

Inequalities in Health

The Role of Nutrition

Professor Sir Michael Marmot

The Caroline Walker Lecture 2001



Michael Marmot

Michael Marmot, Professor of Epidemiology and Public Health and Director of the International Centre for Health and Society at University College London, has been at the forefront of research into health inequalities for the past 20 years, as Principal Investigator of the Whitehall studies of British civil servants, investigating explanations for the striking inverse social gradient in morbidity and mortality. He was awarded a knighthood in 2000 for services to epidemiology and understanding health inequalities.

The Caroline Walker Trust

The Trust was set up in memory of the nutritionist and campaigner Caroline Walker who died in 1988. The aim of the Trust is the improvement of public health through good food. In addition to the Annual Lecture, the Trust is involved in a variety of activities including the production of a range of expert reports.

The Trust is very grateful to the Co-operative Group for their support of the annual lecture and the publication of this document.

©Michael Marmot 2001

Published by
The Caroline Walker Trust
PO Box 61
St Austell
PL26 6YL

www.cwt.org.uk
Registered Charity 328580

Designed and printed by Dual Developments

ISBN 1 897820 14 3

*Tell me where is illness bred
Or in the heart or in the head?
How begot, how nourished?*

Health is unequally distributed within and between societies. How might nutrition play a role in generating these inequalities? I want to do two things in this lecture: first, to consider four ways nutrition may be important for health inequalities; second, to ask more generally how we should think about these inequalities. The way we conceptualise them has much to do with how we should think about their solution.

To begin, a word of definition or, at least, description. Some disciplines take as their focus the causes of individual differences. Psychology, typically, defines its purpose as understanding why one individual differs from another. Behavioural genetics has as its central concern the understanding of the contribution of individual differences in genetic profile to individual differences in behaviour, cognitive function, and psychological traits. Similarly, work on the genome seeks to understand how genetic polymorphisms contribute to the understanding of individual differences in susceptibility to disease. Economists commonly conceive of inequalities as individual differences. The Gini coefficient, for example, is a much used and useful description of the degree of inequality in the distribution of income, among individuals.

Clinical medicine, too, focuses on the individual. Why did this individual become ill and what can be done about it?

Mapping the human genome was a simply astonishing feat. The vistas of biological understanding that it opens up are truly broad. We should not lose sight of the questions that such understanding allows us to pose and those it does not. The question of why one individual Russian may have greater susceptibility to coronary heart disease than another is a different question from why life expectancy in Russia dropped by about 7 years in 7 years. The question of why one child in a middle class school is taller than another is a different

question from why average height of men in Britain in the late 20th century was 9cm greater than it had been 200 years previously. The question of why identical twins show greater concordance for obesity than fraternal twins is a different question from why the prevalence of obesity has trebled in Britain¹ and doubled in the USA² over a frighteningly short period of time.

It is a matter of some surprise to me that the differences between these types of question are not more widely appreciated. In each case above, the first is asking about the cause of individual differences; the second about the causes of differences among populations. Geoffrey Rose taught us that the causes of population rates of disease may be different from the causes of individual cases.³

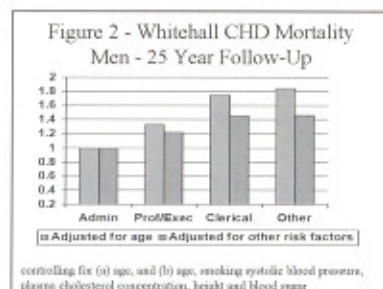
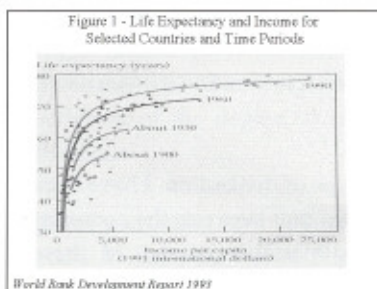
What then of inequalities in health? As noted, economists commonly think of inequality as individual differences. There has even been a move to import this thinking into health inequalities.⁴ In Britain, the short-hand term "inequalities in health" refers to differences between social groups.^{5,6} The distinction between individual differences and differences between social groups relates to the discussion above. Their causes may be different. Blurring the distinction has the potential to lead to confusion. It could be the case, for example, that all the differences between social groups were due to environment, meaning in the widest sense of non-genetic, whereas all the differences among individuals within social groups were genetic.

