DISEASE AND URBANIZATION

Edited by E. J. Clegg and J. P. Garlick

ROUTLEDGE LIBRARY EDITIONS:
HEALTH, DISEASE & SOCIETY

ROUTLEDGE

ROUTLEDGE LIBRARY EDITIONS:
HEALTH, DISEASE & SOCIETY

Volume 11

DISEASE AND URBANIZATION

DISEASE AND URBANIZATION

Edited by
E. J. CLEGG and J. P. GARLICK

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published in 1980 Taylor & Francis Ltd.

This edition first published in 2022
by Routledge
4 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
605 Third Avenue, New York, NY 10158

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN: 978-0-367-52469-2 (Set)
ISBN: 978-1-032-25316-9 (Volume 11) (hbk)
ISBN: 978-1-032-25318-3 (Volume 11) (pbk)
ISBN: 978-1-003-28266-2 (Volume 11) (ebk)

DOI: 10.4324/9781003282662

Publisher's Note
The publisher has gone to great lengths to ensure the quality of this reprint but points out that some imperfections in the original copies may be apparent.

Disclaimer
The publisher has made every effort to trace copyright holders and would welcome correspondence from those they have been unable to trace.

DISEASE
AND
URBANIZATION

Edited by
E. J. CLEGG and J. P. GARLICK

TAYLOR & FRANCIS LTD
LONDON
1980

First published 1980 by Taylor & Francis Ltd, 10–14 Macklin Street,
London WC2B 5NF

Printed and bound in Great Britain by Taylor & Francis (Printers) Ltd,
Rankine Road, Basingstoke, Hampshire RG24 0PR.

British Library Cataloguing in Publication Data

Disease and urbanization.–(Society for the Study of
Human Biology. Symposia; vol. 20 ISSN 0081-153X)

1. Environmentally induced diseases–Congresses
2. Medical geography–Congresses
3. Social medicine–Congresses

I. Clegg, Edward John II. Garlick, James Patton
616.07'1 RB152

ISBN 0–85066–190–0

CONTENTS

PREFACE

In this book we focus attention on selected aspects of disease ecology, which can be resolved into a series of 'contrasts': urban/rural; temperate/tropical; and affluent/poor. In addition to these socio-geographical dichotomies, almost inevitably a further one appears, not an ecological but a nosological one — that between infectious (usually acute) and non-infectious (usually chronic) disease. This dichotomy largely accounts for the temperate/tropical and affluent/poor contrasts and also makes a major contribution to the urban/rural one. Thus, the first group of contributions is concerned largely with infectious disease in rural/tropical/poor societies and the second with the often antithetical combination of chronic disease in urban/temperate/affluent populations.

Not surprisingly, the state of knowledge of the ecology and epidemiology of many diseases falling in the first category is rather poor, although our understanding is constantly increasing. In simple societies living in environments with marked seasonal variation in temperature, rainfall and insolation, environmental pressures fluctuate markedly over the year, and when these variables interact with levels of nutrition varying within or between societies from the more than adequate to the less than inadequate, the complexity of interactions is very great and almost impossible to quantify. However, from the point of view of rational and successful prevention, *if it is possible to* identify the susceptible links in the chain of transmission of disease from one individual to another, the remaining ecological complexities may be of only minor importance, especially where transmissions can be reduced below critical levels by relatively simple control measures. Thus, for many of these diseases the importance of such simple measures as, for example, satisfactory levels of nutrition, adequate supplies of good water, and improved standards of hygiene, both personal and in food preparation, seem to be of the greatest importance. Where disease is vector-borne, the eradication or at least the control of vectors gives hope for the future, providing that the basic necessity is met of an adequate administrative and educational infrastructure on which can be based effective programmes of preventive medicine.

Thus for the first group of diseases, problems are often identifiable, but very difficult although not impossible to solve. For the second group, however, the identification of problems is often not well advanced. While for the first group the passage of time, with increase in knowledge and improvement in standards of living, can be expected to change things for the better — a view borne out by previous experience in present-day developed countries during their period of rapid economic development — with the second group the reverse situation appears to be the case. Many of the diseases discussed (chest disease, cardiovascular disease) appear to be diseases of affluence — or rather of relative inaffluence in affluent societies. Others, cancer especially, might be regarded as inevitable concomitants of increasing life expectation. While this particular interpretation remains true in general, there is little hope of progress unless it can be partitioned into more manageable components (inherited susceptibility; general or specific environmental stresses (occupational, nutritional); etc., etc.). The identification of specific aetiological factors is no easy matter, yet for many of these conditions specific, 'one-disease', factors may be very important; hence single measures to effect environmental amelioration can be expected to influence only a limited number of diseases. The net result seems to be that despite the enormous human and financial resources being poured into research into, for example, coronary disease and cancer, major advances are dearly bought. Furthermore, affluence, with its emphasis on self-gratification, constantly impedes the implementation of control measures based on ecological and epidemiological evidence even when, as in the association between smoking and a variety of chronic lethal diseases, this evidence is incontrovertible.

