctivitis (itchy, red and watery eyes), and asthma occurring together in the same patient, or rhinitis, asthma and food allergies, are examples of complex allergies commonly manifesting together.
- An integrated approach to diagnosis and treatment of allergies is required.

# ***WORLD ALLERGY ORGANIZATION***

Established in 1951, the World Allergy Organization is a global federation of 89 regional and national allergy, asthma and clinical immunology societies.

*WAO's mission* is to be a global resource and advocate in the field of allergy, advancing excellence in clinical care through education, research and training as world-wide alliance of allergy and clinical immunology societies

*[www.worldallergy.org](http://www.worldallergy.org)*



# WAO White Book on Allergy

WAO

WORLD ALLERGY ORGANIZATION

## WAO White Book on Allergy

WAO White Book on Allergy

*[www.worldallergy.org](http://www.worldallergy.org)*

*Editors: Ruby Pawankar , G. Walter Canonica, Stephen Holgate, Richard Lockey*

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# Why do we need the White Book on Allergy

## PURPOSE

**Why** is it necessary to recognize allergic diseases as a global public health concern?

- A steady increase in the prevalence of allergic diseases globally has occurred with about 30-40% of the world population now being affected by one or more allergic conditions.
- A high proportion of this increase is occurring in young subjects; thus, as this young population reaches adulthood, the burden of allergic diseases is expected to increase even more.
- Complex allergies involving polysensitization and multiple organ involvement are increasing, with a high morbidity placing a higher demand on health care delivery services.
- It is forecast that allergic problems will increase further as air pollution and the ambient temperature increase. These environmental changes will affect pollen counts, the presence or absence of stinging insects, and the presence or absence of molds associated with allergic diseases.
- In many countries, attempts to tackle these problems on a national basis are widely variable and fragmented, resulting in decreased quality of life, increased morbidity and mortality, and considerable cost to patients with allergic diseases.

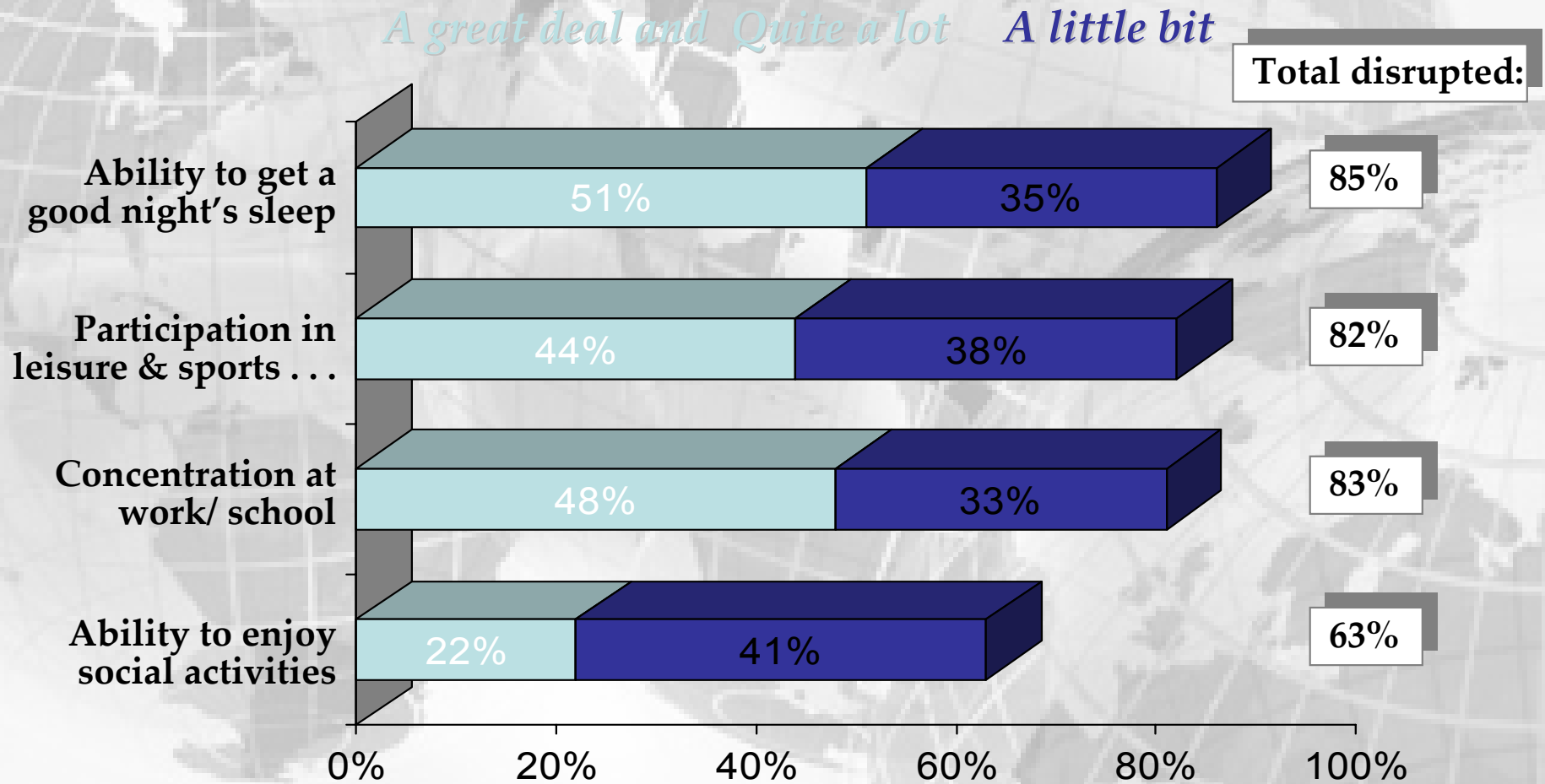
**This White Book** outlines the data which indicate that allergy is a major global public health issue, and provides "high level" recommendations to:

