

Epidemiology and Prevention

J.N. MORRIS

*Departments of Human Nutrition and Community Health,
London School of Hygiene and Tropical Medicine,
London, England*

THE THEME OF OUR MEETING* IS “EPIDEMIOLOGY and Prevention,” and my task is to take stock and to look ahead. Because the span of our effort and opportunity is nowadays so great, and because of the limitations of my own experience, I am obliged to be highly selective, illustrating from the “developed” countries—though some of the issues that I will raise are of the most general concern. I shall be discussing mainly the primary field. First, however, a few words on secondary and tertiary prevention. It is remarkable how productive their partnership between epidemiology and clinical medicine has proved, and how durable, despite their manifest shortcomings, these concepts remain.

Rising Tide of Disability

The aim of *tertiary prevention* is to minimize disability, for individuals, families, and the community; positively, to restore effective function and preserve social roles. In populations with an age structure like

* Opening address, IXth Scientific Meeting, International Epidemiological Association, Edinburgh, August 23, 1981.

that of the United Kingdom, such literally health-giving, preventive activities absorb a large and increasing part of clinical services, for the cataracts, hip degeneration, heart blocks, prostatic obstruction, congestive failure—to mention only some conditions of the elderly that we have little or no idea how to avoid in the first place. And this effort is merely the most visible of the day-to-day response in functional support for the great army with chronic disease and impairments, a growing army because its members live longer and because of the aging of the population.

As epidemiologists we may make two points here. First, on the need for definitions of “health” that are realistic as well as optimal, that apply to various ages and acknowledge physical and mental impairment as a mass phenomenon, and that recognize the natural history of the prevalent chronic diseases, with their precursor states and ubiquitous subclinical pathology as well as their clinical manifestations. The latest formulation by the World Health Organization (WHO) is an advance on the utopian original, but the importance attached to “economically productive” lives isn’t relevant to children or to the growing number of the retired. Complementing such real-life definitions, we need measurements and indicators of the health status of individuals that will realistically portray the well-being and functional capacities of our people, and can also be used to evaluate the efficacy of health and social services. There are highly promising proposals across the world to remedy this deficiency of management as well as of social medicine, and the time surely is now ripe for a concerted effort to apply theory to the actual operation of services. As an early benefit we could for the first time have an informed debate on the contribution that health services are making to the people’s health.¹

Secondary Prevention

Epidemiology is entitled to some modest credit in that, through its analysis and experiment, society has been spared the runaway inflation of screening and secondary prevention programs that once was threatened. There is no questioning the value of secondary prevention, or the contribution of epidemiology to an understanding of the natural history of disease on which it is based and to the planning and evaluation of practical programs. However, the human, technical,

financial, and logistic problems that have been apparent in seeking to control such topical examples as hypertension, breast cancer, and neural tube defects remind us that secondary prevention is second best, and emphasize anew the cardinal, historic, and continuing task of epidemiology: the search for causes and for defences against them—the investigation of etiology in the hope of unraveling the pattern of causation. As we know so well, discovering even a little of the pattern may open practical possibilities of actual prevention.

Social Deprivation

Turning now to primary prevention, I begin at the beginning, with social deprivation. The global situation was described earlier this year at the World Health Assembly as one in which “nearly 1000 million people are trapped in a vicious circle of poverty, malnutrition, disease, and despair that saps their energy, reduces their work capacity, and limits their ability to plan for the future, living for the most part in rural areas and the urban slums of the developing countries.” I hope you will excuse me for considering instead the far less serious, though serious for us, situation here at home—in a developed country. Such understanding might in the long run illumine also the problems of the Third World.