I will however run the risk of blurring a different type of distinction. I have been concerned with another type of inequality in health: that between the countries of East and West in Europe. In investigating possible causes of these differences, I have been proceeding on the assumption that they are more likely to be like those of social inequalities in health within European countries than they are like individual differences.

Four ways nutrition may be causally related to inequalities in health

1. Poverty

The whole question of inequalities in health involves two related issues, that of poverty and health and that of inequality. Figure 1 is much quoted because of the important message it contains.⁷ It shows the relation of Gross National Product per capita to life expectancy for a wide range of countries. At the low end of income, a small increase in national income is related to a large increase in life expectancy. The contrast with the other end of the scale is marked: at high incomes there is little relation between income and health. Now let us contrast that finding with that from comparisons within a country. As an example, Figure 2 shows mortality by grade of employment for British civil servants included in the first Whitehall study. The higher the grade, the lower the mortality.^{8,9} Although we have used employment grade on the x axis, we could have replaced it by income as there is a clear relation between seniority in the Civil Service and income.

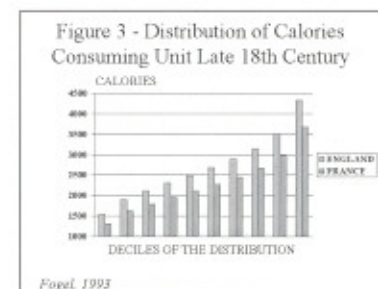


There would, at first, appear to be some difficulty in reconciling these two figures. All of the civil servants have an income that is above the point in Figure 1 where there ceases to be a relation between national income and life expectancy (crudely the inverse of mortality). Yet among these non-poor civil servants there is a clear gradient in mortality rates. There may be a host of technical reasons why I should not compare national income with individual

incomes within a country. Although on thin ice, I shall skate over these here and suggest a non-technical solution to the problem. Within rich countries, the reason income appears to be related to ill-health is because it is a marker of where someone is in the social hierarchy. This in turn may be related to relative status, and to a variety of social and psychological processes that are important for health.

The relation of low income to health as shown in Figure 1 can conveniently be covered by the term poverty or deprivation. The relation of socioeconomic position to health shown in Figure 2 may be labelled inequality, one part of which may be relative deprivation.

Where does nutrition fit here? An important reason for the link between low income and poor health will be undernutrition. Children who are malnourished are at increased risk of a range of infectious disease. The increase in average height that Fogel has documented for European countries is related to their improved nutrition.¹⁰ Figure 3 from Fogel shows the distribution of calories by decile in England and France at the end of the 18th century. The bottom ten percent of the distribution were consuming insufficient calories to do a day's work. Without work they could not have money to buy food. Without food they would be at risk of infectious disease which would further diminish their nutritional status. Therefore one way nutrition is important for health inequalities is because of its close link with absolute deprivation.

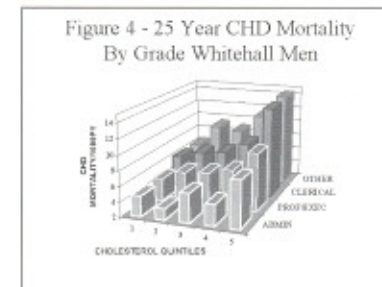


2. Nutrition determining risk of particular disease and its level

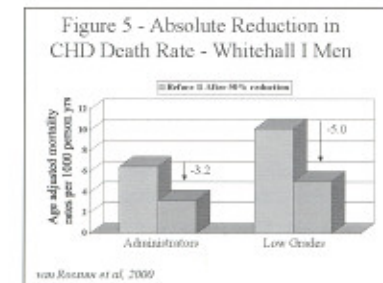
There are actually two ideas contained here. First, one of the striking phenomena about inequalities in health is the generality across time and the application to several causes of death. BS Rowntree's report of health in the city of York, published in 1901, examined death rates among working class people according to the level of deprivation of their neighbourhood. For adults the death rates per 1,000 of the population per annum were 27.8 for the poorest area, 20.7 for the middle area and 13.5 for the highest area.¹¹ The causes of death were quite different from those we see 100 years later and yet there was still a social gradient in disease. Similarly, in the Whitehall study the social gradient in mortality was seen for all the major groups of causes of death: cardiovascular disease, cancers, infections, gastrointestinal disease, renal disease, respiratory disease, accidents and violence.

