CHAPTER 11

CONTROLLING FOR AGE AND SOCIO-ECONOMIC CIRCUMSTANCES

Introduction — 1 Age standardisation — 2 Denominator problems in standardisation — 3 Standardised mortality ratios — 4 Deprivation indices — 5 Further reading on age standardisation and deprivation indices — References and further reading

Introduction

In 1971 in Bournemouth 1,223 males died. Is this a large or a small number of deaths? Obviously the answer depends on how many males there were to start with. Expressing deaths as *rates* allows for a sensible comparison to be made between areas with different sized populations, or the same area at two points in time where the population has increased or decreased. So in 1971 Bournemouth's male death *rate* was 18.7 per 1,000. The number of males in Bournemouth was 65,520 – the *population at risk*.

$$(1{,}223/65{,}520) \times 1{,}000 = 18.666$$
$$= 18.7 \text{ deaths per 1,000 of the population at risk.}$$

With rates we can compare deaths in Bournemouth in 1971, 1981, 1991, 2001, discounting for changes in population size. But is this a high or a low rate? Simply comparing the male death rate for Bournemouth with the national average rate for 1971 suggests that it is on the high side, compared with that for England and Wales at 12.2/1,000.

However, death rates are predominantly influenced by the sex ratio and by the age profile of a population and by its socio-economic circumstances. So we can ask, 'Is this a high death rate *given* the age profile of the population of Bournemouth?' and 'Is this a high death rate given the socio-economic circumstances of Bournemouth?' or 'Is this a high death rate given the gender composition of the population?'. In each case the answer to the question would depend on the comparison being made: by comparison with England and Wales in 1971, by comparison with sixteenth-century London, by comparison

with Calcutta today. And if the death rate in Bournemouth increased between 1971 and 1991 we would want to know how much of the increase was due to the population getting older, or getting poorer, or changing its sex ratio.

The first question might be translated as 'After controlling for age' or 'After discounting for the fact that different areas have different age profiles, is the male death rate in Bournemouth high?' And we could also ask the question 'Is the male death rate in Bournemouth high compared to the female death rate after discounting for the fact that females will on average be older than males?'

Answering these questions requires us to 'control for' different variables through some act of *standardisation*. What is usually just called a *death rate* might be better called an expression of 'deaths standardised for the size of the population at risk' since, in a rate, the size of the relevant population is standardised to 1,000 or 10,000 or some other convenient figure. A percentage is simply a rate out of 100. This chapter is about similar manoeuvres to standardise for age and socio-economic differences, and occasionally for gender and ethnicity. It is not only mortality which is influenced by age, gender, socio-economic circumstances and ethnicity. So also are patterns of illness, involvement in, and victimisation by crime, patterns of drug abuse and alcoholism, and so on (Benzeval et al., 1995; Gomm, 1996).

The reason for standardisation is to facilitate comparisons, but the comparisons might be in order to:

- Investigate causal relationships using standardisation to control variables: for example, estimating how much of the difference in crime between areas is due to differences in age profiles or differences in socio-economic conditions between areas. Chapter 8 uses age standardisation to discount the effect of age on responses to a survey in two areas with different age profiles. Age is, as it were, cleared out of the way so that other factors that might be causing the differences can be investigated.
- Predict the need for services in a local area. For example, estimating the number of cases of dementia likely in the next ten years may mean translating national figures in terms of a local age profile, since dementia is an age-related condition (Meltzer, 1992). Chapter 9 relates the need for coronary care services with degrees of socio-economic deprivation, and then judges the performance of services in meeting these needs. This current chapter also explains how deprivation measures are used to determine central government finance for local expenditure.
- Set local targets, or judge performance, in terms of what is feasible in a local area. For example, health improvement targets achievable in an affluent area may not be achievable in a poorer one or may require more resources to do so. The study in Chapter 9 implies

some performance targets which health services in Sheffield should adopt. Box 11.4 below in this chapter gives a further example.

1 Age standardisation

Researchers often give results in *age standardised* (or age weighted or age adjusted) terms. For example, a study by King and his colleagues (1994) gives the frequency of non-affective psychosis in different ethnic groups in Haringey (Table 11.1). As with many other conditions psychosis is age-related. The *incidence* – number of new cases – is highest in youthful populations, while the *prevalence* – number of all cases at a point in time – is highest in populations with larger percentages of older people. This apparently contradictory state of affairs happens with many chronic conditions because, while onset may occur in youth, giving youthful populations a high incidence rate, a large percentage of such people stay ill, raising the prevalence rate in older populations.