- create a more integrated approach to the diagnosis and management of allergic diseases;
- increase public awareness of allergic diseases and their prevention;
- provide greater education at the primary healthcare level and to non-allergy-oriented secondary care specialists;
- train medical students and other health care professionals, including nurses and pharmacists, to an appropriate level to enable them to collaborate with different organ-based specialists and allergy specialists in providing integrated care for allergy patients;
- institute environmental control measures by the lowering of indoor and outdoor air pollution, tobacco smoking, and allergen and drug exposures, as appropriate;
- encourage a preventative approach to allergic diseases, emphasizing the importance of continued research both in disease causation and management;
- use model projects, for example the Finnish Asthma Program, to disseminate good practice, promote prevention and immune tolerance, and decrease the allergy burden in future years.

# Asthma

- Globally 300 million people have asthma.
- The prevalence of asthma is rising especially in low and middle income countries as they adopt a more Western-type lifestyle.
- The monetary costs of asthma are substantial and include both direct medical costs and the indirect costs, the latter associated with time lost from work and premature deaths.
- National efforts to tackle asthma as a public health problem, such as the program introduced in Finland produce remarkable benefits that are reflected in dramatic reductions in deaths and hospital admissions.
- Many barriers exist to a reduction in the worldwide burden of asthma.
- There are unmet diagnostic, therapeutic, educational and financial needs to achieve better worldwide control of asthma.
- More effort is needed to focus on ways to improve the management of asthma by focusing on disease control rather than treating acute episodes. This concept has to be embedded in healthcare programs.

# ASIAN SURVEY : Impact of AR on Asthma in Child's Quality of Life



*Most patients (73%) had pre-existing AR when diagnosed with asthma. most troublesome symptom was wheezing (17%) and coughing (17%).*

# Food Allergy

- Globally, 220 – 250 million people may suffer from food allergy.
- Food allergy significantly affects the quality of life of sufferers (mainly children).
- Stakeholders must be prepared to meet the needs of patients by enhancing the diagnostic process, the traceability of responsible foods, and the availability of substitute foods, assisting hospitalized patients, and preventing mortality.
- Large areas in the world lack legislation on food labelling. As diagnostic and therapeutic decision strategies are not clear-cut, evidence-based guidelines are necessary for clinicians, patients, governments and industry to deal with the challenge of food allergy. Such guidelines, eg, the WAO recommendation on the Diagnosis and Rationale Against Cow's Milk Allergy (DRACMA) are available and are ready to be implemented.
- Epidemiologic studies are necessary, in particular, in less developed areas of the world.
- Oral desensitization represents a promising approach to reduce the burden of disease caused by food allergy.

# Anaphylaxis

- There is lack of consensus about the definition of anaphylaxis and this lack of consensus in definition contributes to the variability in its identification, treatment and the use of epinephrine.
- The variability and severity of anaphylaxis is somewhat dependent on the route by which the allergen or inciting agent is delivered, i.e. parenteral versus oral administration; the former is commonly associated with more severe reactions.
- There is a variety of other terms which describe anaphylaxis which cause confusion, especially with its definition and treatment. These include: generalized systemic reaction; systemic allergic reaction; constitutional reaction; and serious hypersensitivity reaction.
- Anaphylaxis includes both allergic and non-allergic etiologies.
- The term “anaphylactoid” is outdated
- Epinephrine, at appropriate doses, is the drug of choice to treat anaphylaxis.