During the early 1970s in England and Wales, postneonatal mortality was four to five times higher in Social Class V, the unskilled and poorest of the population, than in Class I, the professional class. (Respiratory and intestinal infections mainly were implicated.) Neonatal mortality was rather more than twice as high. By the late 1970s the gap was narrower, though past experience tells us it is too soon to be rejoicing. Differences in the biological factors of maternal age and parity are no explanation. In the early 1970s, child deaths were about twice as common in Class V as in Class I, and fatal accidents in children four times commoner. Among men such inequalities in mortality were apparent for an extraordinary variety of conditions, including major chronic diseases—stroke, peptic ulcer, bronchitis, respiratory cancers, cancers of the esophagus and stomach—and also motor vehicle and other accidents.² Even coronary heart disease in men recently has begun to conform.³ The available data on morbidity and on children’s growth and cognitive development corresponds.⁴ Overall, despite a general fall in death rates, these classic gradients

haven't altered much since early this century when, after numerous demonstrations in Victorian times, they began to be studied under the broad umbrella of social or, more strictly, occupational "class." It is all exceedingly disappointing when so much else is improving, after such enormous investments have been made by the welfare state, and when the standard of living has doubled since the Second World War.

Similar situations are reported by other developed countries, but despite their manifest scale and persistence, concern with health in these terms has largely gone out of fashion. The whole issue, indeed, tends to be treated as given, almost as though it was a law of the natural and social order. That historic statement, *A New Perspective on the Health of Canadians*,⁵ makes only the briefest reference to it. And none of these modern manifestos and blueprints from Canada, Australia, the United States, or the United Kingdom, even when the issue is appreciated, pauses to consider what are the implications of social deprivation, or more generally of variation in health according to socioeconomic status, for any national strategy of preventing disease and promoting health.

Explanations

Our understanding of the dynamics has progressed little since Johann Peter Frank wrote of poverty as "the mother of diseases," and Rudolf Virchow about "bad social conditions," since William Farr associated the high death rates of the urban poor with unsanitary environment and overcrowding, or John Simon declared that there is no bigger question concerning public health than "how far the poor can be made less poor." Remarkably little is understood either of host or of environmental factors—material or cultural. But today, Public Health workers need to know about the specific contributions of family history and structure; income and expenditure patterns; jobs and unemployment; nutrition and other aspects of lifestyle; parenting and domestic skills; life situations and coping mechanisms—and about access to health services. How do such factors, all of them class-related, in their multiple combinations, relate to the inferior life chances of the socially disadvantaged? Data on biological aspects, genetics, aging, or possible immunological components, for example, also are grossly deficient. On selection and mobility between the social classes there is information about mothers, but little else.⁶ Is it not time for a

revival of interest in the problems of social inequality, deprivation, and health as major aspects of variation? Should we not exploit the theory and technique of modern epidemiology, study the official statistics, of course, but also study actual people at first hand? Should we not now be making field studies of families, groups, local samples, and cohorts likely to be illuminating? Their health, circumstances, and behavior in all relevant aspects that we can define? Liberating ourselves at the same time from the generalities and confoundings of social class? Here surely is a candidate for our agenda for the 1980s, and, incidentally, a range of questions that will test our thinking about "causes" to the uttermost.

I have spoken of the implications for health policy, but there are wider implications. In a country like this we are proud to have abolished subsistence poverty; there's no hunger and no bare feet. But if, as must be postulated, deprivation to lesser degrees is responsible still for serious pathology and premature death—in Adam Smith's words does not provide "the commodities which are indispensably necessary for the support of life"—the issues this time, when the whole of welfare policy is under anxious debate across the Western world, are serious indeed. They are as fundamental as those raised by the founding fathers of public health 100 and 150 years ago. The interest of social scientists has shifted to the concept of *relative* deprivation of generally accepted standards of living.⁷ Public concern with this issue surely is an important advance. But in view of what emerges from vital statistics as still attributable to deprivation, it seems premature, pending far greater understanding than we possess, to abandon altogether the notion of *absolute* safety levels, and it is urgent to study such possibilities. If, for example, social policy is to move away from principles of universal provision and toward greater selectivity, there will indeed be a heavy onus upon epidemiology to help identify those who are vulnerable. Willy-nilly, public health would once again be immersed in politics; our role is to assist it to be political but not partisan.

