

Environmental Determinants of Infectious and Parasitic Diseases

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A review of the role of the environment as a determinant of infectious and parasitic diseases is presented. Historical considerations and the several environmental classifications of diseases are introduced. In a broader perspective the subject is analyzed in view of the emergence of the environmental health area, with its new paradigms. A review of epidemiological studies about environmental sanitation conditions and measures is presented, analyzing the conclusions derived from 256 studies. Finally, an epidemiological study carried out in Betim, Minas Gerais is briefly described, in order to illustrate the potentiality of this kind of study. Setting priorities of interventions regarding diarrhea control was the aim of this investigation. Conclusion about the role of this approach to optimize preventive measures for the control of infectious and parasitic diseases, of sound importance to the reality of the developing world, is stated.

Key words: infectious and parasitic diseases - diarrhea - preventive measures - environmental health - environmental sanitation

Biological explanations and taxonomic classifications of infectious and parasitic diseases have been the predominating approach for the study of these relevant health problems in the medical and public health fields. This approach allowed the development of a good comprehension of these groups of diseases, including mainly their diagnosis and treatment. However, a better formulation of the preventive measures, with emphasis on environmental interventions, are still lacking and could ensure a more permanent and efficacious disease control. Aiming this, environmental health, which has on the environmental epidemiology its methodological framework, has been recently developed.

Analyzing the environment as determinant of a broad spectrum of health injuries, environmental health has the purpose of strengthening a preventive view in the field of public health. Its implementation intends to bring new paradigms both to health area - incorporating a new vision of human health problems - and to environmental area - increasing the importance of the human dimension on environmental impacts.

Based on this background, this paper discusses the environmental approach of health, presenting

historical considerations, environmental classifications of health problems, the role of the environmental health area together with its new paradigms, and the conclusions derived from the epidemiological studies already developed. Finally, an epidemiological study carried out in Betim, Minas Gerais, is briefly described in order to illustrate the potentiality of this kind of study, particularly in setting priorities of interventions.

INFECTIOUS AND PARASITIC DISEASES AND THE ENVIRONMENT

The relation between unsanitary conditions of the environment and health problems, mainly those related to transmission of infectious and parasitic diseases, is well-understood and, even in the Antique Era, intuitive associations were already established. There are several archeological registers of sanitation cares in populations so antiques as that of 4,000 years ago, like civilizations in North India, Egypt and Greece, where baths, sewerage, drainage and aqueducts were found (Rosen 1994).

An illustrative example of this is a report from the year 2,000 B.C., related to medical traditions in India, advising that *impure water should be purified by being boiled over a fire, or being heated in the sun, or by dipping a heated iron into it, or it may be purified by filtration through sand and coarse gravel and then allowed to cool* (USEPA 1990).

Obviously, after the end of the 19th century, with the emergence of the bacteriological era, the comprehension of the environmental influence on health became clearer, although controversially

strengthening the curative approach through a war against the microorganisms, at that time already a “well-known enemy”.

However, even though the curative paradigm had predominated, evidences showed the importance of environmental interventions, especially environmental sanitation measures, on disease reduction. A study in the State of Massachusetts, USA, suggests a similar tendency of increasing water supply improvements and typhoid fever reduction (Fig. 1).

Intending a better understanding of the environmental determinants of infectious and parasitic diseases, some authors have been trying to develop environmental classifications of such diseases. In these classifications, the aim is to present, in a simplified and comprehensive form, categories of diseases and injuries, based on the environmental determinants, highlighting the transmission routes and the consequent control measures.

The first known effort to develop such classifications was delineated by White et al. (1972) in a water-related disease classification with four diseases categories (Table).

After this classification, Feachem et al. (1983) proposed the excreta-related disease classification which stated a comprehensive role of excreta in the transmission of six categories of diseases: non-bacterial faeco-oral, bacterial faeco-oral, geohelminthiasis, taeniasis, water-based helminthiasis and excreta-related insect-vector diseases.

These two classifications became the main references in the 80’s - the International Drinking Water Supply and Sanitation Decade - supporting a rich debate on appropriate technologies for water supply and sanitation, understanding that an

appropriate technology must achieve adequate disease prevention and effective positive health impacts, specially in developing countries.