## A few global facts and figures for two common allergic diseases, asthma and rhinitis:

Country	Year costs calculated	Population (2010)	Disease	Direct costs*	Indirect costs**	Total costs estimated
Australia	2007	23 million	All allergies	A\$1.1 billion	A\$8.3 billion	A\$9.4 billion
Finland	2005	5.3 million	All allergies	€468 million	€51.7 million	€519.7 million
South Korea	2005	50 million	Asthma Allergic Rhinitis			US \$1.78 billion US \$266 million
Israel		7.5 million	Asthma			US \$250 million
Mexico	2007	103 million	Asthma			US \$35 million
USA	2007 2005	310.2 million	Asthma Allergic Rhinitis	US \$14.7 billion US \$11.2 billion	US \$5 billion Up to US \$9.7 billion	US \$19.7 billion Up to \$20.9 billion

\* Direct costs: Expenditure on medications and health care provision

\*\* Indirect costs: Cost to society from loss of work, social support, loss of taxation income, home modifications, lower productivity at work, etc.



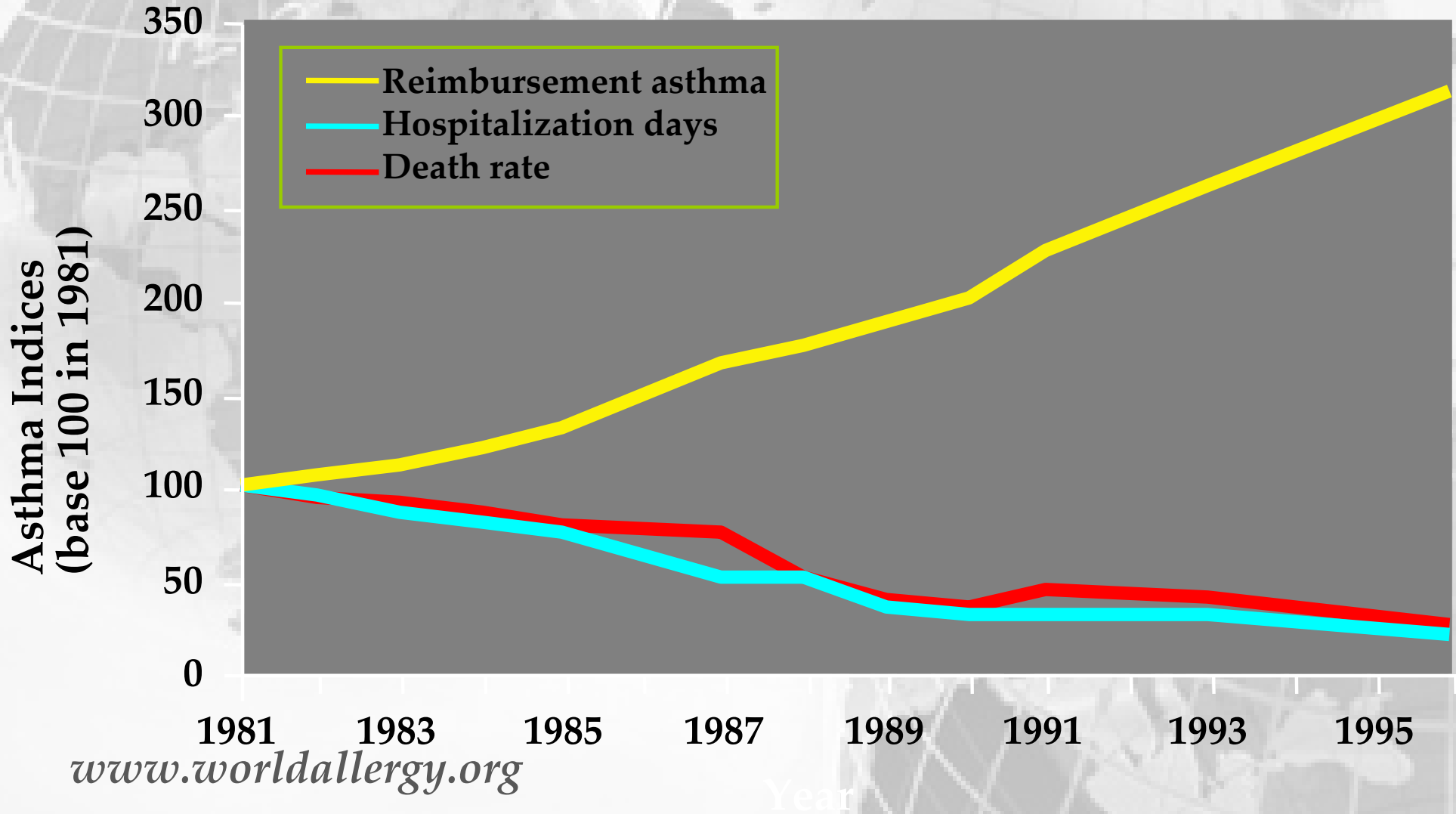


# Socioeconomic costs rise with the incidence of allergic diseases.

- Direct costs include interference with breathing during day or night, emergency department visits, and hospitalizations.
- Indirect costs include time lost from work, lower productivity, and premature death.
- The quality of life of patients with allergic diseases is greatly reduced.

# Healthcare benefits from asthma intervention

Haahtela et al, Thorax 1998



# Outdoor pollutants

- *Sources*
  - industrial
  - commercial
  - mobile
  - urban
  - regional
  - agricultural
  - natural
- *Products*
  - $\text{SO}_2$ ,  $\text{O}_3$ ,  $\text{NO}_x$ , CO, PM, SVOC

# Indoor pollutants

- *Sources*

- cooking
- combustion
- particle resuspension
- building materials
- air conditioning/cleaning
- consumer products
- smoking
- heating
- biologic agents

- *Products*

- NO<sub>x</sub>, CO, CO<sub>2</sub>, SVOCs (semi-volatile organic compounds include aldehydes, dioxins, benzene, 1,3-butadiene, ozone (O<sub>3</sub>), bacteria, mold-byproducts, endotoxin

# Indoor, Outdoor pollution

Table 3 — Respiratory disorders caused by Environmental Tobacco Smoke (ETS), Volatile Organic Compounds (VOCs) and mold/dampness exposure

Study	Country (sample)	Exposure	Health outcome	Measures
Fisk WJ et al, 2007 <sup>[10]</sup>	Meta-analysis (children) (general population)	Mold/dampness	Wheeze Current asthma	OR (95% CI): 1.53 (1.39-1.68) 1.56 (1.30-1.86)