A Healthy Environment

The bridge to the next topic I mention is obvious enough. Any discussion of social deprivation will soon enough be drawn into hous-

ing conditions and squalor, inner-city dereliction—and tower blocks and motorway blight, these particular “diswelfares” of economic growth. More generally, it is notable, in spite of our highly organized services, how often “environmental health” problems arise in this country, with its population typically and increasingly sensitive to every aspect of the environment. In recent years we have encountered one asbestos scare after another, a cadmium scare, a characteristically contentious argument over lead, the chemical disaster at Flixborough, oil pollution, several horrendous fires, recurrent nuclear alarms, hypothermia in the elderly—and of course there is the daily reminder in the toll of serious road accidents.

Let me now glance, if only by way of token, at the *psychosocial*, and the *chemical* environment.

Among the human needs that our well-being depends on are an environment that will foster support in family and social ties and a sense of belonging, that will provide a variety of contacts, stimulation, and growth-promoting experiences, the opportunities to work, and facilities for recreation—all of these, as well as the immediate requirements of the house and home. There is widespread public conviction, and some evidence, that the social distress so prevalent today—family instability and isolation, violence in the family and community, the frequent breakdown of authority, a general hopelessness, sundry psychological disorders, the spread of alcohol abuse to new groups and so on—that this distress is produced in some or large part by the denial to many of such basic human needs. The young, the elderly, and the minorities seem to be at particular risk. Moreover, there is growing emphasis on the importance of the *local* environment, because of the frequent clustering of social distress; in the manifest damage done by demolition of familiar neighborhoods; and in the evidence that identification with a local community matters a good deal.⁸ All this offers some hope that the local environment can be better adapted to mobilize human resources, meet people’s needs, and so promote social and personal well-being.

Have we as epidemiologists anything to offer in this confused and unstable situation? Public health, or community health, as we now call it in this country, surely would be abdicating if it declined to consider these modern issues of the health of towns. Two things: we could be readier to join in investigating these distress signals and their often peculiar distribution, through local studies, seeking also

in particular—and we can surely be helpful here—to define early symptoms and warning signs, and determining those who are and are not vulnerable. On the bigger question of how to create better environments (having won the right to be heard) we could seek, somehow, goodness knows how, to plant the idea of an experimental approach to environmental innovation as an alternative to the architects' and planners' fashion and dogma—testing specific hypotheses on possible relations between living conditions and the physical environment on the one hand, and aspects of family and personal health on the other.

Turning to the *chemical* environment, we find the ongoing, continuing requirement to apply epidemiology, the basic science of public health and preventive medicine, to the possible hazards of dissemination and pollution; to the problems of association and cause, synergism and antagonism, the interactions of chemical with nonchemical factors, risk probabilities and thresholds, safety levels, to environmental monitoring, and population surveillance. Industry provides recurrent examples of how ad hoc epidemiological inquiry can successfully follow the clinical hunch that so often is the start of the suspicion that something is wrong.⁹

A thousand new substances, we are told, are being introduced each year under various elaborate screening and surveillance systems. There doesn't appear to be cause for alarm in general mortality rates (smoking apart), from what we know of the incidence of cancer or of birth defects from systematic registers, or in occupational mortality statistics. And it is possible to give some reassurance to a public that is beginning to come to terms with the notion of "acceptable risk."¹⁰ There is a problem, however, that is inherent in modern government—the multiplicity of sectors that are involved in pretty well anything that matters to social policy, central or local. I remember the list of 12 central government departments and agencies concerned with pesticides—scarcely a top priority in this country.¹¹ Clearly epidemiology needs immediate access to their (we may confidently assume) incompatible data, and free communication with those in the field, particularly in industry, so that necessary investigations can be instituted without delay. This appears to be the direction for action at present, rather than the setting up of new monitoring systems and data mountains. But there is one situation where a new information system is needed—the mass chemical dosage of the population with medicines.

