

BURDEN OF DISEASE: CURRENT SITUATION AND TRENDS

Annette Prüss-Üstün

World Health Organization, Geneva, Switzerland

Lorna Fewtrell

Centre for Research into Environment and Health, Crewe, UK

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Summary

There are numerous water-related health outcomes including infectious illnesses, chemical toxicoses and drowning. The provision of safe water and adequate sanitation are major factors determining the level of many water-related diseases and this chapter examines the global burden of disease due to diarrheal illness caused by water, sanitation and hygiene deficiencies as well as the burden of disease due to schistosomiasis, trachoma and dracunculiasis. The global burden of disease is based on estimates of disability-adjusted life years, which accounts for both years of life lost and the years lived with a disability.

Overall, unsafe water, sanitation and hygiene account for 54 million disability-adjusted life years, which makes it the 6th most important risk factor in the year 2000. The diseases examined in detail in this chapter are, however, very unevenly distributed throughout the world with the largest burden of disease being born by the developing regions, with the African regions being the hardest hit by diarrheal disease,

schistosomiasis and trachoma.

1. Introduction

Water, as well as being essential for life, can also act as a medium for carrying pathogenic micro-organisms and toxic chemicals or constitute a medium for vector proliferation, which can cause ill health and death. The lack of adequate supplies of clean water or the poor management of water resources can have numerous ramifications including the transmission of illness due to contaminants within the water itself or facilitating the spread of illness through lack of water for appropriate hygiene. *Classification of Water-Related Disease* has already outlined the different types of water-related diseases and defined the predominant routes of transmission. This chapter will briefly review the principal water-related health outcomes and their quantification at global level before examining the trends in risk factors and illness by focusing, primarily, on estimates made of the burden of disease.

2. Water-related Health Outcomes

Infectious diarrhea or gastroenteritis is the most frequent, non-vector, water-related health outcome, both in the developed and developing world. Diarrhea causes 2.2 million deaths/year, mostly among children under the age of five and while water is not solely responsible, water sanitation and hygiene are extremely important factors in this death toll. The following list outlines some of the other health effects in which water plays a major role (those marked * will be examined in more detail):

- Infectious diarrhea* (including cholera, salmonellosis, shigellosis, amoebiasis, other protozoal and viral intestinal disease)
- Typhoid and paratyphoid fevers
- Acute hepatitis (A, E)
- Legionellosis
- Schistosomiasis*#
- Trachoma*#
- Dracunculiasis*#
- Scabies
- Dengue
- Filariasis
- Malaria
- Leptospirosis
- Cyanobacterial poisoning
- Fluorosis
- Arsenicosis
- Drowning#

- considered to be 100% due to water, sanitation and hygiene factors.

The list is by no means exhaustive but goes some way to emphasizing the importance of water. Clearly, as well as inadequate water supplies leading to compromised hygiene they may also impact on food production which, in turn, may affect levels of malnutrition.

3. Trends in Risk Factors

The provision of safe water and adequate sanitation are major factors determining the level of water-related disease. Safe drinking water prevents the transmission of pathogens or toxic products through ingestion of water, while adequate sanitation is seen as a more ‘upstream’ measure reducing the likelihood of contamination of drinking water sources or bathing and recreational sites in the first place. The provision of improved water supplies and adequate sanitation has been the focus of intense activity for some time, with the philosophy that:

“all peoples, whatever their stage of development and social and economic conditions, have the right to have access to drinking-water in quantities and of a quality equal to their basic needs”

being adopted at the United Nations conference in 1977. A conference was also held to see the launch of the International Drinking Water Supply and Sanitation Decade (IDWSSD – 1981-1990). Although a great deal was achieved during the IDWSSD, the final results fell short of the planned targets for all regions and efforts have had to be maintained. The Global Water Supply and Sanitation Assessment 2000 shows that access to improved water supplies and sanitation continues to increase. It is reported that the percentage of people served with some form of improved water supply rose from 79% in 1990 to 82% in 2000, while at the same time access to excreta disposal facilities increased from 55% to 60%. However, despite the fact that the percentage of people with improved access to water and sanitation facilities has increased, the total number of people with limited provision has not changed because of the steady population growth. It is estimated that 1.1 billion people do not have access to improved water supply and 2.4 billion are still without access to any sort of improved sanitation facility. International development targets aim to reduce the proportion of people without access to adequate sanitation facilities and safe water by 50%, by the year 2015. This would leave 600 million people not served by a water supply and 1.3 billion without access to water and sanitation services. This is, however, a target rather than a realistic projection and probably requires considerably enhanced international efforts to be achievable.

