

J. Seaman

Epidemiology of Natural Disasters

With contributions by S. Leivesley and C. Hogg



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Save the Children Fund, London

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Contributions to Epidemiology and Biostatistics

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Drug Dosage

The authors and the publisher have exerted every effort to ensure that drug selection and dosage set forth in this text are in accord with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations, and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check the package insert for each drug for any change in indications and dosage and for added warnings and precautions. This is particularly important when the recommended agent is a new and/or infrequently employed drug.

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Epidemiology of Natural Disasters

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Foreword

Disasters, seen as large-scale disruptions of human ecology, represent a major health problem in the deaths, casualties and suffering which they cause. Doubtless, in the future their importance will increase even further in the wake of population explosion, technological development and social or political upheavals. The last decade has seen significant changes in the health management of disasters, whether natural or man-made. It is increasingly appreciated that the phenomenon goes far beyond the punctual provision of relief to the population affected and extends from advanced preparedness to the problems of long-term rehabilitation. Media reports and better communications have stimulated public pressure for more effective disaster aid. Both governmental and the non-governmental international agencies which have always been pivotal in disaster relief have seen the need for a more integrated approach to the subject, using the large body of knowledge which has been accumulating through case studies and exercises in the evaluation of disasters. Disaster epidemiology is a newly emerging discipline which attempts to develop a systematic approach to the measurement of the health effects of disasters, aiming at a more efficient matching of needs and resources.

This highly topical book will be useful to all those concerned with the health problem represented by disasters, from the field worker or the member of a rescue team after an earthquake, to the official in charge of predisaster planning and the management of relief. It successfully draws together the many aspects of disasters which can contribute to management. At a time when more and more health professionals are showing an interest in disaster work, this book elucidates the differences between the population approach and the individual approach and so helps to solve the conflicts they generate.

Conveying so much information in so few pages, with the right mix of scientific data and human concern, in a practical and clear format, is no

mean achievement. It is the result of the many years of field work and study of disasters by *John Seaman*, most recently as editor of the journal *Disasters*. It also reflects the experience of the London Technical Group, founded in 1971, now the International Disaster Institute.

I am convinced that this book will directly contribute to reducing the suffering of those many millions of our fellow human beings who will be exposed to disasters in the years to come.

Prof. *Michel F. Lechat*, Bruxelles

Contents

Acknowledgements	VI
Foreword	VII
Introduction	1
1. Death and Injury	8
2. Communicable Disease and Disease Control after Natural Disasters	49
3. Environmental Exposure after Natural Disaster	70
4. Food and Nutrition	89
5. Psychological Response to Disasters	109
6. The Practical Application of Epidemiological Methods to Disasters	140
Appendix: Volcanoes	157
Subject Index	173

Introduction

The effects of disasters are often obvious. No complex analysis is required to know that disasters may kill and injure many thousands of people, or that they may leave large populations homeless or without food. But while the vulnerability of populations of the richer countries has declined, that of the developing world has increased through population growth, urbanisation and pressure on land; despite the apparent simplicity of the relationship between disasters and the health of populations, problems still regularly arise with the effective provision of relief.

Worldwide, disasters are very common events and enormous sums are spent on disaster relief and reconstruction. It is estimated that disasters involving international assistance occur on average once a week [15]; although it is impossible to calculate the exact sums spent on relief, as no central records are kept, one estimate suggests that emergency relief, from international and local sources combined, now consumes approximately \$ 1 billion each year [10].

The 'epidemiology of disasters' finds its origins in the massive international relief operation mounted during the civil war in Nigeria in the late 1960s. The war caused food shortages which affected, to a greater or lesser extent, a population of several million people in a wide area. As relief supplies were limited, it was necessary to discriminate between those who were genuinely in need of food and those who were not. Through the involvement of epidemiologists from the US Center for Disease Control and from the Quaker Relief Service, techniques were developed for the rapid assessment of nutritional status, and surveys were conducted to identify the population in need [1, 5, 9].