Differences in the *incidence* of psychosis between ethnic groups in Haringey might reflect the different age profiles of these population sub-groups, rather than anything else about differences in mental health. In order to compare like with like it is necessary to control for

Table 11.1 Incidence (number of new cases) of non-affective psychosis, including schizophrenia, in the catchment area of St Ann's Hospital, Haringey, 1991–2, from health service, social services, probation and prison contacts, by ethnic group

Ethnic group	Number of new cases 1991–2/ numbers in population at risk	Age standardised[a] incidence rate per 10,000 in local population (95% CI)[b]
White	24/121,438	2.0 (1.2 to 2.8)
Black		
Caribbean	15/14,973	8.9 (4.4 to 13.5)
Black African	8/9,381	8.7 (2.4 to 14.9)
Black other	4/2,994	12.0 (0 to 25.7)
Total 'Black'	27/27,348	8.7 (5.3 to 12.0)
Indian	3/6,326	4.5 (0 to 9.6)
Pakistani	2/1,065	15.3 (0 to 36.5)
Other 'Asian'	3/4,253	7.0 (0 to 15.0)
Total 'Asian'	8/11,644	6.9 (2.1 to 11.6)
Other	3/3,847	5.8 (0 to 12.3)
Total	62/167,984	3.6 (2.7 to 4.5)

[a] Recalculating the figures as if each ethnic group had exactly the same age profile as the age profile of the population of England and Wales.

[b] Where confidence intervals for percentages or rates give minus figures the lowest limit is expressed as 0 (see Chapter 10, Table 10.3).

Source: King et al., *British Medical Journal* 1994, 306: 1117, with permission from the BMJ Publishing Group

age differences. One way is only to compare the incidences between ethnic groups age group by age group. Another is to standardise for age, recalculating the figures to show what the differences between ethnic groups would be if each group had exactly the same age structure. For example, if in Haringey the percentage of black males aged 16–25 was twice that of the percentage of this sex–age group in the population of Haringey as a whole, then the figures could be re-calculated so that each new case of psychosis among black males aged 16–25 counted only half as much as each new case among males of this age group of other ethnicities.

In addition, as an inner urban area, Haringey will have a population which is on average younger than that of England and Wales. Hence findings on the incidence of psychosis here will not be representative for England and Wales as a whole. In order to deal with this kind of problem it is common to age standardise results from a local survey in terms of a *reference population*. One of the methods used is shown in Box 11.1.

Table 11.2 imagines a study of the prevalence of psychosis (columns A and C) in an area with a youthful population (column B), not unlike Haringey. Since psychotic illness is age-related the findings of this study do not provide a very good model for areas with different age profiles. Thus the calculations produce an estimate of the prevalence of psychotic illness (column E) for a reference population which has an age profile like that of the UK (column D). For example, the first row of the table shows that there are 15 cases of psychotic illness among the 3,400 people aged 16–19 years within the study population. That is a rate of 4.40 per 1,000 of this age group (column C). In the reference population, 7% are in this age group. The final column shows that, if the reference population had the same age prevalence rates as the index population, there would be 0.31 cases in this age group for every 1,000 people in the reference population as a whole. It may help you to think here of the reference population being divided into slices of 1,000, each slice with the same age profile. Adding the figures in column E gives an expected number of cases per 1,000 of the reference population of 5.38. Multiplying this figure by the number of thousands of people in the reference population would give the actual number of cases that could be expected in the reference population.

The reference population has a higher estimated rate of psychosis (5.38/1,000) than the study, or index area (4.75/1,000), because the reference population contains larger proportions of the age groups of higher risk of psychosis – more in the older age groups. (The series of government-sponsored, epidemiological needs reviews, standardise to a notional health authority which has an age structure as for England and Wales: for example, Stevens and Raftery, 1994).