For all these reasons the tone of the contributions will be seen to be realistic rather than optimistic. For the infectious diseases, the relative ineffectiveness of malaria eradication programmes in certain ecological conditions, the 'new' (or at least newly recognized) diseases such as dengue haemorrhagic fever, the lethal combination of inadequate diet and infection — all these indicate the necessity firstly for further ecological and epidemiological investigation, but above all for adequate basic health care, in both the cities and rural areas of poor tropical countries. Yet the way ahead seems in many cases reasonably clear; too often what is lacking is the economic ability to follow it.

For the chronic diseases, the outlook is the same—somewhat gloomy, yet with rays of hope occasionally appearing. The progressive identification of specific environmental carcinogenic agents seems to be of potentially great value; the recent reduction in mortality from ischaemic heart disease suggests that the adaptive process (but to what?) may already have begun. For chronic lung disease, general environmental amelioration (smoke-free zones) and individual education (reduction in smoking) should produce good results. In general, one might draw from these papers the conclusion that solutions to many of the problems of disease in urban communities, if not in sight, are not far over the horizon. Implementing them, though, will involve enormous expense and/or major changes in some of the personal habits which are the very hallmarks of affluence.

Thus the tone of this volume is very practical. Given its theme, this could hardly be otherwise. At some points, the objective study of man and the study of the problems he faces in the various ecosystems of which he forms a part come together. This is one of these points.

The organizers and the Society are most grateful to Messrs. Pfizer Ltd., Upjohn Ltd. and the Ciba Foundation for financial assistance. Dr D. A. J. Tyrrell, C.B.E., F.R.S. was most helpful in discussions on the design of the symposium.

ECOLOGICAL FACTORS IN DENGUE HAEMORRHAGIC FEVER

W. W. MACDONALD

Department of Entomology, London School of Hygiene and Tropical Medicine

IN addition to malaria, which in some countries, such as India, is an urban as well as a rural problem, there are two widespread and serious mosquito-borne infections in urban communities in parts of the developing world. These are bancroftian filariasis and dengue haemorrhagic fever. Whereas filariasis has been recognized for some hundreds of years and the general features of its epidemiology have been understood since early in this century, dengue haemorrhagic fever presents a relatively new problem. It was only in 1954, during an epidemic in the Philippines, that the infection was recognized as a distinct entity, although retrospective case detection studies have revealed probable earlier transmission. In 1956 a dengue aetiology was established, and in the following years, each of the four types of dengue virus has been isolated during outbreaks.

Following the 1954 outbreak in the Philippines, primary outbreaks were reported in 1958 from Thailand, in 1960 from Singapore, in 1962 from Malaysia, in 1963 from Vietnam and Eastern India, in 1969 from Indonesia, in 1970 from Burma, and in 1972 there was an outbreak on Niue Island in the South Pacific. In most countries there have been recurring outbreaks, and Thailand in particular has suffered severely, with epidemics every year without exception for the past 20 years (Table 1). Dengue haemorrhagic fever has been associated primarily with urban populations, but in Thailand, although the early outbreaks were almost limited to Bangkok, there has been a steady

TABLE 1. Reported cases of, and deaths from, dengue haemorrhagic fever in Bangkok (including Thonburi) and in all of Thailand.

	Greater Bangkok			All Thailand		
	Cases	Deaths	% Deaths	Cases	Deaths	% Deaths
1958	2418	240	9·93	2706	296	10·94
1959	124	15	12·10	160	21	13·12
1960	1742	59	3·39	1851	65	3·51
1961	481	23	4·78	561	36	6·42
1962	4185	216	5·16	5947	308	5·18
1963	1657	144	8·69	2215	173	7·81
1964	5403	278	5·15	7663	385	5·02
1965	1994	59	2·96	4094	193	4·71
1966	3046	52	1·71	5816	137	2·36
1967	834	8	0·96	2060	65	3·16
1968	1631	21	1·29	6430	71	1·10
1969	2199	19	0·86	8670	109	1·26
1970	577	19	3·29	2767	67	2·42
1971	1092	10	0·92	11540	308	2·67
1972	2475	9	0·36	23786	682	2·87
1973	1509	22	1·46	8280	315	3·80
1974	1068	24	2·25	8160	328	4·02
1975	1778	4	0·22	17767	438	2·47
1976	1441	13	0·90	9616	359	3·73
1977	4235	18	0·43	38678	746	1·93

spread through the country into townships and villages, and every province in the country has now experienced the infection. In 1974 in Malaysia one of the most severely affected areas was rural western Johore.