Since then, progress in the 'epidemiology of disasters' has been

uneven. Most studies have been made on the causes and effects of food shortage on populations in the developing world. Techniques developed during the crises in the West African Sahel, Ethiopia, Bangladesh and Uganda [3, 6, 8, 12, 14] have become a routine part of relief work in famine areas and in refugee populations.

Much less information is available concerning the effects of the more violent types of disaster, such as earthquake, cyclone, tornado and flood, on the health of populations. In a literature review in 1972, *Western* [15] could find only two papers published prior to the Nigerian civil war where the epidemiological method had been consciously applied to these types of disasters. Since then, perhaps only a dozen more studies meeting this description have been added to the literature.¹

Western [15] advanced three main reasons for the lack of information on disasters. First, the study of disasters has tended to follow narrow specialty lines. Although many aspects of disasters have been intensively studied, and some, such as the geophysics of earthquakes, have led to considerable advance in understanding the causes of natural catastrophe, there is no academic specialization with an interest in their effects on populations. Most studies of the medical aspects of disasters have been conducted by physicians and other medical workers who become involved by engaging in relief work.

Second, many aspects of disasters and perhaps particularly those covered by this book are, by their nature, difficult to study. The lack of time in which to organise an investigation, the reluctance of relief workers to keep records, the movement of populations from and within disaster areas, and many other factors, work against accurate and complete observation.

Lastly, most relief agencies concerned with disaster – and there are estimates that these now number several hundred worldwide – regard relief as an entirely operational affair. Many administrators refuse to acknowledge that useful generalisations may be drawn from experience of the effects of disasters and the types of relief which may be useful in future relief operations. Medicines, clothes, shelter, food and medical personnel may be despatched to any disaster area with an assurance that they will be

¹ Most of these studies have been conducted by epidemiologists from the US Center for Disease Control, Atlanta, Ga. Only two other centers have had a sustained interest in the subject: the Center for Research on the Epidemiology of Disasters, School of Public Health, University of Louvain, Bruxelles, Belgium, and the International Disaster Institute, London, UK.

required. As a result, few agencies have been prepared to accord a high priority to systematic observation and record-keeping, and much valuable experience has been lost.

Definitions of Disaster

There have been many attempts to define the world 'disaster'², none of which is entirely satisfactory. They are either too broad, so that trivial events might be included, or too narrow, so that exceptions could easily be found. We suggest that no effective formal definition is possible, or even required. The term 'disaster' is often used to cover such disparate events as wars, industrial accidents, blizzards, avalanches, volcanoes, earthquakes, fires, famines and many types of windstorms and floods – events which have little in common except for their destructiveness.

Disasters are often classified into two groups, 'natural' and 'man-made', and are sometimes subdivided again into those of 'slow' and 'sudden' onset. These headings are descriptively convenient, but do not form a satisfactory classification of either the immediate causes or the effects of different agents or communities. Some types of disasters – such as fires, may be 'natural' or 'man-made' according to circumstances. Some 'sudden-onset' disasters such as floods, may occur rather slowly under some conditions, and the 'slow-onset' disaster of famine – or at least the abrupt termination of food supplies to part of a population – may be very sudden indeed, as the market price of food rises out of reach of the poor [13]. 'Natural' disasters may be the direct result of human actions, for example, through the siting of settlements in areas of known risk to flood, or the use of construction methods known to be of high risk in earthquakes. As sociologists have often pointed out, natural events such as earthquakes

² For example: '... the relatively sudden and widespread disturbance of a social system and life of a community or a large part of a community by some agent or event over which those involved have little or no control' [2];

'... an event (or series of events) which seriously disrupts normal activities' [4];

'More sociologically, a disaster is an event, located in time and space which produces the conditions whereby the continuity of the structure and processes of social units become problematic' [7];

'A disaster is an overwhelming ecological disruption occurring on a scale sufficient to require outside assistance' [11].

and floods are not intrinsically dangerous; it is the relationship between the natural agent and people that makes them so.