Age standardisation is the most common form of standardisation. However, standardisation by social class, or for deprivation, and oc-

Box 11.1 A method for age standardisation

Age standardisation (or age adjustment or age weighting) expresses frequencies from a survey of a local population (*index population*) in terms of the population structure for a *reference* (or *standard*) population, often the population of the UK, or one of its constituent nations. The frequencies might be percentages of people giving particular responses to a survey, death rates, rates of child abuse or, as in the example below, rates of illness. The result is that differences in age profile between the local area and the reference population are discounted. In the language of experiments, age differences are controlled (see chapter 5). If this is done ethnic group by ethnic group, then differences in age profile between ethnic groups in a local area are also controlled for and comparisons between groups can be made having excluded the influence of age differences on differences in rates (see Table 11.1).

Table 11.2 Age standardisation using the direct method

	A	B	C	D	E
Age groups	Number of all cases of psychotic illness in study area (prevalence)	Population (%) in study area (index population) (100% = all 16–64)[a]	Prevalence rate per 1,000 in study area A/(B/1,000)	Percentage of population in age groups in reference area (100% = all 16–64)	(C × D)/100 = number of cases expected in each age group per 1,000 of reference population
16–19	15	3,400 (17%)	4.40	7%	0.31
20–24	20	3,800 (19%)	5.26	11%	0.58
25–29	18	3,600 (18%)	5.00	13%	0.65
30–34	6	2,000 (10%)	3.00	12%	0.36
35–39	6	1,600 (8%)	3.75	11%	0.41
40–44	4	1,600 (8%)	2.50	11%	0.27
45–49	4	1,400 (7%)	2.90	11%	0.32
50–55	6	1,000 (5%)	6.00	8%	0.48
55–59	8	800 (4%)	10.00	8%	0.80
60–64	6	400 (2%)	15.00	8%	1.20
All 16–64	93	19,600	4.75	100%	5.38

Age standardised prevalence rate for reference population as a whole = **5.38/1,000**

[a] Percentages rounded. The percentages in column B are given here to show the profile of the population. They are not necessary for the calculation.

Procedure

1 Take the number of cases for the first age group (A) in the index population and divide by the number in the age group (B) divided by 1,000. That gives the age group prevalence rate for the index population (C).
2 Repeat for all other age groups. There is no need to calculate for the 16–64 age group as a whole.

3 For the first age group multiply the age group prevalence rate (C) by the *percentage* of that age group in the reference population (D), i.e., in the first row of Table 11.2 4.4 (C) × 7% (D) or (4.4 × 7)/100 = 0.31 (E). That gives the number of cases to be expected for this age group per 1,000 of the reference population.
4 Repeat step 3 for all other age groups.
5 Add up all the expected cases in column E. This gives the standardised prevalence rate per 1,000 of the reference population for all age groups, 16–64.
6 (not shown on the table) Multiply the standardised prevalence rate by the number of thousands of people 16–64 in the reference population. If there are 6 million, for example, then multiply by 6,000; if there are 6,000, multiply by 6. This gives an estimate of the number of cases to be expected at any one time in this population.

For other ways of age standardisation, see Jones and Moon (1987), Unwin et al. (1997) or Marsh (1988).

casionally for ethnicity, are also done: sometimes all together. For example, even after age standardisation the imaginary study in Table 11.2 still doesn't necessarily provide a good model for other areas. With such a youthful population it probably refers to an inner urban area where it is to be expected that socio-economic deprivation and in-migration of people with mental health problems will push the rate of psychosis up (Giggs and Cooper, 1987). To compensate for this to some extent it would be possible also to standardise by social class; following the same procedures as in Table 11.2 with data for social class groups rather than age groups in columns A and B. However, if data about the social class of individuals are not available, a rather cruder form of standardising for socio-economic circumstances can be done using measures of the deprivation of the area in which they live (section 4), though this risks committing the ecological fallacy (see Chapter 10, section 13).

In order to apply findings cited in standardised (or reference area) form to another area, they have to be 'unstandardised' again to answer the questions, 'What would be the rates in a population with the same structure as the one I'm interested in?' or, 'How many actual cases should I expect to occur in my practice area?' Doing this is the reverse of the standardisation procedure in Box 11.1, and is shown in Box 11.2.

Taking Boxes 11.1 and 11.2 together gives the route shown in Figure 11.1.

Where the data were derived from a *national* survey, then, in effect, the national survey results serve as the results for a reference

Box 11.2 Extrapolating from age standardised (reference area) data to another practice area

Table 11.3 shows how to extrapolate age standardised figures to a local population in order to estimate the number of cases that would occur locally. This may be done to estimate local demand for service. It is often done to establish a benchmark against which the local situation is judged. An actual figure for the locality higher than the expected figure may indicate particular local health problems. If the actual figure is lower than expected this may indicate that local cases are escaping the notice of treatment services. The most common standardisation statistic used in this way is the standardised mortality ratio (SMR) (see section 3 in this chapter).