The principal vector has almost always proved to be *Aedes aegypti*, but *Ae. albopictus* is sometimes a secondary vector and in the Niue Island outbreak *Ae. cooki* may have been involved, with or without *Ae. aegypti*.

Outbreaks vary in severity both between years and between seasons. In Thailand, the major epidemics were for a time biennial, and this rhythm was particularly evident from 1958 to 1968, when there were peaks in the reported cases during the even years, but in recent years the pattern has been disrupted and 1975 and 1977 had most severe outbreaks (Table 1). A biennial pattern was also clear in Burma, where 1000 to 2500 cases were reported during 1970, 1972 and

1974 and much lower numbers in the intervening years. No satisfactory explanation of this pattern has been proposed.

Where there is a pronounced wet season, as in Thailand and Burma, there has usually been a positive correlation between this season and the outbreaks. However, the correlation has not been exact, and significant numbers of cases have been reported at all other times of the year. In Hue, Vietnam, there was an outbreak during the dry season of 1973, and in that case it was thought that an increased number of *Ae. aegypti* were present owing to the increase in the number of water storage containers available for breeding.

In all outbreaks of dengue haemorrhagic fever, children have been most affected. In Bangkok during 1962–65, the median age of children hospitalized was 3 years 10 months. Later, during 1971–73, there was a shift to 5 years 7 months. Where suitable treatment facilities are available, the case fatality rate has fallen to 2 to 5 per cent, and in Bangkok, where medical staff have most experience of the infection, the rate has been reduced in recent years to less than 1 per cent, as compared with rates of about 10 per cent during the outbreaks in the 1950s (Table 1).

The prevention of outbreaks of dengue haemorrhagic fever is dependent at present on control of the vector *Ae. aegypti*. There is no alternative. To control *Ae. aegypti* we need first of all a substantial knowledge of its ecology on which control strategy can be planned, and, secondly, an acceptable means of attacking one or other stage of the life-cycle. We now have a relatively thorough understanding of the mosquito; we now have satisfactory means of attacking both the aquatic immature stages and the adults; but, perhaps paradoxically, we have no immediate prospect of preventing outbreaks. The reason for this pessimistic outlook centres in part around the habits of the people in affected areas, around their beliefs, and sometimes prejudices, and around their lack of appreciation of how essential is the part that they must play before vector control can be achieved. But the administrators and health officials also have heavy responsibilities, and the means by which effective co-operation of health workers and the public can be created need examination and definition.

In the remainder of this paper, the near total dependence of *Ae. aegypti* on man will be demonstrated and our current knowledge on some facets of its ecology will be outlined. Consideration will then be given to aspects of human behaviour which favour the mosquito in order to enquire whether and how changes in man himself could lead to the control of dengue haemorrhagic fever.

Vector Ecology in Relation to Transmission

Ae. aegypti has long been established as a most efficient vector of dengue (and of yellow fever). Its origins are the forests of Africa, where feral populations can still be found, and it has spread outwards into villages and towns first within tropical Africa and subsequently through the warmer regions of the Americas and of Asia and as far as Australia and the South Pacific. The spread has followed the lines of human communications, especially by road, by sea and by rail.

In South-east Asia, survey records show that *Ae. aegypti* at the beginning of the century was primarily a coastal species and that incursions into inland towns and villages have been relatively recent. Even within the past 20 years in Malaysia, the available records point clearly to an inland spread and consolidation of populations. For example, Macdonald (1956) reported three surveys in each of three inland villages, Rembau, Chengkau and Kota, during a period of 20 months from May 1954. In Rembau the proportions of houses with *Ae. aegypti* larvae were 20, 10 and 20 per cent, in Chengkau the figures were 5 per cent, zero and 5 per cent, and in Kota no larvae were found at any of the three surveys. Some 20 years later *Ae. aegypti* was found in approximately half the houses in all three villages, which were situated a few miles apart. There are now few, if any, towns in Malaysia without *Ae. aegypti*, and the same may be true also of villages. During the period 1971–74, staff of the Institute for Medical Research in Kuala Lumpur surveyed 152 towns and villages throughout peninsular Malaysia and, except for 10 villages, *Ae. aegypti* was present in every locality visited (Cheong Weng Hooi, personal communication). In 1970, Macdonald and Rajapaksa (1972) surveyed the distribution and relative prevalence of *Ae. aegypti* in Sabah and recorded a number of areas where it was absent, More recent, unpublished reports give evidence of new foci in several of these areas, notably in the capital town, Kota Kinabalu.