Another important formulation about the theme proposed an environmental classification of housing-related diseases in developing countries (Mara & Alabaster 1995), incorporating and amplifying White’s and Feachem’s traditional classifications. In this proposal, six classifications of the following related diseases group are presented: (a) building (15 categories); (b) water supply (7 categories); (c) sanitation (8 categories); (d) refuse (2 categories); (e) food (4 categories); (f) industry (6 categories).

TABLE
Classification of infectious and parasitic diseases related to water

Category	Example
Waterborne	
Classical	Typhoid
Nonclassical	Infectious hepatitis
Water-washed	
Superficial	Trachoma, scabies
Intestinal	<i>Shigella</i> dysentery
Water-based	
Water-multiplied percutaneous	Schistosomiasis
Ingested	Guinea worm
Water-related insect vectors	
Water-biting	Sleeping sickness
Water-breeding	Malaria

Source: adapted from White et al. (1972).

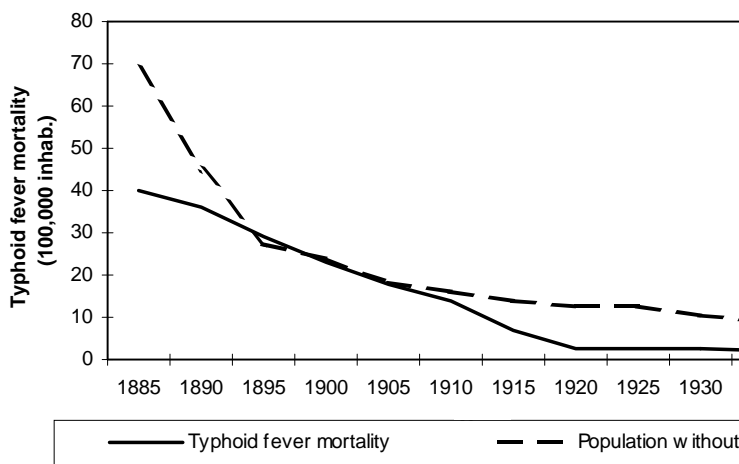


Fig. 1: reduction of typhoid fever mortality and improvement of collective water supply in the State of Massachusetts, USA (Fair et al. 1966).

This new broad classification has the merit of including other determinants besides that related to the traditional environmental sanitation conditions and other health problems besides the communicable ones, like non-communicable diseases, mental illnesses and psychosocial disorders.

Besides these reflections, Cairncross et al. (1996) discussed the importance of grouping the infectious diseases into two domains: the public and the domestic. Clearly, this approach highlights a fundamental difference between environmental determinants of diseases, at the point of view of control strategies: the place where the environment imposes the health risk. Public institutions, according to the public or domestic nature of the disease, have to establish specific control policies. Also the impact of hygiene education practices can be different according to that nature.

ENVIRONMENT AND HEALTH ON A BROAD PERSPECTIVE

In the late 80's, after the mentioned scientific efforts to the understanding of the relation between water supply and sanitation, and health, with emphasis on infectious and parasitic diseases, the area of environmental health started to be consolidated. The intense discussions in the United Nations Conference on Environment and Development (UNCED) were fundamental to the conception of a broader focus of the environmental determinants of health, widening not only the set of environmental risks but also the nature of health problems, including others like mental and psychosocial disorders and non-communicable diseases.

In its conceptual framework, the development of an integrated approach linking environment and health should attend three global objectives (WHO 1993): (i) to obtain a sustainable basis for "health for all" principle, through population control and the promotion of compatible life styles and consumption patterns on rich groups and developed countries; (ii) to provide an environment with ability to promote health, through reducing physical, chemical and biological hazards and assuring the necessary resources to an adequate health status for all; and (iii) to achieve for all individuals and organizations the consciousness of their own responsibility on health and on their environmental basis.

This context induced some authors to go ahead in new formulations in this field. As a result, a World Health Organization (WHO) Expert Committee held a discussion about *Environmental Health in Urban Development* (WHO 1991), where determinant factors for health in urban areas and consequences of urban development on health were stated. A set of three recommendations to govern-

ments were pointed out: (i) the strengthening of urban planning and regulation, including policy and programs coordination, decentralization and resources; (ii) the strengthening of environmental health technology and administration, including personal training and information; and (iii) the strengthening of community actions.