Iatrogenesis

I must declare my interest: the many years in which I have been epidemiologist to the trial of the cholesterol-lowering drug Clofibrate.¹² As you may recall, we found a lower incidence of nonfatal infarcts in the experimental group than in comparable controls, but, to our dismay, a higher death rate from all causes. The distribution of these deaths was exceedingly puzzling, one feature being the remarkable number of different conditions that contributed to the deaths. And there's the rub. These deaths were noticed not because they were clinically striking, merely an increase in common everyday pathology, exposed by the standard epidemiological practice of recording all deaths that occurred during the trial, and then for several years afterwards. In this instance, as a matter of fact, we were testing an etiological hypothesis—that high cholesterol levels are a cause of coronary heart disease (CHD)—and we were not engaged in evaluating a drug. But should not close monitoring of the kind described be routine, at least with new and potent drugs taken long-term? How else can it be known whether there are chronic, high- or low-level, and maybe cumulative risks and, if so, whether these are worth taking? The randomized clinical trial is inappropriate here. To mount trials one by one, carry through for a period of years, and then analyze the results is not the tempo of modern pharmacology or the rest of science—this apart from the horrendous problems with blindness. Close recording, however, in large enough populations, as a condition of the right to prescribe, and with central monitoring plus (if feasible) record-linkage, to spot the suspicious incidence—of disease or death, we don't know what we're looking for—this may be the kind of self-discipline that technological innovation requires. I fancy that some such systems will claim a good deal of our energies in the years ahead.¹³

Lifestyle

Mass medication is of course a striking feature of the modern lifestyle. But let me pass now to the customary connotations of lifestyle in diet, smoking, exercise, and the like—the product of host and environmental situations, so it looks to us¹⁴—and focus on coronary heart disease. Future historians could well agree that disappointment

with the treatment of CHD and, by contrast, the prospects of its prevention that have been emerging in modern research, were largely responsible for the shift of public consciousness during the 1970s toward prevention and health, entailing a break with values and culture patterns of the 1960s.

When Herman Biggs wrote, and R.H. Tawney so effectively quoted, that “public health is purchasable: within natural limitations, a community can determine its own death-rate,”¹⁵ they were thinking mainly of the demonstrable influence of the environment and of social deprivation. What is being learned today about lifestyles adds another dimension to the possibility of control by man of his health and length of life; though it could be claimed that what is being learned is, in fact, completing the loop back to the Greeks! What is new is the possibility of improving health in the refractory periods of middle and even old age, particularly in men; and, through optimal diet, weight regulation, and physical fitness, moving individually and epidemiologically toward that will-o’-the-wisp, positive health. And yet, and yet, whether as investigators, health-policy decision makers, or members of the public, we are asked to characterize the present situation after 30 to 35 years of worldwide research, the word we would very likely choose is “uncertainty”—uncertainty that extends far beyond what we have come to expect in biomedical science and recalls rather the situation in clinical practice or the social sciences. The first discovery in this modern era, the production of modern epidemic lung cancer by cigarettes, remains one of the very few “certainties.” A vast amount has indeed been accumulated about the etiology of coronary heart disease, yet it remains full of mystery.

Uncertainties

There is no need in this paper to dilate on the causes of the uncertainty. Consider the crucial lipids hypothesis. There are contradictions between the findings obtained in comparing populations, and those obtained in comparing individuals within populations. Moreover, there are inconsistencies also among populations at similar stages of development, and in the findings made among individuals in the same population. In such situations observation must lead to experiments, but these are inordinately difficult to conduct and the few that have been completed have led to yet more controversy. There is a rumbling and utterly unsatisfactory debate on the possible hazards of interven-

tion. The methodological problems of assessing the diet of individuals have their counterparts in the case of exercise, where no country has more than one substantive study, and the elementary discipline of testing local associations by replication is missing. And so forth and so on. Setting the scene: coronary ischemic heart disease is multifactorial, of course, with largely independent factors—some pathogenic and some protective, some long-term and some short-acting, variously clustering and variously relating to the pathological processes and clinical manifestations of the disease. There is little evidence that any of them are “sufficient” or even “necessary” in any useful meaning of these terms. I have often wondered what Karl Popper would make of it all.