Simoni M et al, 2005 <sup>[7]</sup>	Italy (children and adolescents)  Children  Adolescents	Mold	Wheeze Current asthma Rhino-conjunctivitis Eczema Current cough/phlegm  Early wheeze Asthma Rhino-conjunctivitis	OR (95% CI):  1.98 (1.47-2.66) 1.39 (1.00-1.93) 1.46 (1.01-2.09) 1.44 (1.09-1.91) 1.86 (1.19-2.91)  1.56 (1.15-2.11) 1.62 (1.00-2.62) 1.78 (1.30-2.45)
Rumchev K et al, 2004 <sup>[9]</sup>	Western Australia (children)	VOCs (1 mg/m <sup>3</sup> increase)  VOCs (10 mg/m <sup>3</sup> increase)	Risk of asthma	OR (95% CI): 1.02 (1.02-1.03)  1.27 (1.18-1.37)
Simoni M et al, 2007 <sup>[20]</sup>	Italy (women, never smoker)	ETS	Wheeze Attacks of shortness of breath with wheeze Asthma Any OLD Rhino-conjunctivitis	OR (95% CI): 1.71 (1.04-2.82) 1.85 (1.05-3.26) 1.50 (1.09-2.08) 2.24 (1.40-3.58) 1.48 (1.13-1.94)
Agabiti N et al, 1999 <sup>[21]</sup>	Italy (children) (adolescents)	ETS	Asthma Wheeze	OR (95% CI): 1.34 (1.11-1.62) 1.24 (1.07-1.44)

OR, odds ratio; 95% CI, 95% Confidence Interval; OLD, obstructive lung diseases.

# ER Visits for Respiratory Complaints and Air Pollutants

- Numerous studies have found an association between PM 10 levels and ER visits for asthma.
- An increase of 11  $\mu\text{g}/\text{m}^3$  in fine PM was associated with an 11% increase in asthma ER visits.<sup>1</sup>
- Ozone and SO<sub>2</sub> have been associated with ER visits for asthma in Mexico.<sup>2</sup>

# Environmental factors increase the impact of chronic allergic disease.

- Allergic problems will increase further with environmental changes such as air pollution and ambient temperature increases that affect pollen counts and the presence or absence of stinging insects and molds associated with allergic diseases.
- Exposure to outdoor/indoor pollutants has been associated with new onset of asthma, asthma complications, rhinitis, rhinoconjunctivitis, acute respiratory infections, increase of anti-asthmatic drug use, and hospital admissions for respiratory symptoms.
- Access to healthy and adequate food sources may influence asthma through malnutrition or obesity risk, as both are linked to asthma and allergy.
- Other factors include exposure to environmental tobacco smoke, early life respiratory viral infections, certain drugs, and stress.