Subsequently, the World Bank Urban Management Program, through researchers of the London School of Hygiene and Tropical Medicine, published a consistent literature systematization of environmental health impacts in developing countries cities (Bradley et al. 1992) which became one of the most important references in the area. In this text, five classification tables related to environmental and health are presented: (a) an environmental classification aiming health analysis, which focuses the environment through three perspectives: resources (availability, access and cost); hazard (route of entry, prevention, containment and amelioration) and ambience (protection and adaptation); (b) an environmental taxonomy related to disease patterns, detailing the water-wastes complex, the shelter and built environment and the food; (c) environmental determinants of health problems, with nine groups; (d) a summary of urban environmental factors and potential areas of action; (e) a list of major urban disease categories.

Afterwards, Schaefer (1994), through the WHO and inspired by the UNCED recommendations, discussed the relation between health, environment and development, in view of country strategy formulations to achieve human well-being, according to 21 Agenda. In this document, based on *Our Planet, our Health* (WHO 1993), a detailed list of consequences on health and actions by development sectors were presented.

ENVIRONMENTAL SANITATION AND HEALTH: THE STATE-OF-THE-ART

Several epidemiological studies related to environmental sanitation conditions or interventions have been developed during the last decades. As a whole, they contribute to a better comprehension of the nature of this relationship. The design and the results of 256 epidemiological studies in this field were compiled and this systematization is shown in Figs 2, 3 and 4, which contribute to understand its geographical distribution and the positive or negative association regarding the environmental sanitation variable and the health indicator adopted (Heller 1997).

This systematization, adjoined by the literature review, allowed the following conclusions (Heller 1997): (i) water supply and sanitation interventions promote positive health impacts on several indicators and environmental and social realities; it shows

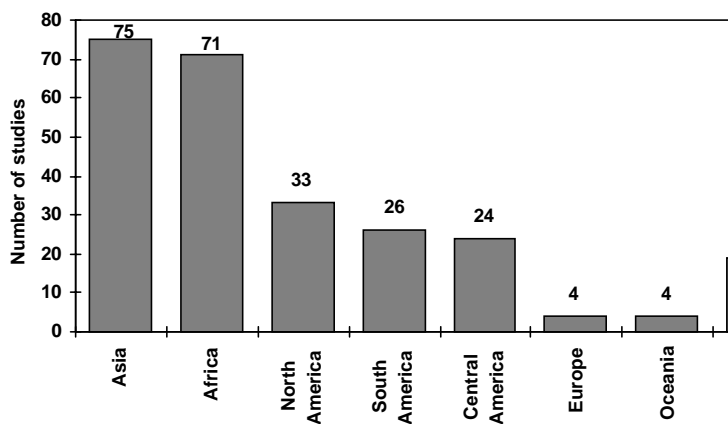


Fig. 2: association between environmental sanitation and health. Geographical distribution.

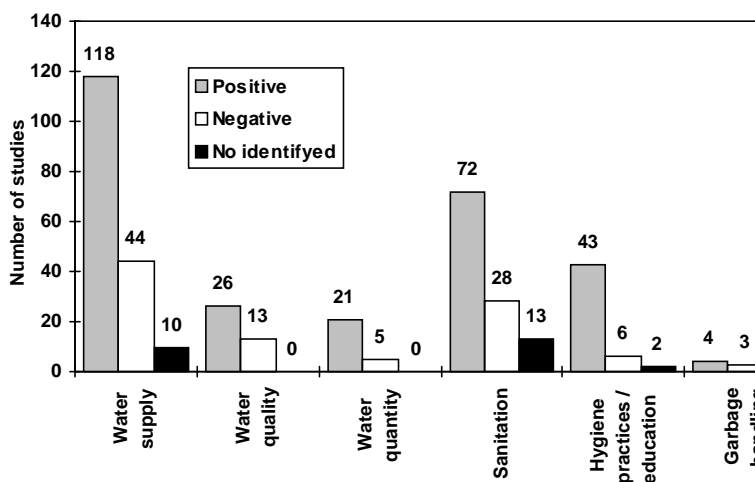


Fig. 3: association between environmental sanitation and health. Studies distribution according to the environmental sanitation variables and the results.