Three adaptations have favoured *Ae. aegypti* in its spread from Africa. First, the species has become strongly domestic and anthropophilic, although hosts other than man, including household animals, will serve as a blood source if the need arises. Second, instead of the ancestral tree-hole, the females now preferentially select man-made containers for egg-laying, such as water jars and drums, discarded tyres, flower vases and tin cans. Third, the eggs, after being laid, may remain for weeks or months in diapause before hatching; this feature is common to aedine mosquitoes, and it has evolved to enable forest-dwelling species to survive in the egg stage through dry seasons when natural containers such as tree-holes dry up.

Larval ecology

The principal larval habitats are man-made containers, and it is not uncommon to find in cities such as Bangkok or Jakarta several breeding-places per household, and in some houses there may be 10 or more. Two indices are commonly used to express the prevalence of *Ae. aegypti* in an area: the *Ae. aegypti* premise index and the Breteau index. The first indicates the percentage of houses with positive *Ae. aegypti* habitats, the second denotes the number of positive habitats per 100 houses. Surveys in South-east Asia of shophouses or of low-income districts often reveal premise indices of 70 to 80 per cent or higher, and Breteau indices of 200 to 300.

The larval habitats are, of course, not of equal importance in their contribution to the adult population. Some kinds of container support larger numbers of larvae than others, and the relative numbers of different kinds may vary both between areas and between seasons or years. It is generally not very difficult to define the distribution and relative prevalence of different habitats, but it is less easy to estimate the contribution which each type makes to the adult population. In low-income areas of Rangoon, the most productive habitats are probably 44-gallon metal drums which are used widely for water storage; in Bangkok, on the other hand, earthenware jars are by far the most prolific, whilst in Jakarta the most important are perhaps the indoor concrete tubs used for storing water for bathing.

The relative abundance of different habitats also varies at a local level. In Malaysia, for example, ant-traps or anti-formicas might account for nearly one-third of positive habitats in shophouses and urban slum areas, whereas in rural Malay houses ant-traps are seldom used. However, with the increased usage of refrigerators throughout the country, the prevalence of food storage cupboards with their legs in water-filled ant-traps may be declining.

In Bangkok, Tonn *et al.* (1969) studied larval habitats in 14 localities at three different times of the year and showed that almost all the differences between localities, including kinds and numbers of containers, and their location indoors or outdoors, were highly significant. The same authors looked at the differences between seasons, and they concluded that in Bangkok, although there were minor seasonal shifts in the type of favoured habitat, the fluctuations in larval populations did not seem to be much greater than 15 per cent between the cool, the warm and the wet seasons.

The most important measurement to be derived from studies of the larval habitat is the output of adults. It is also one of the most difficult to estimate. The output from a class of containers depends on the number of containers, the number of eggs laid in them, the survival rate through the immature stages to the pupal stage, and the emergence rate from the pupae. A few studies have been made, and in Bangkok, for example, Southwood *et al.* (1972) estimated that in a small study area of 0·53 ha there was a mean daily emergence throughout the year of about 77 adults from the principal habitats. The most productive sources were water-jars, which contributed 71 per cent of the adults, although the probability of an egg laid in a jar reaching the adult stage was only 0·012. The two other major habitats were the plates on which flower-pots rested and ant-traps, which contributed 26 per cent and 3 per cent, respectively, to the adult population. In these two kinds of container, the probabilities of an egg giving rise to an adult were 0·135 and 0·019, respectively. From such ecological studies, workers in Bangkok estimated in 1968 that about 800 000 containers supported *Ae. aegypti* in the city and that some 1·9 million adults were emerging each day.

The studies in Thailand have made it possible to define quickly, though approximately, the most productive habitats in any given area, and they have shown that treatment or elimination of only one or two classes of container might reduce the *Ae. aegypti* population by 70 to 80 per cent or more. However, it is not yet possible to define accurately the level of reduction required to prevent virus transmission. The experience of workers in Brazil, where in the past urban yellow fever was transmitted by *Ae. aegypti*, has led to a premise index of 5 per cent being regarded as the level below which transmission would be prevented. The attainment of this level is not easy, but it can be achieved.