That there is a social gradient in disease rates has to do with the operation of forces in society. Which particular diseases will show the social gradient has to do with the operation of particular causes. When tuberculosis was a major cause of death it showed a social gradient. Now that it is a minor contributor to mortality, coronary heart disease and lung cancer are major contributors to the social gradient in mortality.

Coronary heart disease shows a clear social gradient in mortality. To illustrate my point under this heading let us concentrate first on the effect of diet through its effect on plasma cholesterol. The amount and type of fat in the diet influence the level of plasma cholesterol. The level of plasma cholesterol is a major risk factor for CHD; but there is little or no social gradient in plasma cholesterol level. Figure 4 illustrates from the first Whitehall study. At each level of cholesterol, low grades have higher CHD mortality rates than do high grades. The reason heart disease is so common as a cause of death has much to do with the high mean level of plasma cholesterol seen among all men regardless of their grade of employment. The reason that heart disease shows a social gradient is for reasons other than plasma cholesterol. In this case, diet plays a role in determining which disease people get, but not its social distribution.



There is, however, a second point. What would be the effect of lowering plasma cholesterol by an equal amount in all social groups? The data suggest that the **relative** risk of developing CHD for a given increase in plasma cholesterol is similar in each grade of employment in the Whitehall study. What is true for **relative** risk cannot be true for absolute risk because the **absolute** rate of disease is higher the lower a person is in the social hierarchy. Therefore if a given reduction in plasma cholesterol achieved the same proportionate reduction in CHD mortality in each social group, the absolute reduction would be greatest in the lowest group. To make this concrete: if the top civil servants halved their death rate from CHD and the messengers did likewise, the messengers would enjoy greater absolute reduction because their starting level was higher.^{8,9} This is illustrated in Figure 5.



What is true for plasma cholesterol may also be true for salt. Salt intake is related to blood pressure and trial evidence suggests that reducing salt intake reduces blood pressure.¹² Blood pressure shows only a shallow social gradient in Whitehall and there is scant evidence of a social class gradient in salt intake. As with cholesterol, a given reduction in blood pressure is likely to achieve the same proportionate reduction in CHD in each social group. As with cholesterol, the absolute benefit is likely to be higher in the lowest social group.

3. Nutrition and early life

Like most scientists, I have my axe to grind. My particular axe relates to the importance of circumstances in adult life for the generation of inequalities in health. A line of inquiry that emphasises that the origins of adult diseases, such as CHD and diabetes, are at the earliest stage of life is therefore a challenge to the evidence that my colleagues and I have been assembling.

A most dramatic demonstration of the importance of circumstances affecting adults, if one were needed, is what has happened in the countries of central and eastern Europe.¹³ I cited the figures for Russia above. We also examined CHD trends by age groups in east and western European countries. In virtually all eastern European countries, CHD mortality rates increased during the 1960s. A striking part of this rapid change is that it affected different age groups at about the same time. If rates of CHD were all determined by what had happened earlier in life, one might expect time trends to show a cohort effect i.e. people born in some years would be affected more than people born in others and they would carry this predetermined risk with them through their lives. We examined the data to see if there was a birth cohort effect and found little evidence to support this view. (Marmot and Bobak, unpublished).

Having confessed to my initial reluctance to accept the importance of early life as a determinant of disease in adult life, I have to admit to being impressed by the body of evidence that David Barker has accrued. In a variety of studies he has demonstrated that children who were either of low birth weight, were thin at birth, or had low growth in the first year of life have higher rates of CHD when they reach adulthood.¹⁴ The leading hypothesis to explain this is that

inadequate nutrition in utero, and in the first year of life, lead to low growth and to programming of metabolic and physiological functions that make them vulnerable to the effects of later life experience.