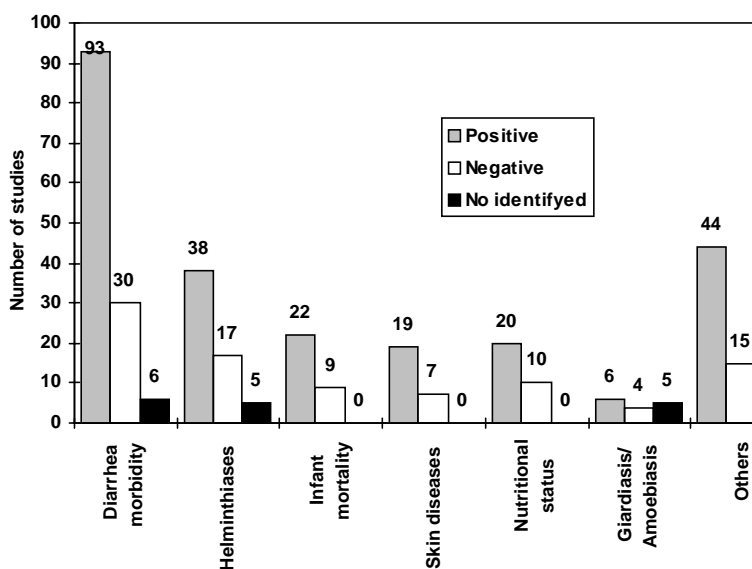


Fig. 4: association between environmental sanitation and health. Studies distribution according to health indicator variables and results.

necessity to investigate particular situations, regarding different kind of interventions, different health indicators and different socio-economical and cultural realities; (ii) understanding health impact of other environmental sanitation measures remains still incipient, particularly garbage handling, stormwater drainage, vectors control and hygiene education; (iii) in relation to health indicators, the use of diarrhea morbidity reveals an adequate approach to measure impacts; the use of other morbidity indicators and also mortality and anthropometric indicators depends on deeper evaluation.

STUDY OF THE ASSOCIATION BETWEEN ENVIRONMENTAL SANITATION AND INFANT DIARRHEA IN BETIM, MINAS GERAIS

An example of an epidemiological study carried out in order to analyze the association between environmental sanitation and health was developed in the city of Betim, in the metropolitan region of Belo Horizonte (Heller 1995). The general objective of the study was to evaluate the association between several environmental sanitation and hygiene conditions and infant diarrhea, regarding setting priorities for intervention.

Case-cohort design, a variant of the case-control method, was employed. A total of 1,000 children above five years of age, with report of diarrhea, constituted the sample of cases. The same number of children with the same age, randomly selected on the catching area, was selected as controls. Information about exposure variables was collected through questionnaires. Data were analyzed by univariate and multivariate techniques.

Several environmental sanitation and hygiene exposures showed to be significantly associated with the disease. Multivariate analysis revealed the most important relative risks presented in Fig. 5,

with the respective confidence intervals.

As a function of the results for the relative risks and other calculated risk measures, the following priority order for intervention was proposed: (a) hygiene education actions, emphasizing food hygiene and conservation, garbage handling, water handling, feces disposal from children diapers and the control of vectors in the domicile and the plot; (b) implementation of adequate solutions for wastewater and excreta disposal regarding its elimination from the streets; (c) prioritization, in housing programs, of sanitary facilities and domestic reservoirs, regarding elimination of water storage in vessels; (d) improvement of urban solid wastes management, increasing the catching area and the frequency of collection to a minimum of three times a week, as well as providing the population with information regarding the adequate domestic storage of garbage; (e) implementation of measures to flood control in plots.

CONCLUSIONS

As described in the present text, associating the environment as a determinant of the transmission of infectious and parasitic diseases is an approach that gained even more importance in the study of these diseases and of the preventive measures to its control. This approach is now part of a broader area, named environmental health, that has as the main objective to think the environment, the health and the relation between them in an integrated way.