In this book, a more restricted classification of natural disasters has been used, including only earthquakes, cyclones and storm surges, tornadoes, tsunamis, floods and volcanoes. The reasons for this are two-fold: first, these types of disasters are responsible for most disaster-related loss of life, particularly in developing countries, and second, because they are the main concern of the international relief organisations. While other types of events such as blizzards and forest fires may be no less 'disasters' to an affected community, they are mainly of interest to local relief agencies, including usually the fire service and the police, and they do not fall easily into the same descriptive framework. Drought and famine have been excluded on the grounds that they raise wholly different issues in terms of cause, effect and relief; therefore, they should not be included in the same classification of 'disasters' at all [see also chap. 4, p. 89].

Sources of Information on Disaster

In a very complete review of the sources of information relevant to the epidemiology of disasters, *Western* [15] divided them into those dating before 1945 and those after 1945. As he pointed out, several factors make it difficult to compare the earlier with the more recent literature.

(a) *Changes in living conditions.* The population explosion, urbanisation and differing economic conditions in various regions of the world have created differential risks to populations. In some rich countries, the vulnerability of populations to certain types of disaster has been substantially reduced by measures such as flood control works and the enforcement of building standards in areas of high earthquake risk. In much of the poor world, the reverse has occurred; the exponential rise in the population of some cities, the pressure on land and the steadily deteriorating economic conditions of both governments and individuals have forced increasing populations into more hazardous zones.

(b) *Medical progress during the past 30 years.* Improvements in hygiene, vaccines, antibiotics and other drugs, have practically eliminated the scourges which were associated with disasters in the past (e.g. typhus, relapsing fever and plague). Such epidemics are now restricted to isolated epicentres and pose little threat after most calamities.

(c) *Improved communications and transport.* With the introduction of

the jet engine and cheap electronic devices, it is now possible for the outside world to hear of and respond to a disaster in remote parts of the world within a few days at most.

(d) *Increased interest.* Before World War II, the international relief agencies were few in number. Most international relief was channelled through Red Cross agencies. Since then, the economic boom in the western countries has led to both a greater knowledge of conditions in the developing world and to much greater opportunities for action. The period has seen the creation of the United Nations technical agencies, including one (UNDRO) with a specific responsibility for disaster-related activities, the growth of bilateral aid and the creation of a considerable number of private charitable groups, many of which have an interest in overseas disaster relief.

Contemporary sources of information on natural disasters span a wide range, from press reports, reports from governments, United Nations and independent agencies, to articles in the technical and scientific press. The total contemporary literature relevant to disasters, not including the technical literature on geophysics and meteorology, must now run to some hundreds of thousands of documents. We have been very select in our use of this literature, partly because many agency and government sources are simply not available for inspection, but mainly because of the poor quality and biases of the literature itself. Few documents, for example, give more than a summary description of the nature of the specific disaster with estimated numbers of dead and injured, before passing on to a list of relief requirements and material delivered; even fewer give any details of the sources of the information presented. Most agency material is written in such a way as to put the work of that agency in the best possible light. Even in the technical press, much of the literature is concerned with descriptions of technique (e.g. hospital planning, rescue), usually without any reference to any actual experience of disaster.

The Aim and Scope of the Book

For the reasons mentioned, very little of the information contained in this book was obtained by formal epidemiological enquiry. This book is an attempt to apply the epidemiological method, using that term in its broadest sense, to existing information, rather than a review of epidemiological research in its more usually-accepted form.

The topics of the six main chapters of this book are: death and injury, communicable disease, environmental exposure, food and nutrition, psychological response, and application of epidemiological methods to disasters. In the final chapter, the implications for disaster planning and conducting relief operations are discussed. These topics are dealt with at very different depths, reflecting the extent of the published literature on each topic. The discussion has been limited to the period immediately after disaster, as almost nothing has been published on the longerterm effects of disasters on health.