Nevertheless, as the result of a monumental, international, intellectual effort, a fairly solid consensus has been achieved that knowledge is firm enough on many things that should be done, things that make good sense in themselves and represent realistic decisions about the options that are open. We have to take this course because it is so unlikely that waiting for another few years will resolve the difficulties. Indeed the situation may become more complicated still. The diet-heart question is in the midst of something of a revolution that looks at present to be adding several factors, in lipids, and quite unrelated to lipids, to the prevailing paradigm. For one, the salt-hypertension hypothesis is beginning to press upon us, and there is little prospect of the kind of experiment being done about it in relation to coronary incidence that could provide clinching evidence. It looks more like a rerun of the lipids affair.

Unfortunately, the uncertainty of current knowledge spills over into uncertainty on how to apply what we do agree about. When the antismoking campaign “took off” in this country close on 20 years ago, with the first report of the Royal College of Physicians, there was little difference in smoking behavior between the social classes—around 55 to 60 percent of all men smoked. Last year, in 1980, 21 percent of men in the professional Class I were smoking cigarettes, and 57 percent of those in the unskilled Class V—a tragic failure of health education, despite considerable and even imaginative programs, particularly here in Scotland, that illustrates how entrenched lifestyles are in society and culture.

As if these were not enough, there is great uncertainty also about the roles and responsibility for changing behavior—of the government, of health and education services, and of the public: individuals, par-

ents, the people themselves. Because CHD is a mass disease (something like one man in three in this country may be expected to suffer) and because, as epidemiology again has shown, the risk factors are widely diffused, and those identifiable as specially vulnerable account for only a minority of the cases, a mass attack on the problem is required. The main issue must therefore be over what the government should be doing, and this is mixed up in philosophic and political dilemmas concerning the liberty of the individual versus the claims of the common good, and the disadvantages of paternalism against the responsibilities of the community. Meanwhile, ruthless commercial interests usually manage to keep a step or two ahead and, altogether, too little is done to enable people to mend their ways.

Agenda

A formidable array of questions thus confronts us. But, first, a word as epidemiologists on these philosophic/political issues. The question that must now be asked is whether the terms of these classic debates have not been altered by the new knowledge, by the new potentials of behavior for good and ill that are suggested, and by the new possibilities for preventing premature death? This must affect the choice of individuals between conflicting values—as choose they must—and the priority that the government will give to intervention.¹⁶ To make use of such knowledge also is a moral obligation. Our own role in generating the necessary facts is crucial, as seen again in the recent success in this country on legislation over seat belts.

All kinds of research are needed, epidemiological, laboratory experiment, and clinical science, so that between us we can also identify the processes and the mechanisms that carry so much conviction in these situations of uncertainty, and that multiply possible points of entry.

In our own field, observation and surveys must continue. The neglect over the years of the methodology of dietary study has to be repaired, together now with increasing capability of nutritional assessment in tissues and body fluids. The study of stress also deserves special support; it is a reasonable expectation that if the decline of CHD continues, this factor will become more, not less, important.

Two kinds of epidemiological experiment may be insufficiently attempted at present. Only in smoking have we exploited the natural experiments in progress all around us. Evidence of the advantage to

those who quit smoking has proved crucial, and despite the well-known limitations imposed by selection—which are glaring in smoking. After all, John Snow's experiment "on the grandest scale," etiological and explanatory, on the water supplies of London, was a natural experiment. What of the great numbers who are changing their diets, or have taken up vigorous exercise? In the short space of two years, the marathon has become a widespread national movement in this country. It so happens that my own main research interest at the moment is this problem of selection vis-à-vis vigorous exercise: how much of the benefit in CHD incidence that is observed is due to the exercise, and how much to the person who is taking it? A quite fascinating series of questions arise.¹⁷

The other kinds of experiment with promise are preventive trials, quite modest efforts, often action research, with prospect of a clear answer. We may not be able to carry out the experiments we would like, but reducing all the uncertainty we can will also be valuable. It may not be possible to test salt reduction against coronary incidence, but what about the reduction of blood pressure? How much, and in whom? What kind of exercise, and how much of it, achieves what gains in working capacity and in physical fitness, what fulfillment of genetic potential, at what ages and in which circumstances? What dietary changes are necessary for worthwhile lowering of serum cholesterol? We need more information on every one of these questions. We should also be seeking to persuade the authorities to take local action in controversial fields of behavior, and to study how people actually respond to different mixes of education, administrative measures, and self-help. And the possibilities of trials extend far beyond CHD. To recall the socially deprived, how can primary health care and preventive services in maternal and child health discriminatingly reach those who need them most? Catch trouble early? And if they do, what benefit is demonstrable? Can health/welfare services make up for social disadvantage? Today, such questions surely are subjects for experiment, not merely observation and disputation.¹⁸