Inadequacy of nutrition in early life is a plausible candidate, therefore, for a link between poor social conditions in early life and subsequent cardiovascular disease. The story does not end there. What happens subsequently is also important. In support of Barker's hypothesis we have used height as a marker of influences of early life, and genetic endowment. Short height is related to low employment grade in the Whitehall studies.¹⁵ Independent of employment grade, short height is a predictor of CHD.¹⁶ Employment grade predicts CHD independent of short height.

David Barker's more recent analyses suggest interactions between early life and subsequent experience. In a follow-up of a Finnish cohort, he showed that thinness at birth was related to subsequent CHD risk. He showed further that there were interactions. As predicted, adult social class was related to CHD. The relation was particularly strong in men who were thin at birth. This suggests that such men were especially vulnerable to the effects of adult social conditions.

The early life story is not, of course, confined to nutrition. Children from deprived backgrounds come to the school system less able to benefit from it. The relation between social deprivation and school performance is so tight that it suggests that school performance is a better marker of deprivation than it is of quality of schools.¹⁷ Poor educational performance will in turn affect social position in adult life and hence exposure to a wide range of influences that we think are important to the generation of health inequalities.¹⁸

4. Differences in nutrition may make a direct contribution to the social gradient in adult disease

In 2. above, I discussed why an aspect of nutrition, such as fat intake that does not vary among social classes in Britain, may still be important for inequalities in health. There are more direct ways that nutrition may be important. In

particular, in Britain, there are marked social class differences in intake of fruit and vegetables. Table 1 comes from a comparison between the Whitehall II study and Gazel, which is a study of office workers in the French national Gas and Electricity company.¹⁹ There is an interesting contrast between the French and the English public sector workers. In England, higher status civil servants have higher intakes of fresh fruit and vegetables. This social gradient is not in evidence in France.

Table 1 – Whitehall II (UK) and GAZEL (France) Risk Factors by Grade of Employment

	WHITEHALL II EMPLOYMENT GRADE			GAZEL EMPLOYMENT GRADE		
	Higher	Intermediate	Lower	Higher	Intermediate	Lower
Average or poor health (%)						
Men	17.7	23.3	35.4	12.0	15.4	19.9
Women	23.3	32.8	42.4	13.5	18.7	23.5
Current Smokers (%)						
Men	9.3	17.9	35.8	28.9	32.5	31.9
Women	12.8	20.7	27.5	21.6	18.6	18.8
Fruit/vegetables > daily (%)						
Men	61.9	51.6	36.0	59.1	57.3	61.4
Women	61.4	66.7	54.4	73.7	73.5	72.6
Low decision latitude (%)						
Men	11.8	34.7	82.5	18.3	42.0	77.9
Women	2.2	13.7	49.2	4.3	29.5	51.2

Fuhrer et al, AJPH (in press)

We should consider the possibility that fruit and vegetable consumption is simply a cultural marker and not causally related to inequalities in health. This is possible. Against this, however, are data showing that such intakes are related both to risk of cancer and CHD. The DASH trial in the USA showed that a diet high in fruit and vegetables had a substantial effect on lowering blood pressure. Adding low salt, lowered blood pressure further.²⁰ There have been objections that fruit and vegetables are not causal, because trials of antioxidants have

shown no protection against CHD or cancer.²¹ It may be that those trials, in isolating antioxidant vitamins, focussed on the wrong micronutrients.

It is also likely that low intake of fruit and vegetables plays a role in the high rates of CHD in Eastern Europe. Table 2 is from a study comparing two groups of "central European" men: in the Czech Republic and Bavaria.²² Czech men have higher rates of CHD mortality than do men in Bavaria. The low intake of fruit and vegetables may be inferred from the differences in micronutrients between the Czech and Bavarian men. Note, I am not attempting to contradict what I said about the trials of antioxidants. It may be that these micronutrients are not causal, but they are markers of differences in diet intake that may be causal of differences in CHD between the populations of East and West in Europe.