References

- 1 Arnhold, R.: The QUAC stick: a field measure used by the Quaker Service team, Nigeria. *J. trop. Pediat.* 15: 243–247 (1969).
- 2 Beach, H.D.: Management of human behaviour in disaster (Department of National Health and Welfare, Canada 1967); cited in Western [15].
- 3 Beillik, R.J.; Henderson, P.: Mortality, nutritional status and diet during the famine in Karamoja, Uganda 1980. *Lancet* ii: 1330–1333 (1981).
- 4 Cisin, I.H.; Clark, W.B.: The methodological challenge of disaster research; in Baker, Chapman, Man and society in disaster (Basic Books, New York 1962).
- 5 Davis, L.E.: Epidemiology of famine in the Nigerian crisis: rapid evaluation of malnutrition by height and arm circumference in large populations. *Am. J. clin. Nutr.* 24: 358–364 (1971).
- 6 Dodge, C.P.: Practical application of nutritional assessment – malnutrition in the flood area of Bangladesh, 1974. *Disasters* 4: 311–314 (1980).
- 7 Dynes, O.R.; Quarantelli, E.L.: Helping behaviour in large-scale disasters – a social organizational approach. Disaster Research Center, rep. 91 (Ohio State University, Columbus 1975).
- 8 Hogan, R.C.; Broske, S.P.; Davis, J.P.; Eckerson, D.; Epler, G.; Guyer, B.J.; Kloth, T.J.; Kloff, C.A.; Ross, R.; Rosenberg, R.L.; Staehling, N.W.; Lane, J.M.: Sahel nutrition surveys, 1974/1975. *Disasters* 1: 117–124 (1977).
- 9 Lowenstein, M.S.; Phillips, J.F.: Evaluation of arm circumference measurement for determining nutritional status of children and its use in an acute epidemic of malnutrition, Owerri, Nigeria, following the Nigerian civil war. *Am. J. clin. Nutr.* 26: 226–233 (1973).
- 10 National Research Council: The US Government disaster assistance program. Report of Committee on International Disaster Assistance (National Academy of Sciences, Washington 1978).
- 11 Pan American Health Organization: The health management of natural disasters (Pan American Health Organization, Washington 1980).
- 12 Seaman, J.; Holt, J.; Rivers, J.: The effect of drought on human nutrition in an Ethiopian province. *Int. J. Epidemiol.* 7: 31–40 (1978).
- 13 Seaman, J.; Holt, J.: Markets and famines in the third world. *Disasters* 4: 283–297 (1980).

- 14 Sommer, A.; Mosely, W.H.: East Bengal cyclone of 1970 – epidemiological approach to disaster assessment. *Lancet i*: 1029–1036 (1972).
- 15 Western, K.A.: The epidemiology of natural and man-made disasters – the present state of the art; thesis University of London (1972).

1. Death and Injury

Introduction

In the popular press, the prominence given to any disaster depends mainly upon the numbers of people killed or injured; much less upon the extent to which an economy or society has been disrupted. With few exceptions, disaster relief agencies have also tended to reflect the same scale of values. Large reported death tolls tend to elicit massive support from abroad in terms of medicine, equipment and medical personnel. For example, within 2 weeks of the 1976 Guatemalan earthquake, over 120 tons of drugs had arrived from abroad; the task of sorting and classifying these had not been completed several months after the impact [42, 69]. This is perhaps the most well-documented case, but similar examples can be found in the lore of almost any major disaster.

Most commentators on the medical aspects of disaster relief have also tended to assume that major disasters lead to large needs for medical assistance. There is now a large literature on the medical aspects of disaster relief. The greater part of this literature is taken up with descriptions of the organisational aspects of relief such as hospital planning, the management of mass casualties, suitable types of medical supplies and the most effective administrative procedures to be adopted [47]. Few commentators have asked the fundamental questions: 'What are the effects of disasters on human populations?'; 'Who is killed?'; 'Who is injured?'; and 'How does this vary among disasters of different types in different areas?'. In other words, 'What is the problem with which medical relief is actually concerned?'.