Table 11.3 Extrapolating from a reference area to a practice area to estimate the number of cases expected

	A	B	C	D
Age groups	Population (%)[a] in practice area (100% = all 16–64)	Prevalence rate in reference area[b]	(A × B)/1,000 = number of expected cases	Expected prevalence rate for practice area
16–19	800 (2%)	4.40	3.52	283 cases in a population of 39,200 = a prevalence rate of 7.22 per 1,000
20–24	1,600 (4%)	5.30	8.48	
25–29	2,000 (5%)	5.00	10.00	
30–34	2,800 (7%)	3.00	8.40	
35–39	3,200 (8%)	3.75	12.00	
40–44	3,200 (8%)	2.50	8.00	
45–49	4,000 (10%)	2.90	11.60	283.20/(39,200/1,000) = 7.22
50–55	7,200 (18%)	6.00	43.20	
55–59	7,600 (19%)	10.00	76.00	
60–64	6,800 (17%)	15.00	102.00	
All 16–64	39,200	5.38	283.20	**7.22/1,000**

[a] Percentages rounded. The percentages are given here to show the age profile of the population. They are not necessary for the calculation.
[b] Note that the study area from Table 11.2 has been used here as the reference population.

Procedure

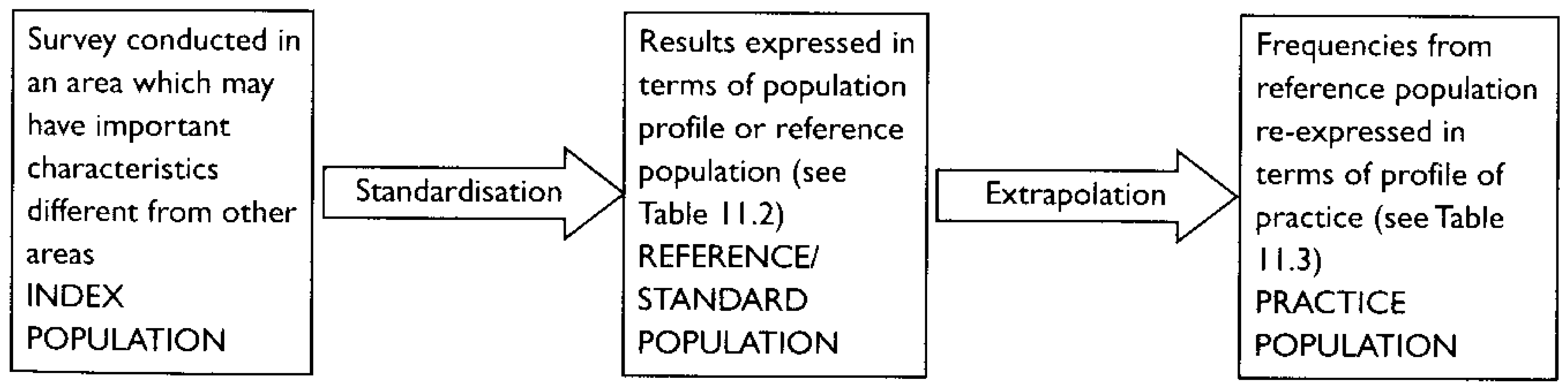
1 For the first age group multiply the number of people in the age group (A) in the practice area by the age group prevalence rate for the reference population (B) and divide by 1,000. That gives an estimate of the number of cases to be expected from this age group in the practice population (C).
2 Repeat for all other age groups.
3 Add together all the expected cases to produce the final figure for column C. That is the number of cases in all age groups 16–64 to be expected in the practice population. This is probably the most important figure for practical purposes.

4 Divide the total number of cases expected (the result of step 3 above), by the number of thousands of people there are in the population 16–64: if there are 39,200, then divide by 39.2. The result is the prevalence rate per 1,000 for the practice population.

You will notice that Table 11.3 assumes that the study which provided the index area data for Table 11.2 has been standardised to a reference population, as described earlier. For that reason, the age prevalence rates in column B of Table 11.3 are the same as those in column C of Table 11.2.

