BURDEN OF DISEASE EXPRESSED AS DALY AT GLOBAL, NATIONAL AND LOCAL LEVEL

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***Abstract**: Disease burden can be expressed as Disability-Adjusted Life Years (DALY), combining the burden due to death and that of disability in a single index. The use of this synthetic index allows the comparison between the burden due to various environmental risk factors and other risk factors or diseases (at global, national or local level). The environmental burden of disease quantifies the amount of disease caused by environmental risks. An independent International Network of Burden of Disease has been established and the World Health Organization is routinely publishing the data of the burden of disease in the World Health Report, promoting its development and implementation. Many countries, including Romania, have completed the global burden of disease (GBD) method in order to assess the national (NBD) and local burden of disease.*

***Keywords:** burden of disease, Disability-Adjusted Life Years, environmental risk factors, global, national or local level*

***Rezumat:** Povara bolii poate fi exprimată prin anii de viaţă ajustaţi la incapacitate (DALY) combinând povara decesului cu cea a incapacităţii într-un indicator sintetic. Utilizând un astfel de indicator sintetic se permite compararea poverii bolii datorată diferiţilor factori de risc ambientali cu alţi factori de risc sau boli (la nivel global, naţional sau local). Povara ambientală a bolii cuantifică partea de boală atribuibilă factorilor de risc din mediul ambiant. S-a constituit o reţea internaţională independentă a poverii bolii şi Organizaţia Mondială a Sănătăţii publică periodic datele poverii bolii în Raportul Mondial al Sănătăţii promovând dezvoltarea şi aplicarea programului. Multe ţări, inclusiv România, au aplicat cu succes metoda studiului poverii globale a bolii (GBD) pentru a evalua povara naţională (NBD) şi locală a bolii.*

***Cuvinte cheie:** povara bolii, anii de viaţă ajustaţi la incapacitate, factori de risc ambientali, nivel global, naţional şi local*

INTRODUCTION

In 1993, the Harvard School of Public Health in collaboration with the World Bank and WHO assessed the global burdent of disease (GBD). Aside from generating the most comprehensive and consistent set of estimates of mortality and morbidity by age, sex and region ever produced, GBD also introduced a new metric – disability adjusted life year (DALY) – to quantify the burden of disease.

The GBD was initiated in an attempt to provide information on:

- the impact of premature mortality and non-fatal health outcomes;
- the contribution of different diseases, injuries and risk factors to these levels of ill-health;
- short to medium-term projections of premature mortality and non-fatal health outcomes.

In the "Global Burden of Disease for the year 2004" study, a wide range of data sources was used to estimate the incidence of various degrees of prevalence, severity and duration of disease and mortality data on more than 130 major causes for the Member States of WHO and sub-regions of the world since 2000 and for the subsequent years.

II. National burden of disease in Romania

In 1998, for the first time in Romania, Daly was calculated for 1996 in a project conducted by the Institute of Health Management Services aiming at health reform and funded by the World Bank. In 1999, the methodology of the previous study was applied and DALY was calculated for 1998 at national and county level.

Picture no. 1. The burden of disease measured in DALYs on the five major cases in Romania, 1998 (Data Source: Institute of Public Health Bucharest, 2000)

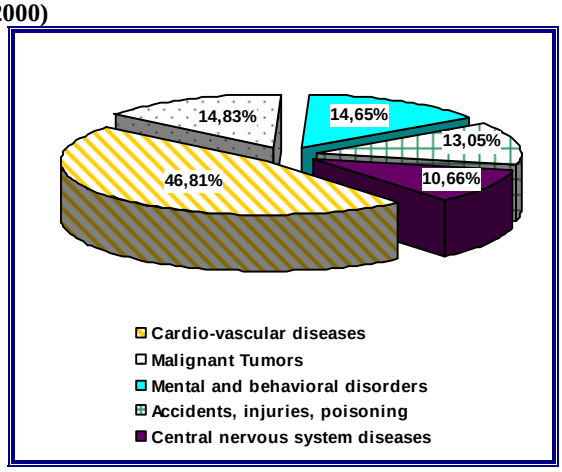
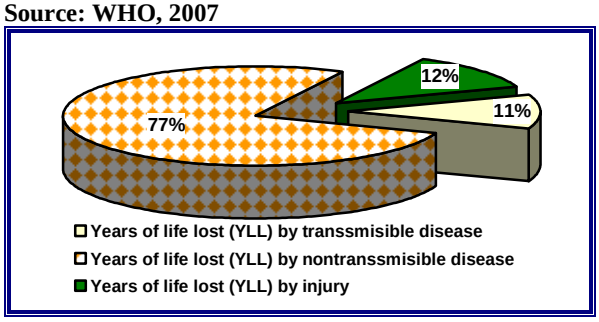