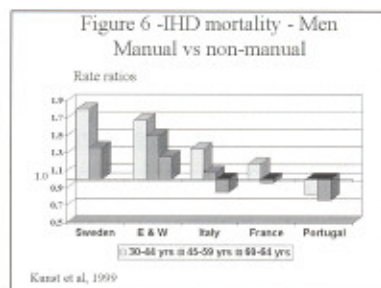
Table 2 – Mean Levels of Micronutrients in Czech and Bavarian Men

	CZECH REPUBLIC (N=188)		BAVARIA (N=153)	
	Mean	SD	Mean	SD
Homocysteine ^a (umol/l)	10.5	3.5	8.9	2.3
Vitamin A (mg/l)	0.73	0.22	0.70	0.20
Vitamin E (mg/l)	14.9	5.3	15.1	5.0
Alpha-carotene (ug/l) ^a	15.6	14.0	21.4	25.0
Beta-carotene (ug/l) ^a	60.0	45.3	109.8	111.7
Lycopene (ug/l)	82.5	56.6	176.7	123.0

^a geometric mean

Bobak et al, 1999

What of the lack of social differences in fruit and vegetable intake in France shown in Table 1? It is of interest that in the comparison of social differences in mortality across Europe, Kunst et al found comparatively smaller social differences in CHD in France, Portugal and Italy (Figure 6)²³ It is possible that the figures in Table 1 are relevant. If it were the case that there was not a social gradient in fruit and vegetable consumption and smoking in Mediterranean countries that may account for a shallower gradient in CHD. As Table 1 shows, there is a gradient in psychosocial characteristics such as control at work, which may be important for the gradient that we do see in self reported health as well as CHD.



Thinking about inequalities

At the beginning of this lecture, I referred to the fact that the inequalities in health I was discussing were those between social groups and between countries, rather than among individuals. I then went on to discuss how nutrition may play a part in linking social position to ill health. As this lecture was about nutrition I referred only fleetingly to smoking and not at all to other health behaviours, important as they may be. It is appropriate to ask what role nutrition and other health behaviours play, but it is also appropriate to ask why there should be social differences in these health behaviours.

One way of approaching this issue is with the tools of social psychology – to ask what motivates behaviour and why people make the choices they do.²⁴ A different way is to stand further back and ask about the nature of inequality in society. The Black Report on Inequalities in Health was seen as presenting an opposition between an approach to explanation that focussed on health behaviours and one that focussed on the material conditions of life.²⁵ In fact,

there need be no strong opposition between these positions.²⁶ One way that the structure of society may influence the unequal distribution of health is through its impact on health behaviours. This has, perhaps, been traced more clearly for smoking than it has for nutrition. Hilary Graham, particularly, has shown how the nature of women's experiences of difficulties in everyday life appear to foster smoking.²⁷

Another opposition has arisen which, in my view, also paints a needless dichotomy. This is the idea, following Black, that one should think of health inequalities as deriving from material conditions of life not psychosocial factors.²⁸ The problem with this is twofold. First, health inequalities are not limited to those living in absolute deprivation. They are seen in people living at a material level above the threshold required for good health.²⁹ Second, material conditions and psychosocial factors are intimately related.¹⁸ In fact, the Black Report made the link clear. Part of the problem of inequalities in health has to do with education, with conditions at work, with job insecurity and unemployment and the nature of neighbourhoods.

The general thesis underlying Black and much of the work before and since, is that inequalities in health reflect inequalities in society. The question is whether such inequalities in society should be of concern. I was asked to think about this in an American context.³⁰ One could imagine an argument that went as follows: Americans think that economic inequalities are a good thing because they reflect economic freedoms that are essential for wealth creation; they think that social safety nets are a bad thing in principle. Therefore the type of society people want is one characterised by high inequalities of income and wealth, and little spending on social safety nets. If health inequalities happen to follow from such a set of social arrangements that is unfortunate but not of central concern.

Daniels et al have used Rawls' theory of justice to argue that this is not a just society because it does not establish "equal liberties, robustly equal opportunity, a fair distribution of resources, and support for our self respect".³¹ They argue that such a just society would go a long way to eliminating the most important injustices in health outcomes. I agree with their conclusions that therefore priority should be given to early life intervention, ensuring adequate nutrition to those least able to afford it, improving work environments, and income redistribution.