There are factors, other than water and sanitation measures, which can impact on the water-related disease burden. Improving health care and development in developing nations, for example, may reduce disease burden, especially through decreases in mortality. A good example is provided by the increased use of oral rehydration therapy, a practice that reduces mortality rates from diarrheal diseases. Increased availability of praziquantel, the drug used to treat schistosomiasis, has also led to substantial decreases in mortality.

4. Trends in Health Outcomes

It is important to examine both the overall burden of water-related illness as well as trends in illness. Such examinations and estimations provide a rational input in defining priorities, planning and allocating resources in order to reduce the disease burden by quantifying disease in a common 'currency' and in an internally consistent way. It is

also useful to compare the effect that various interventions will have on different disease outcomes in a quantified and comparable way. In order to do this a common metric is needed (i.e. a summary measure of population health), with which the outcomes of divergent health outcomes can be expressed. Several such measures have been devised including the Quality Adjusted Life Year (QALY), the Disability-Adjusted Life Year (DALY), the Disability-Adjusted Life Expectancy (DALE) and the Healthy Life Year or HeaLY. The benefits and challenges of using these various measures have been comprehensively examined in the literature. Here, we use the DALY as it is centered on disease rather than healthy life span, it quantifies disease burden by combining mortality and morbidity and it can be applied across cultures.

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Bibliography

Ahmad, O.B., Lopez, A.D. and Inoue, M. (2000) The decline in child mortality: a reappraisal. *Bulletin of the World Health Organization* **78**, 1175-1191. [Provides figures on child mortality on a country-by-country basis between 1955 and 1999]

Anand, S. and Hanson, K. (1997) Disability-adjusted life years: a critical review. *Journal of Health Economics* **16**, 695-702. [Discussion on the use of DALYs]

Barendregt, J.J., Banneux, L. and Van de Maas, P.J. (1996) DALYS: the age weights on balance. *Bulletin of the World Health Organization* **74**, 439-443. [Discussion on the use of DALYs]

Briscoe, J. (1984) Intervention studies and the definition of dominant transmission routes. *American Journal of Epidemiology* **120**(3), 449-455. [A hypothetical examination of different infection transmission routes and why elimination of a single route may not bring about the expected reduction in illness]

Dolin, P.J., Faal, H., Johnson, G.J., Minassian, D., Sowa, S., Day, S., Ajewole, J., Mohamed, A.A. and Foster, A. (1997) Reduction of trachoma in a sub-Saharan village in the absence of a disease control programme. *Lancet* **349**, 1511-1512. [Background information on trachoma and how improvements in water, sanitation and hygiene can decrease prevalence]

Esrey, S.A. (1996) Water, waste and well-being: a multicountry study. *American Journal of Epidemiology* **143**(6), 608-623. [An important intervention study used in the global burden of disease assessment]

Esrey, S.A., Potash, J.B., Roberts, L. and Schiff, C. (1991) Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis and trachoma. *Bulletin of the World Health Organization* **69**(5), 609-621. [This paper reviews over 140 papers looking at the impact of water, sanitation and hygiene on various health outcomes]

Havelaar, A.H., De Wit, M.A.S. and Van Koningsveld, R. (2000) Health burden of infection with thermophilic *Campylobacter* species in the Netherlands. National Institute of Public Health and the Environment. Report no. 284550004. Bilthoven. [Paper providing figures on DALYs due to *Campylobacter* infection in the Netherlands]

Huttly, S.R.A., Morris, S.S. and Pisani, V. (1997) Prevention of diarrhoea in young children in developing countries. *Bulletin of the World Health Organization* **75**(2), 165-174. [An examination of breast-feeding, water, sanitation and hygiene improvements and education in diarrhea reduction]

Hyder, A.A., Rotllant, G. and Morrow, R.H. (1998) Measuring the burden of disease: healthy life years. *American Journal of Public Health* **88**, 196-202. [Discussion on an alternative measure to DALYs]