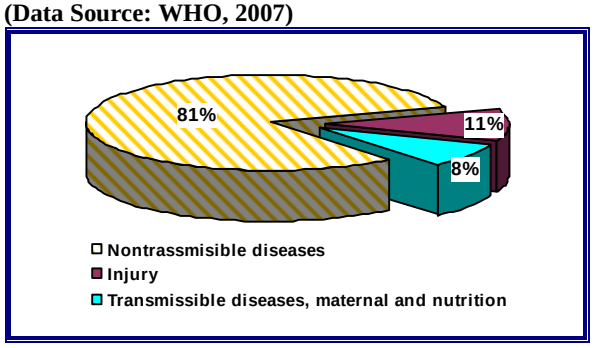
Table no. 1. Statistical WHO data on disease burden in Romania in 2004 (Data Source: WHO, 2007)

No..	Indicators for Romania 2004	Values
1	Population (000)	22387.4
2	Total deaths (000)	258.7
3	Mortality rate /100000 inhab.	1155.4
4	Total DALYs (000)	4106.1
5	DALY rate/100000 inhab.	18341.1

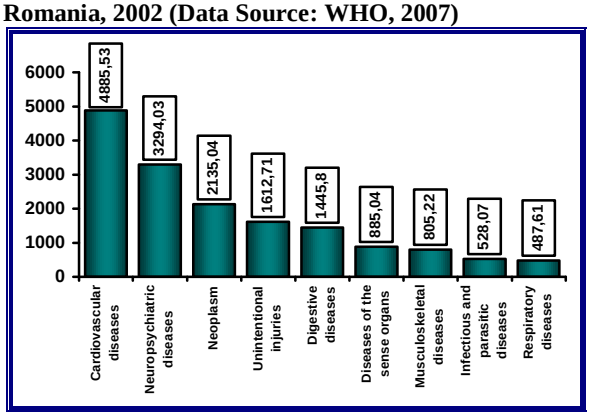
Picture no. 2. Distribution of years of life lost through diseases and injury in Romania in the year 2002 (Data Source: WHO, 2007



Picture no. 3. Structure of disease burden measured in DALYs on the three major cases in Romania, 2002 (Data Source: WHO, 2007)



Picture no. 4. DALY rate (%) on the main causes in Romania, 2002 (Data Source: WHO, 2007)



II. Disease burden attributable to environmental factors (Environmental disease burden)

Globally, it was estimated that the following were assigned to the environmental factors:

- a percentage of 24% of the disease burden (healthy life years lost);
- a percentage of 23% of all deaths (premature mortality).

Among the children between 0–14 years old, the proportion of deaths assigned to environment was of 36% (there were large regional differences in the environmental contribution to various disease conditions – due to differences in environmental exposures and access to health care across the regions).

Diseases with the largest absolute burden attributable to modifiable environmental factors included:

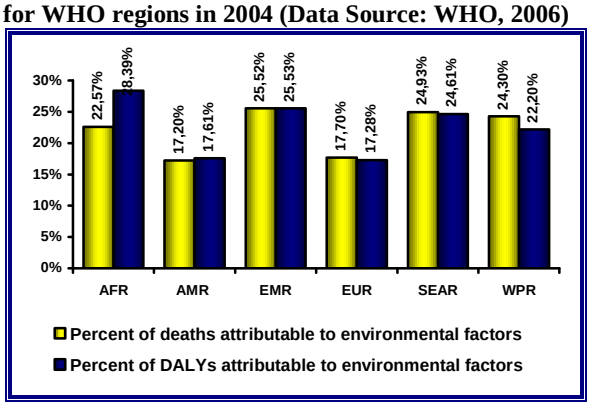
1. **Diarrhoea.** 94% of the diarrhoeal burden of disease is attributable to environment, and associated with risk factors, such as unsafe drinking-water and poor sanitation and hygiene.
2. **Lower respiratory infections.** These are associated with indoor air pollution related largely to household solid fuel use and possibly to smoking, as well as to outdoor air pollution. In the developed countries, 20% of such infections are due to environmental causes, rising to 42% in developing countries.
3. **Other unintentional injuries.** These include injuries arising from workplace hazards, radiation and industrial accidents; 44% of such injuries are attributable to environmental factors.
4. **Malaria.** The proportion of malaria attributable to modifiable environmental factors (42%) is associated with policies and practices regarding land use, deforestation, water resource management, settlement grouping and modified house design, e.g. improved drainage. For the purposes of this study, the use of insecticide-treated nets was not considered an environmental management measure.

42% of chronic obstructive pulmonary disease (COPD), a gradual loss of lung function, is attributable to environmental risk factors. The largest overall difference between WHO regions was the infectious diseases. The total number of healthy life years lost per capita as a result of environmental burden per capita was 15-times higher in the developing countries than in the developed world. The environmental burden per capita of diarrhoeal diseases and lower respiratory infections was 120- to 150-times higher in certain WHO developing countries, as compared to the developed countries. These differences arise from variations in exposure to environmental risks and in access to health care. No overall difference between developed and developing countries in the fraction of noncommunicable diseases attributable to the environment was observed. However, in the developed countries, the impact of cardiovascular diseases and cancers per capita is higher. The number of healthy life years lost from cardiovascular disease, as a result of environmental factors, was 7-times higher, per capita, in certain developed regions than in the developing regions, and cancer rates were 4-times higher. Physical inactivity is a risk factor for various noncommunicable diseases including ischaemic heart disease, cancers of the breast, colon and rectum, and diabetes mellitus. It has been estimated that in certain developed regions, such as North America, physical inactivity levels could be reduced by

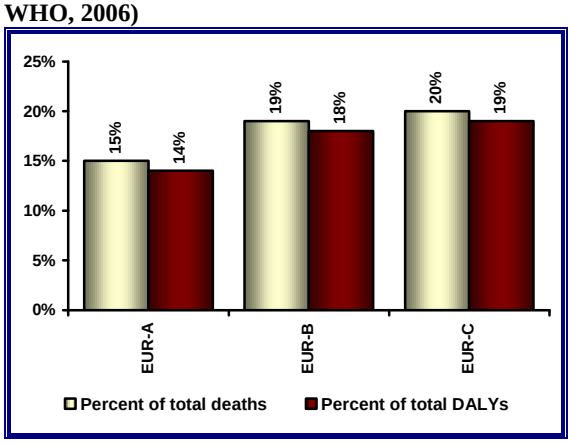
31% through environmental interventions, including pedestrian- and bicycle-friendly urban land use and transportation, and leisure and workplace facilities and policies that support more active lifestyles. Developing countries, meanwhile, carry a heavier burden of disease from unintentional injuries and road traffic injuries attributable to environmental factors. In the developing countries, the average number of healthy life years lost, per capita, as a result of injuries associated with environmental factors, was roughly double than in the developed countries. The gap was even greater at subregional level. The results suggest that an important transition in environmental risk factors will occur along with the development of the countries.

Nearly one quarter of the global disease burden is assigned to the modifiable environment. Out of the 102 major diseases reported in the World Health Report 2004, 85 are partly caused by exposures to environmental risk factors. The environmental attributable fractions for the diseases varied widely, but, in total, environmental causes contributed to 24% of the number of years of healthy life lost to disease, and to 23% of the mortality associated with the diseases.