While agreeing with their conclusions for policy, I have some uncertainty about their analysis. This uncertainty comes from reading Amartya Sen. Sen argues that any ethical social system requires equality of something. The question is what? In Sen language, in which space is inequality to be measured?³² Equality of economic freedoms is one such space; equality of basic liberties as in Rawls is another. How to choose between these different notions of equality? One way is with regard to their consequences, such as health. Sen, critical of Rawls because of insufficient concern with outcomes, suggests his own evaluative framework for assessing inequality – their impact on capability and freedom to lead the lives that we want to lead.³³

Given that we have been pursuing the importance of control over work, and life in general as a cause of health inequalities.³⁴⁻³⁶ I am drawn to Sen's analysis. An aim of policy should be to create the conditions for people to lead the lives they want to lead. Good nutrition will be part of these conditions.

Acknowledgements

Professor Sir Michael Marmot is supported by an MRC Research Professorship and by the John D and Catherine T MacArthur Foundation Research Network on Socioeconomic Status and Health. I thank Mandy Feeney for her help in preparing this paper.

References

1. National Audit Office. Tackling obesity in England. 2001. London, The Stationery Office.
2. Flegal KM, Carroll MD, Kuczmarski RJ, Johnson CL. Overweight and obesity in the United States: prevalence and trends, 1960-1994. *Int.J.Obes.* 1998;**22**:39-47.
3. Rose G. Strategy of preventive medicine. Oxford: Oxford University Press, 1992.
4. Murray CJL, Gakidou E, Frenk J. Health inequalities and social group differences: what should we measure? *Bulletin of the World Health Organisation* 1999;**77**:537-43.

5. Black D, Morris JN, Smith C, Townsend P, Whitehead M. Inequalities in health: The Black report; The health divide. London: Penguin Group, 1988.
6. Independent Inquiry into Inequalities in Health Report. 1998. London, The Stationery Office.
7. World Bank. World Development Report 1993. New York: Oxford University Press, 1993.
8. Marmot MG, Shipley MJ. Do socioeconomic differences in mortality persist after retirement? 25 year follow up of civil servants from the first Whitehall study. *Br.Med.J.* 1996;**313**:1177-80.
9. Von Rossum C, Shipley M, Van de Mheen H, Grobbee D, Marmot MG. Employment grade differences in cause specific mortality. 25 year follow-up of civil servants from the first Whitehall study. *J Epidemiol Community Health* 2000;**54**:178-84.
10. Fogel RW. New sources and new techniques for the study of secular trends in nutritional status, health, mortality and the process of aging. *Historical Methods* 1993;**26**:5-43.
11. Rowntree BS. Poverty: A study of town life (1901). In Davey Smith G, Dorling D, Shaw M, (Eds.) *Poverty, inequality and health in Britain, 1800-2000: A reader*, pp 97-106. Bristol: The Policy Press, 2001.
12. Cutler JA, Follmann D, Allender PS. Randomised trials of sodium reduction: an overview. *Am J Clin Nutr* 1997;**65**:643S-51S.
13. Marmot M, Bobak M. International comparators and poverty and health in Europe. *Br Med J* 2000;**321**:1124-8.
14. Barker DJP. Mothers, babies, and health in later life. Churchill Livingstone, 1998.