Toward the Year 2000

Let me draw to a close now. We are bidden by WHO to be bold and imaginative, to address our sights to the year 2000 and the goal

of "Health for All." Recent victories will be recorded at our meeting, the epic of smallpox eradication, for one, and a beginning decline of CHD in several countries. The causes of this decline are by no means clear—I am reminded of the equally dramatic and puzzling decline of infant mortality early in this century—but it would indeed be a sick joke of history if the causes turned out to be different from the risk factors so painstakingly identified that have also been in decline during the same period. The outlook on the prevention of malignant disease has been transformed by epidemiology—its evidence of geographical differences, the migrant studies, time trends, the smoking discoveries, asbestos, and other occupational carcinogens. The prospects look bright for attack in terms of lifestyle and environment.¹⁹

Two Brief Probes into the Future

Postindustrial Society

Looking ahead, the postindustrial society will surely have arrived in the developed countries; only the current recession is concealing its advance. It doesn't require much prescience to predict that the new age of information, education, R and D, of electronic technology, universal computers, and microchips and robots, of abundant leisure, is likely to bring new health problems. And these are likely to be mental, psychosocial, stress-induced. Thus, the critical issue of the significance of employment and work in human personality will come to a head. The message is plain for us in the more conventional groves of epidemiology; we must enlarge our interests and adapt our skills.

"Primordial Prevention"

The grand question for prevention, it may be said, as we look ahead to the year 2000, is this: can developing countries, as they advance economically and industrially, avoid the errors made so liberally in the West, and learn from its failures? Can they achieve the benefits of technology and economic growth with less of the health costs and the social "diswelfares"? In the cardiovascular section of WHO we have been seeking for several years now to float the idea of primordial

prevention: that developing countries, when they "take off," as deliberate acts of national policy might aim not merely to control the risk factors of CHD, for example—the cigarettes, malnutrition, obesity, sedentary living, and so on—but take preemptive action against these risk factors becoming established in the first place. Health would truly become, in the words of WHO, an integral part of development. Cigarettes provide their own horror story, but food and agricultural policies are likely to prove the test. CHD, the "modern epidemic," is a useful reflection of lifestyles and the diseases of development, not least in the thinking that action needs to begin early in life. Alcohol abuse, motor accidents, and elementary industrial hazards may be even more urgent. In time, we may hope, the cancers associated with economic growth—those of breast and colon/rectum as well as lung cancer—can be part of the movement.²⁰

Would it not be useful here to bring together the main lessons that have been learned in recent years on the sources of health and disease—in standards of living, in lifestyles and environment, in human biology—into a modern regimen of health, guidelines for today and tomorrow? With the authority of WHO this could be an inspiration to all and a reinforcement in difficult local situations. Might the I.E.A. propose such an enterprise and collaborate on the necessary study and analysis? We could provide the information and state the options in an objective and critical way, while being as ideologically committed as any.

* * *

The time indeed has arrived for epidemiology. As students and teachers, the scholars and the scientists that we strive to be, and as public servants, the opportunity before us has never been greater. Let us with courage and in mutual support seek to rise to it.

References

1. J.N. Morris, *Uses of Epidemiology*, 3rd ed. (Edinburgh & London: Churchill-Livingstone, 1975).
2. Department of Health and Social Security, *Inequalities in Health*, Report of a research working group, Sir Douglas Black, chairman (London: Her Majesty's Stationery Office, 1980).