Epidemiological studies, and particularly the study carried out in Betim, Minas Gerais, have the potential to improve the understanding of those relations, and may contribute to optimize the actions to be prioritized in the prevention of this group of disease, of sound importance for the reality of the developing world.

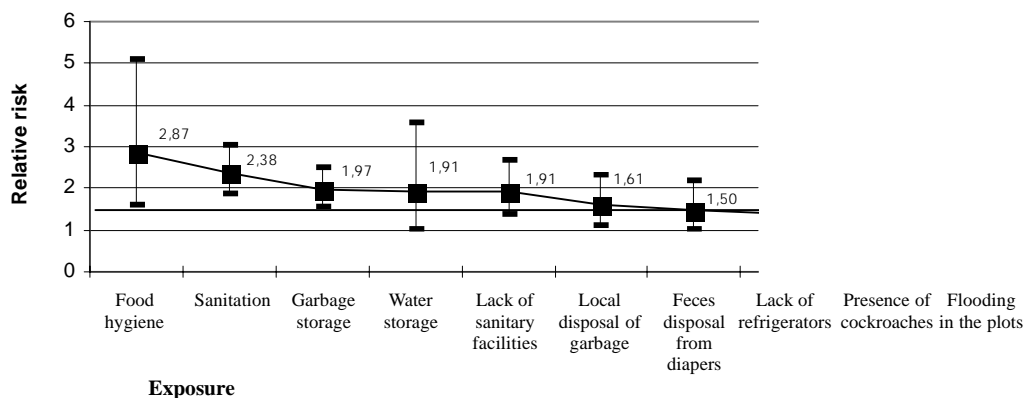


Fig. 5: environmental sanitation and diarrhea in Betim, Minas Gerais. Relative risks with the respective confidence intervals.

REFERENCES

- Bradley D, Stephens C, Harpham T, Cairncross S 1992. *A Review of Environmental Impacts in Developing Country Cities*, Urban Management Program Discussion Paper, The World Bank, Washington, D.C., 58 pp.
- Cairncross S, Blumenthal U, Kolsky P, Moraes L, Tayeh A 1996. The public and domestic domains in the transmission of disease. *Trop Med Intern Health* 1: 27-34.
- Fair GM, Geyer JC, Okun DA 1966. *Water and Wastewater Engineering*, John Wiley & Sons, New York.
- Feachem RG, Bradley DJ, Garelick H, Mara DD 1983. *Sanitation and Disease: Health Aspects of Excreta and Wastewater Management*, John Wiley & Sons, Chichester, 501 pp.
- Heller L 1995. *Associação entre Cenários de Saneamento e Diarréia em Betim-MG: O Emprego do Delineamento Epidemiológico Caso-controle na Definição de Prioridades de Intervenção*, PhD Thesis, Escola de Veterinária, UFMG, Belo Horizonte, 294 pp.
- Heller L 1997. Estado da arte da investigação epidemiológica na área de saneamento. *Rev Eng San Amb* 2: 176-189.
- Mara DD, Alabaster GP 1995. An environmental classification of housing-related diseases in developing countries. *J Trop Med Hyg* 98: 41-51.
- Rosen G 1994. *Uma História da Saúde Pública*, Hucitec, São Paulo, (Saúde em debate 74), 423 pp.
- Schaefer M 1994. *Salud, Medio Ambiente y Desarrollo: Enfoques para la Preparacion de Estrategias a Nivel de Paises para el Bienestar Humano, Segun la Agenda 21*, Organizacion Mundial de la Salud, Geneve, 49 pp.
- USEPA - United States Environmental Protection Agency 1990. *Environmental Pollution Control Alternatives: Drinking Water Treatment for Small communities*, USEPA, Cincinnati, 82 pp.
- White GP, Bradley DJ, White AU 1972. *Drawers of Water: Domestic Water Use in East Africa*, The University of Chicago Press, Chicago, 306 pp.
- WHO - World Health Organization 1991. *Salud Ambiental en el Desarrollo Urbano*. Geneve, OMS, Serie de Informes Técnicos 807, 70 pp.
- WHO - World Health Organization 1993. *Nuestro Planeta, Nuestra Salud: Informe de la Comision de Salud y Medio Ambiente de la OMS*, Washington, Publicación científica 544. 302 pp.