15. Marmot MG, Davey Smith G, Stansfeld SA, Patel C, North F, Head J *et al.* Health inequalities among British Civil Servants: the Whitehall II study. *Lancet* 1991;**337**:1387-93.
16. Marmot M, Shipley M, Brunner E, Hemingway H. Relative contribution of early life and adult socioeconomic factors to adult morbidity in the WHI study. *Journal of Epidemiology Community Health* 2001;**55**:301-7.
17. Blane D, Morris JN, White IR. Education, social circumstances and mortality. In Blane D, Brunner E, Wilkinson R, eds. *Health and Social Organisation: towards a health policy for the 21st century*. London: Routledge, 1996.
18. Marmot M, Wilkinson RG. Psychosocial and material pathways in the relation between income and health: a response to Lynch *et al.* *Br.Med.J.* 2001;**322**:1233-6.
19. Fuhrer R, Shipley MJ, Chastang JF, Schmaus A, Niedhammer I, Stansfeld SA *et al.* Socioeconomic position, health and possible explanations: A tale of two cohorts. *Am J Public Health* (in press).
20. Svetkey LP, Sacks FM, Obarzanek E, Vollmer WM, Appel LJ, Lin PH *et al.* The DASH Diet, Sodium Intake and Blood Pressure Trial (DASH-sodium): rationale and design. DASH-Sodium Collaborative Research Group. *J.Am.Diet.Assoc.* 1999;**99**:S96-104.
21. Hennekens CH, Buring JE, Manson JE, Stampfer M, Rosner B, Cook NR *et al.* Lack of effect of long-term supplementation with beta carotene on the incidence of malignant neoplasms and cardiovascular disease. *N.Engl.J.Med.* 1996;**334**:1145-9.
22. Bobak M, Hense HW, Kark J, Kuch B, Vojtisek P, Sinnreich R *et al.* An ecological study of determinants of coronary heart disease rates: an comparison of Czech, Bavarian and Israeli men. *International Journal of Epidemiology* 1999;**28**:437-44.
23. Kunst AE, Groenhouf F, Andersen O, Borgan J-K, Costa G, Desplanques G *et al.* Occupational class and ischemic heart disease mortality in the United States and 11 European Countries. *Am J Public Health* 1999;**89**:47-53.
24. Jarvis MJ, Wardle J. Social patterning of individual health behaviour: the case of cigarette smoking. In Marmot MG, Wilkinson RG, (Eds.) *The social determinants of health*. Open University Press, 1999.
25. Blane D. An assesment of the Black Report's "explanation of health inequalities". *Soc.Health* 1985;**7**:421-45.
26. MacIntyre S. The Black report and beyond what are the issues? *Soc Sci Med* 1997;**44**:723-45.
27. Graham H. Gender and class as dimensions of smoking behaviour in Britain: insights from a survey of mothers. *Soc Sci Med* 1994;**38**:691-8.
28. Lynch JW, Davey-Smith G, Kaplan GA, House JS. Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *Br.Med.J.* 2000;**320**:1200-4.
29. Morris JN, Donkin AJM, Wonderling D, Wilkinson P, Dowler EA. A minimum income for healthy living. *J Epidemiol and Community Health* 2000;**54**:885-9.
30. Marmot M. Do inequalities matter? In Daniels N, Kennedy B, Kawachi I, (Eds.) *Is inequality bad for our health?* Boston: Beacon Press, 2000.
31. Daniels N, Kennedy B, Kawachi I. Justice is good for our health. In Daniels N, Kennedy B, Kawachi I, (Eds.) *Is inequality bad for our health?* Boston: Beacon Press, 2000.
32. Sen A. *Inequalities reexamined*. Oxford: Oxford University Press, 1992.
33. Sen A. *Development as Freedom*. New York: Alfred A. Knopf, Inc, 1999.