Because the practice area has an older population than the reference area, the overall estimate for prevalence in the practice area is higher, though the prevalence rates for each age group are the same. The calculation predicts that in the practice area there will be about 283 cases of psychosis per year among those 16–64 years old.

Figure 11.1 Standardising to a reference area, and extrapolating from a reference area to a practice area



population. There is no reason why extrapolation should not be done direct from a research study area to a practice area elsewhere, using the same procedures as in Table 11.3 but with study area rates in column B. Data given in a reference format are only as good as the study from which they derived. For example, if the study area in Table 11.2 was the basis for the reference area data in Table 11.3, then the prevalences for those aged 55+ were calculated from rather rare cases in rather small populations. If they were in error, then the extrapolation in Table 11.3 will have exaggerated the error.

Remember also that these age standardising procedures only bring populations into line with each other in terms of age structure. There may be other ways in which populations differ which mean that applying the results from a study in one place to the situation in another can be misleading.

Extrapolations such as those in Box 11.2 are really only worthwhile for large practice populations (20,000 plus) and for fairly common conditions. For example, psychosis is a rare condition, and its most newsworthy form – schizophrenia – even rarer. It would not be sensible to carry out the extrapolation in Box 11.2 for a practice population smaller than 20,000. Given the association between psychosis and area poverty here, it would be wise to make allowance for differences in social deprivation or affluence as well.

2 Denominator problems in standardisation

Expressing deaths as rates, or age standardising a set of data, or calculating a standardised mortality ratio (section 3), all require some accurate knowledge about numbers of people in a population. The study by King et al. (Table 11.1) was a *case finding*, or a *clinical epidemiological study*. The researchers found the number of cases known to services and then expressed these as rates for the population as a whole. Thus, in order to produce an incidence rate of 8.9/10,000 for psychosis in Haringey for African Caribbean people, King and his colleagues not only had to discover how many new cases of psychosis there were in this group in 1991–2 (the *enumerator*) but also to know how many people there were in this category in total in 1991–2, in terms of which to express the number of cases as a rate per 10,000 of the population at risk (the *denominator*). This makes the accuracy of the calculation dependent on the accuracy of the population data from which the denominator is calculated.

Researching in 1991–2 King and his colleagues were fortunate since they were able to avail themselves of recent census data for Haringey. Even so, it is known that the census of 1991 particularly under-recorded numbers of young males in London, and perhaps especially young black males (London Research Centre, 1992). Given that the incidence of psychosis is highest from 16 to 25, this under-recording might be important. Census data are particularly inaccurate in Northern Ireland, even for census data which are up to date in their time (DHSS (NI), 1982).

Under-estimating the denominator figure for a rate will automatically increase the rate. This will have its greatest effect with regard to groups which are small in total. For example, in Table 11.1 if the population of African Caribbeans had been under-estimated by 10 per cent then the 'true' incidence of psychotic illness (before age standardisation) would be approximately 8.8 and not 10/10,000 (15 cases divided by 16.97×10 rather than 15 divided by 14.93×10). But an under-estimation of the much larger local population of white people by 10 per cent would only raise their rate before age standardisation from 1.8 to 1.98/10,000. Here a 10 per cent under-estimation of the denominator has almost a seven times larger effect on the prevalence for the smaller population as compared with the larger population.

During the 1980s research suggested that young black males were particularly prone to schizophrenia (for example, Cooper et al., 1987; McGovern and Cope, 1987). On the one hand this tended to feed racist stereotypes of 'big, black, dangerous and mad' killers on the rampage and, on the other, the notions that racism drove black people mad, or that political resistance against racism was being mistaken for mental illness (Fernando, 1988). However, much of this research was conducted without accurate denominator data, and it now seems likely that some at least of the higher rates of schizophrenia recorded were due to an under-estimation of the young black population. More recent research suggests only small differences in rates of psychosis (including schizophrenia) between black people and white at a national level, though this is not inconsistent with the possibility that locally there might be greater differences either way (Nazroo, 1997b).

As noted, the possibility for denominator errors to give misleading rates is greater the smaller the number of people in the relevant fraction of the population. In addition, the rarer the condition the greater the possibility for there to be errors in the enumerator. An *ascertainment bias* is a particularly common problem in clinical epidemiological studies, as in case control studies (see Chapter 10, section 9). The lesson here is always to treat with scepticism differences in rates as between small populations, or between a small and a large population, where there are any doubts about the representativeness of samples. Confidence interval calculations (Chapter 10, sections 6 and 7) will not show whether there are enumerator or denominator errors.