3. M.G. Marmot, A.M. Adelstein, N. Robinson, and G.A. Rose, "Changing Social-Class Distribution of Heart Disease," *British Medical Journal* 2 (1978): 1109-1112.
4. J.N. Morris, *Uses of Epidemiology*, 3rd ed. (Edinburgh & London: Churchill-Livingstone, 1975).
5. M.H. Lalonde, *A New Perspective on the Health of Canadians: A Working Document* (Ottawa: Information Canada, 1975).
6. R. Illsley, *Professional or Public Health? Sociology in Health and Medicine* (London: Nuffield Provincial Hospitals Trust, 1980); E.M. Goldberg and S.L. Morrison, "Schizophrenia and Social Class," *British Journal of Psychiatry* 109 (1963): 785-796.
7. P. Townsend, *Poverty in the United Kingdom* (London: Allen Lane, 1979).
8. H.M. Choldin, "Retrospective Review Essay: Neighborhood Life and Urban Environment," *American Journal of Sociology* 84 (1978): 457-463; Department of Health and Social Security, *Unequal City: Birmingham*, Interim and final reports (London: Her Majesty's Stationery Office, 1977).
9. J.C. McDonald and J.M. Harrington, "Early Detection of Possible Occupational Hazards," in *Report of National Health and Safety Conference, Section M* (London: Her Majesty's Stationery Office, 1980); E.D. Acheson and M.J. Gardner, "The Ill Effects of Asbestos on Health," in *Asbestos: Final Report of the Advisory Committee, Health and Safety Commission* (London: Her Majesty's Stationery Office, 1979); R.S.F. Schilling, ed., *Occupational Health Practice*, 2nd ed. (London: Butterworths, 1981).
10. W.W. Lowrance, *Of Acceptable Risk* (Los Altos, Calif.: William Kaufmann, 1976).
11. H.A. Waldron, *The Medical Role in Environmental Health* (London: Oxford University Press, 1978).
12. Committee of Principal Investigators (M.F. Oliver, J.A. Heady, J.N. Morris, and J. Cooper), "WHO Cooperative Trial on Primary Prevention of Ischaemic Heart Disease Using Clofibrate to Lower Serum Cholesterol: Mortality Follow-up," *Lancet* 2 (1980): 379-385.
13. W.H.W. Inman, "Postmarketing Surveillance of Adverse Drug Reactions in General Practice," *British Medical Journal* 282 (1981): 1131-1132, 1216-1217.
14. J.N. Morris, *Uses of Epidemiology*, 3rd ed. (Edinburgh & London: Churchill-Livingstone, 1975); L. Breslow and J.E. Enstrom, "Persistence of Health Habits and their Relationship to Mortality," *Preventive Medicine* 9 (1980): 469-483.
15. M. Terris, "Models for Action," *Journal of Public Health Policy* 1 (1980): 103-109; R.H. Tawney, *Equality* (London: Allen & Unwin, 1938), p. 168.

16. D.E. Beauchamp, "Public Health and Individual Liberty," *Annual Review of Public Health* 1 (1980): 121–136; I. Berlin, *Against the Current* (London: Oxford University Press, 1981), pp. 25–79.
17. J.N. Morris, M.G. Everitt, R. Pollard, S.P.W. Chave, and A.M. Semmence, "Vigorous Exercise in Leisure-Time: Protection against Coronary Heart Disease," *Lancet* 2 (1980): 1207–1210.
18. J.N. Morris, *Uses of Epidemiology*; Department of Health and Social Security, *Inequalities in Health*.
19. R. Doll and R. Peto, "The Causes of Cancer: Quantitative Estimates of Avoidable Risks of Cancer in the USA Today," *Journal of the National Cancer Institute* 66 (June 1981): 1191–1308; J. Higginson, "Cancer and the Environment," in N.F. Stanley and R.A. Joske, eds., *Changing Disease Patterns and Human Behaviour* (Sydney: Academic Press, 1980).
20. R. Doll and B. Armstrong, "Cancer," in H.C. Trowell and D.P. Burkitt, eds., *Western Diseases* (London: Edward Arnold, 1981).

Address correspondence to: Professor J.N. Morris, Departments of Human Nutrition and Community Health, London School of Hygiene and Tropical Medicine, Keppel Street, London, WC1E 7HT, England.