15. Marmot MG, Davey Smith G, Stansfeld SA, Patel C, North F, Head J *et al.* Health inequalities among British Civil Servants: the Whitehall II study. *Lancet* 1991;**337**:1387-93.
16. Marmot M, Shipley M, Brunner E, Hemingway H. Relative contribution of early life and adult socioeconomic factors to adult morbidity in the WHI study. *Journal of Epidemiology Community Health* 2001;**55**:301-7.
17. Blane D, Morris JN, White IR. Education, social circumstances and mortality. In Blane D, Brunner E, Wilkinson R, eds. *Health and Social Organisation: towards a health policy for the 21st century*. London: Routledge, 1996.
18. Marmot M, Wilkinson RG. Psychosocial and material pathways in the relation between income and health: a response to Lynch *et al.* *Br.Med.J.* 2001;**322**:1233-6.
19. Fuhrer R, Shipley MJ, Chastang JF, Schmaus A, Niedhammer I, Stansfeld SA *et al.* Socioeconomic position, health and possible explanations: A tale of two cohorts. *Am J Public Health* (in press).
20. Svetkey LP, Sacks FM, Obarzanek E, Vollmer WM, Appel LJ, Lin PH *et al.* The DASH Diet, Sodium Intake and Blood Pressure Trial (DASH-sodium): rationale and design. DASH-Sodium Collaborative Research Group. *J.Am.Diet.Assoc.* 1999;**99**:S96-104.
21. Hennekens CH, Buring JE, Manson JE, Stampfer M, Rosner B, Cook NR *et al.* Lack of effect of long-term supplementation with beta carotene on the incidence of malignant neoplasms and cardiovascular disease. *N.Engl.J.Med.* 1996;**334**:1145-9.
22. Bobak M, Hense HW, Kark J, Kuch B, Vojtisek P, Sinnreich R *et al.* An ecological study of determinants of coronary heart disease rates: an comparison of Czech, Bavarian and Israeli men. *International Journal of Epidemiology* 1999;**28**:437-44.
23. Kunst AE, Groenhouf F, Andersen O, Borgan J-K, Costa G, Desplanques G *et al.* Occupational class and ischemic heart disease mortality in the United States and 11 European Countries. *Am J Public Health* 1999;**89**:47-53.
24. Jarvis MJ, Wardle J. Social patterning of individual health behaviour: the case of cigarette smoking. In Marmot MG, Wilkinson RG, (Eds.) *The social determinants of health*. Open University Press, 1999.
25. Blane D. An assesment of the Black Report's "explanation of health inequalities". *Soc.Health* 1985;**7**:421-45.
26. MacIntyre S. The Black report and beyond what are the issues? *Soc Sci Med* 1997;**44**:723-45.
27. Graham H. Gender and class as dimensions of smoking behaviour in Britain: insights from a survey of mothers. *Soc Sci Med* 1994;**38**:691-8.
28. Lynch JW, Davey-Smith G, Kaplan GA, House JS. Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *Br.Med.J.* 2000;**320**:1200-4.
29. Morris JN, Donkin AJM, Wonderling D, Wilkinson P, Dowler EA. A minimum income for healthy living. *J Epidemiol and Community Health* 2000;**54**:885-9.
30. Marmot M. Do inequalities matter? In Daniels N, Kennedy B, Kawachi I, (Eds.) *Is inequality bad for our health?* Boston: Beacon Press, 2000.
31. Daniels N, Kennedy B, Kawachi I. Justice is good for our health. In Daniels N, Kennedy B, Kawachi I, (Eds.) *Is inequality bad for our health?* Boston: Beacon Press, 2000.
32. Sen A. Inequalities reexamined. Oxford: Oxford University Press, 1992.
33. Sen A. Development as Freedom. New York: Alfred A. Knopf, Inc, 1999.

34. Marmot MG, Bosma H, Hemingway H, Brunner E, Stansfeld S. Contribution of job control and other risk factors to social variations in coronary heart disease. *Lancet* 1997;**350**:235-40.
35. Bobak M, Marmot MG, Skodova Z. Psychosocial factors at work and myocardial infarction in the Czech Republic. *Acta Cardiol.* 1997;**LII**:136-7.
36. Bobak M, Pikhart H, Hertzman C, Rose R, Marmot M. Socioeconomic factors, perceived control and self-reported health in Russia. A cross-sectional survey. *Soc Sci Med* 1998;**47**:269-79.

Following the publication of the Acheson Inquiry the government has implemented several social and health policy initiatives aimed at reducing inequalities in health. In spite of these developments gaps remain in our understanding of the basis of health inequalities. The relative contribution and causal pathways between the different psychological, social, economic and environmental factors requires further detailed research.

In the Fourteenth Annual Caroline Walker Lecture, Professor Sir Michael Marmot, Professor of Epidemiology and Public Health and Director of the International Centre for Health and Society at University College London outlines the potential role of nutrition as a causative factor in health inequalities within and between societies. Michael Marmot as a leading authority in research into health inequalities provides an expert insight into this important topic.

The Caroline Walker Trust is grateful to the Co-operative Group for it's support in the publication of this lecture.

THE CAROLINE WALKER TRUST
ISBN 1 897820 14 3
£7.50