Picture no. 5. Deaths and Burden of disease (in DALYs) fractions assigned to environmental factors, for WHO regions in 2004 (Data Source: WHO, 2006)



Picture no. 6. Deaths and Burden of disease (in DALYs) fractions attributable to environmental factors, for EUR subregions in 2004 (Data Source: WHO, 2006)

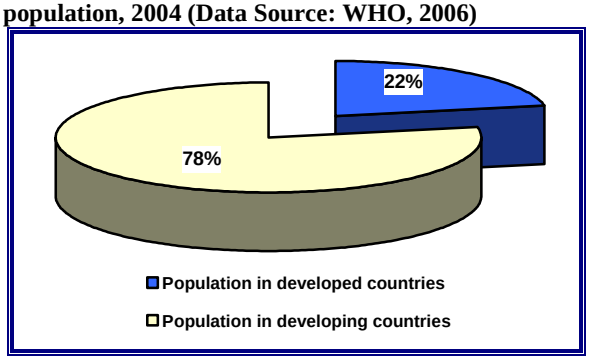


Children suffer a disproportionate share of the environmental health burden. Globally, the per capita number of healthy life years lost to environmental risk factors was about 5-times higher in children under five years old than in the total population. Diarrhoea, malaria and respiratory infections, all have very large fractions of disease attributable to environment, and are also among the biggest killers of children under five years old. In the developing countries, the environmental fraction of these three diseases accounted for an average of 26% of all deaths in children under five years old. Perinatal conditions (e.g. premature birth, low birth weight), protein-energy malnutrition and unintentional injuries also have a significant environmental component, particularly in the developing countries. On average, children in the developing countries lose 8-times more healthy life years, per capita, than their counterparts in the developed countries from environmentally-caused diseases. In certain very poor regions of the world, however, the disparity is far greater; the number of healthy life years lost being as follows:

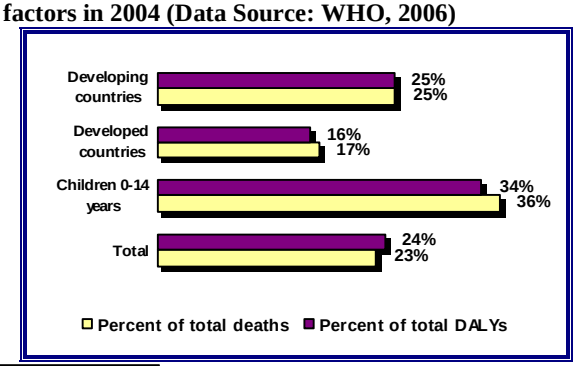
- childhood lower respiratory infections is 800-times greater, per capita;
- road traffic injuries is 25-times greater, per capita;
- diarrhoeal diseases is 140-times greater, per capita.

At global level, it was estimated that environmental risk factors contribute to 24.48% of all deaths and to 25.39% of all DALYs.

Picture no. 7. Share of population in the developed and developing countries in relation to the total world population, 2004 (Data Source: WHO, 2006)



Picture no. 8. Deaths and Burden of disease (in DALYs) fractions attributable to environmental factors in 2004 (Data Source: WHO, 2006)



III.Country profiles of environmental disease burden

In 2007, WHO prepared the first assessment of the impact of environmental risk factors for each of the 192 (of 193) countries for which data were available. These countries considered this analysis as milestone in setting the policy makers at national level to set priorities for preventive actions. Each profile of each country had three parts:

1. Disease burden attributable to three selected environmental factors. This first part presents the annual burden of disease attributable to three risk factors and is expressed in the number deaths and DALY:

a. contaminated water, sanitation and hygiene;
b. pollution of the environment by domestic solid fuel use;
c. air pollution from the external environment.

Results for each country were calculated taking into account the basic exposure method and by using globally valid data (indicators as access to water sources, the annual average concentration of dust in the air inspired - PM10 etc.).

2. Preliminary assessments of total disease burden attributable to environmental condition and the country. Health indicators presented in this second part - total deaths and DALYs per capita and the national burden of disease attributable to the environment – represent the disease burden that could have been avoided by changing the whole environment. The statistical data used were the data reported nationally by each country.
3. Disease burden attributable to environmental categories of diseases. The last part of the profile is a breakdown by category of diseases of the information presented in part two. The number of DALYs per capita was indicated, which was attributable to risk factors by categories of the environmental conditions. The national rate, measured as the number of DALYs per capita indicated the diseases most influenced by the environmental factors in the country. These values can be compared with the national lowest rate, respectively with the largest national rate, allowing the development of comparative analysis between countries.