Mead, P.S., Slutsker, L., Dietz, V., McCraig, L.F., Bresee, J.S., Shapiro, C., Griffin, P.M. and Tauxe, R.V. (1999) Food-related illness and death in the United States. *Emerging Infectious Diseases* **5**(5), 607-625. [An important intervention study used in the global burden of disease assessment]

Murray, C.J.L. (1994) Quantifying the burden of disease: the technical basis for disability adjusted life years. *Bulletin of the World Health Organization* **72**(3), 429-445. [Outlines the need for a 'level playing field' in terms of examining different health outcomes]

Murray, C.J.L. (1996) Rethinking DALYs. In: *The Global Burden of Disease*. Murray, C.J.L. and Lopez, A.D. (Eds) World Health Organization, Harvard School of Public Health, World Bank, Geneva. [An introduction to DALYs and the concepts behind them]

Murray, C.J.L. and Lopez, A.D. (1996a) *The Global Burden of Disease*. World Health Organization, Harvard School of Public Health, World Bank, Geneva. [The first examination of the global burden of disease].

Murray, C.J.L. and Lopez, A.D. (1996b) *Global Health Statistics*. World Health Organization, Harvard School of Public Health, World Bank, Geneva. [Data to accompany the volume on global burden of disease]

Prüss, A., Kay, D., Fewtrell, L. and Bartram, J. (2002) Estimating the burden of disease due to water and sanitation at global level. *Environmental Health Perspectives* **110**(5), 537-542. [This paper provides more details on the estimation of the global burden of disease due to unsafe water, sanitation and hygiene. Figure 3 is reproduced, with permission, from this paper]

Quick, R.E., Venczel, L.V., Mintz, E.D., Soletto, L., Aparicio, J., Gironaz, M., Hutwagner, L., Greene, K., Bopp, C., Maloney, K., Chavez, D., Sobsey, M. and Tauxe, R.V. (1999) Diarrhoea prevention in Bolivia through point-of-use water treatment and safe storage: a promising new strategy. *Epidemiology and Infection* **122**, 83-90. [An important intervention study used in the global burden of disease assessment]

Semenza, J., Roberts, L., Henderson, A., Bogan, J. and Rubin, C. (1998) Water distribution system and diarrhoeal disease transmission: a case study in Uzbekistan. *American Journal of Tropical Medicine and Hygiene* **59**, 941-946. [An important intervention study used in the global burden of disease assessment]

VanDerslice, J. and Briscoe, J. (1995) Environmental interventions in developing countries: interactions and their implications. *American Journal of Epidemiology* **141**(2), 135-144. [Information on possible interactions between different water, sanitation and hygiene interventions]

WHO (various years) World Health Report. World Health Organization, Geneva. [A yearly report containing global health statistics]

WHO (2001b) Dracunculiasis. Global surveillance summary, 2000. *Weekly Epidemiological Record* **76**, 133-139. [Data on the global reduction in dracunculiasis]

WHO and UNICEF (2000) Global Water Supply and Sanitation Assessment 2000 Report. World Health Organization and United Nations Children's Fund. [A key resource examining levels of water and sanitation provision to the global community]

Williams, A. (1999) Calculating the global burden of disease: time for a strategic reappraisal? *Health Economics* **8**, 1-8. [Discussion on the use of DALYs]

Biographical Sketches

Dr Lorna Fewtrell is a research scientist with over 15 years experience of project management. She has built on her background of biochemistry and toxicology by extending into the health and environment field and specializes in drawing together information from a wide range of sources. The marriage of

biochemistry and environmental sciences allows insights and understanding of a broad range of health and ecotoxicological issues and has resulted in a number of environmental investigations and health effect reviews.

Annette Prüss-Üstün is an epidemiologist and public health specialist working in the area of environmental health for 15 years, over 10 of which have been with WHO. She has contributed to developing methods for quantifying health impacts from various environmental and occupational risks, and more generally to synthesizing the evidence on various environmental risks and health. Her areas of expertise also include water, sanitation and hygiene, health-care waste management, trachoma and the environment, and community-based methods for creating healthy environments in developing countries, health impacts from exposure to lead, and needlestick injuries in health-care workers.