## Environmental Risk Factors: Indoor and Outdoor Pollution

- Epidemiological studies show that indoor and outdoor pollution affects respiratory health, including an increased prevalence of asthma and allergic diseases.
- Outdoor pollution is associated with substantial mortality; for example in China, outdoor pollution is associated with more than 300,000 deaths annually.
- Conservative estimates show that exposure to indoor air pollution may be responsible for almost 2 million deaths per annum in developing countries.
- Exposure to outdoor/indoor pollutants is associated with new onset of asthma, asthma exacerbations, rhinitis, rhinoconjunctivitis, acute respiratory infections, increase of anti-asthmatic drug use, and hospital admissions for respiratory symptoms.
- Abatement of the main risk factors for respiratory disease and, in particular, environmental tobacco smoke, indoor biomass fuels and outdoor air pollution, will achieve huge health benefits.



# Climate change and impact on allergies

- Climate change coupled with air pollutant exposures may have potentially serious adverse consequences especially for human health in urban and polluted regions.
- High summer temperatures have an impact on rates of acute exacerbation and hospital admission for elderly patients with breathing problems and may cause unexpected death.
- Pollen allergy is frequently used to study the interrelationship between air pollution and respiratory allergy. Climatic factors (temperature, wind speed, humidity, thunderstorms, etc.) can affect both biological and chemical components of this interaction.
- Changes in the weather such as thunderstorms during pollen seasons may induce hydration of pollen grains and their fragmentation which generates atmospheric biological aerosols carrying allergens. As a consequence asthma outbreaks can be observed in pollinosis patients.
- Migration from one country to another involves exposure to a new set of pollutants and allergens as well as changes in housing conditions, diet and accessibility to medical services which may affect migrants' health.

# Interventions on the Health Effects of Air Pollution

- Public health measures to decrease air pollutant levels improve respiratory outcomes.
- In Dublin, Ireland a ban on bituminous coal sales in 1990 after 72 months resulted in a:<sup>1</sup>
  - - 70% decrease in black smoke concentrations
  - - 5.7% decrease in non-trauma death rates
  - - 15.5% decrease in respiratory death rates
  - - 10.3% decrease in cardiovascular death rates

# Disease Prevention by environmental interventions

*Globally, 24% of the total disease burden, or 13 million premature deaths, could potentially be prevented through environmental improvements (or shifted to other causes of premature death or disability).*

# Disease prevention opportunities

*Environmental health interventions can make a valuable and sustainable contribution towards reducing the global disease burden and improving the well-being of people everywhere.*

*Many interventions can be cost-effective and have benefits beyond improving people's health*

*Both the health sector and non-health sector actors can, and need, to take joint action to effectively address environmentally-mediated causes of disease. To do this global partnerships are essential.*

*[www.worldallergy.org](http://www.worldallergy.org)*

# Disease prevention opportunities



*Strategies for primary prevention in high risk atopic individuals and secondary prevention guidelines should be developed both for populations in developing countries, and for immigrants from developing countries to atopy-prevalent developed countries.*

# Declaration of the World Allergy Organization

## II. Allergens And Environmental Pollutants

### Identified Need:

Evidence-based information about the major indoor and outdoor allergens and pollutants responsible for causing or exacerbating allergic diseases and asthma is either lacking or, when available, is not always universally accessible.

### Recommendation:

Local indoor and outdoor allergens and pollutants which cause and exacerbate allergic diseases should be identified and, where possible, mapped and quantified. Appropriate environmental and occupational preventative measures should be implemented where none exist or as necessary. Strategies proven to be effective in disease prevention should also be implemented.



# Preventative strategies and an integrated approach to treatment are needed:

1. Increased availability and accessibility to allergy diagnosis and therapies
2. Advanced research toward preventive strategies to increase tolerance to allergens and slow disease progression
3. Global partnerships of multi-disciplinary teams involving clinicians, academia, patient representatives, and industry

# TAKE HOME MESSAGE

*Global partnerships of multidisciplinary teams, involving policy makers, governments, health authorities, global organizations, clinicians, academia, patient representatives, and industry, should work towards a common goal of reducing the burden of non-communicable diseases, developing cost-effective innovative preventive strategies and a more integrated, holistic approach to treatment, thereby preventing premature and unwanted deaths and improving the quality of life of patients.*

*[www.worldallergy.org](http://www.worldallergy.org)*