IV. National environmental disease burden in Romania, 2004

1. Profile

Population (million)	21.7
Overall national income / capita (USD)	8940
Percent of urbanization	54%
Percent of population living in cities with over 100,000 inhabitants	33%
Percent of population living below the poverty line (national)	22% (1994)
Percent of population living below the poverty line (at the international level, <1 $ / day)	<2% (2003)
Mortality rate of children under 5 years (per 1,000 live births)	20
Life expectancy (years)	72

2. Environmental disease burden (preliminary data), 2004

DALYs/1000 inhabitants	The lowest global value	National Value	The higher global value
	14	31	316
Deaths		47000	
Percent of the total disease burden		17%	

Picture no. 9. The share of disease burden and environmental disease burden in Romania, 2004 (Data Source: WHO, 2006)

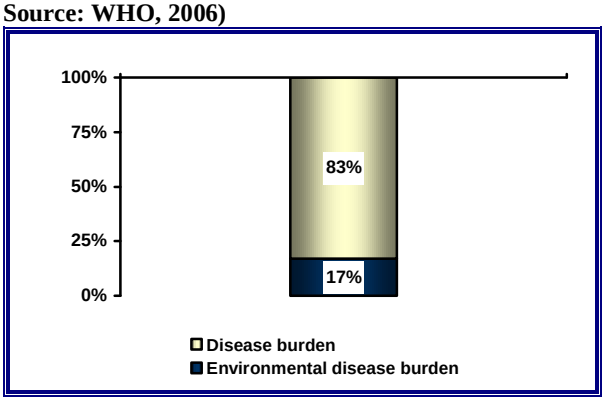


Table no. 2. Environmental disease burden by categories (DALYs/1000 inhabitants.) Romania in 2004 (Data Source: WHO, 2006)

Group of disease	The lowest global value	National Value	The higher global value
Diarrhoea diseases	0.2	0.4	114
Respiratory infections	0.1	2.0	56
Malaria	0.0	0.0	32
Other diseases by vectors	0.0	0.0	4.2
Lung cancer	0.0	1.3	2.5
Other cancers	0.5	3.1	4.1
Neuro-psychiatric disorders	1.4	2.4	4.4
Cardio-vascular diseases	1.3	8.0	13.0
Chronic obstructive pulmonary disease	0.0	0.7	4.7
Asthma	0.3	0.3	2.4
Musculoskeletal diseases	0.5	1.5	1.5
Injuries through road accident	0.3	1.3	10.0
Other involuntary injury	0.9	5.8	19.0
Intentional injuries	0.1	0.7	7.0

V. Regional burden of disease in the county of Sibiu

In 1999, the methodology of the project developed by the Institute of Health Management Services, funded by the World Bank was applied and DALYs were calculated for 1998 at national and county level. The DALYs emphasize another hierarchy of disease burden per counties, in Romania. To identify the unprivileged areas, the quartiles were calculated: Q1 contains the best placed counties, with the lowest losses and Q4, the counties with the highest levels of the phenomenon. The unprivileged counties were: Botosani, Ialomita, Calarasi, Giurgiu, Teleorman, Olt, Arad, Bihor, Salaj, Satu-Mare. The county of Sibiu was located in quart Q1, among the counties with the lowest burden of disease.

Table no. 3. Hierarchy of DALYs in the county of Sibiu in 1998, for the first seven groups of diseases (Data Source: Institute of Public Health Bucharest, 2000)

Group of disease	Disease code (ICD 10)	Quart	The problem's level
Diseases of the central nervous system	356-397	**Q4**	**I**
Malignant tumours	80-176	**Q3**	**II**
Accidents, injuries, poisoning	879-975	**Q3**	**II**
Diseases of the cardio-vascular system	445-497	**Q1**	**III**
Mental and behavioural disorders	306-355	**Q1**	**III**
Diseases of the digestive system	543-591	**Q1**	**III**
Diseases of the respiratory system	498-542	**Q1**	**III**

Comparative data show that the most important issues concerning the disease burden in the county of Sibiu in 1998, was the group of nervous system diseases, followed by the group of malignant tumours and the group of accidents, trauma, poisoning.

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