In the Haringey study (Table 11.1) the figures for the enumerators were taken from the survey – which attempted a 100 per cent count of all new cases – but the figures for the denominator were taken from census data. In the studies reviewed by Cohen et al., in the exemplar reading in Chapter 8, and for the angina symptoms survey of Payne and Saul in Chapter 9, figures for both the enumerators and the denominators were derived from the surveys, the total size of the sample being grossed up to stand as 100 per cent of the population, and the size of any sub-groups in the sample being grossed up to stand as 100 per cent of the sub-group in the population. But something of the same denominator problem remains. First, though researchers may aim to take (say) a 10 per cent sample from a population, they need data independent of the survey to tell them the size of the population and hence how many respondents equal 10 per cent. In stratified probability sampling (Chapter 10, section 3) accurate estimates of the actual numbers of people in sub-groups of the population are necessary. And the same data are needed in order to estimate the extent and shape of survey non-response (Chapter 10, section 8). Cohen and his colleagues (see Chapter 8) were faced with a situation where they wanted to square up the results of a survey which used one kind of random stratified sampling, with the results of another survey which used another kind of random stratified sampling. This is relatively easy, using procedures similar to those in Boxes 11.1 and 11.2, but the accuracy of the results depends on how representative the samples were. In turn, knowing how representative the samples were depends on having information about the size and structure of the population independent of the survey data. In the absence of accurate census data, Cohen et al. had to use hospital records and the results of two other surveys to estimate denominator figures.

3 Standardised mortality ratios

Standardised mortality ratios (SMR) are often used to compare death rates between sub-groups of a population. The term *ratio* is used, rather than rate, because 100 is set as a reference point and death rates for sub-groups are expressed as so many percentage points above or below 100. In reading such figures it is important to check what reference point is being used. The most common is an average for a whole population. Thus, if the average for the whole population is 100, and the figure for men is 110, that means that men have a death rate 10 per cent higher than the average for men plus women. However, the death rate for women might be taken as the reference point and calibrated at 100. Then if the figure for men was 110, that would mean that male death rate was 10 per cent greater than that for women. The principle of age standardisation was explained above. Box 11.3 shows how an age standardised mortality ratio is calculated.

As Box 11.3 shows, once age differences between populations are discounted, males in Bournemouth in 1971 had an SMR of 90, whereas England and Wales had, by definition, an SMR of 100. Hence Bournemouth had a 10 per cent lower (age standardised) death rate (SMR) than England and Wales.

The example in Box 11.3 is an SMR for deaths from all causes. But SMRs can be calculated for particular causes of death (see Figure 11.2). However, deaths per year, even for the most common causes, are rare in small populations, and hence vulnerable to large chance fluctuations. In their paper in Chapter 9, Payne and Saul use the SMRs for electoral wards for deaths from coronary heart disease in ages 35–64. To produce large enough figures they have to use deaths over a 5-year period. Standardised *morbidity* ratios are also possible, allowing for age standardised comparisons of rates of illness. Those for angina are cited in Chapter 9. The Bournemouth example above is calculated for the population of an area, but it might be calculated for a sub-group of a population: males, African Caribbean males, African

Box 11.3 Age standardised mortality ratio (SMR) calculations

Table 11.4 Calculating a standardised mortality ratio for Bournemouth, 1971

	A	B	C	D
Age groups	Male population: Bournemouth (000s)	Male death rates for reference population[a] (deaths per 1,000)	(A × B) Expected male deaths[b]	Actual deaths for Bournemouth
Under 1	0.74	19.78	15	We don't need to know the actual number of deaths for each age group for this calculation
1–4	2.93	0.76	2	
5–14	8.38	0.40	3	
15–24	8.83	0.92	8	
25–44	13.41	1.62	22	
45–64	18.36	13.45	247	
65–74	8.23	51.82	426	
75+	4.64	137.42	638	
All ages	65.52		1,361	1,223

[a] The reference population here is England and Wales.
[b] If Bournemouth had the same death rates for each age group as the reference population (England and Wales).

Source: Based on Open University, 1975: 24

The SMR (males: Bournemouth: all ages: all causes)

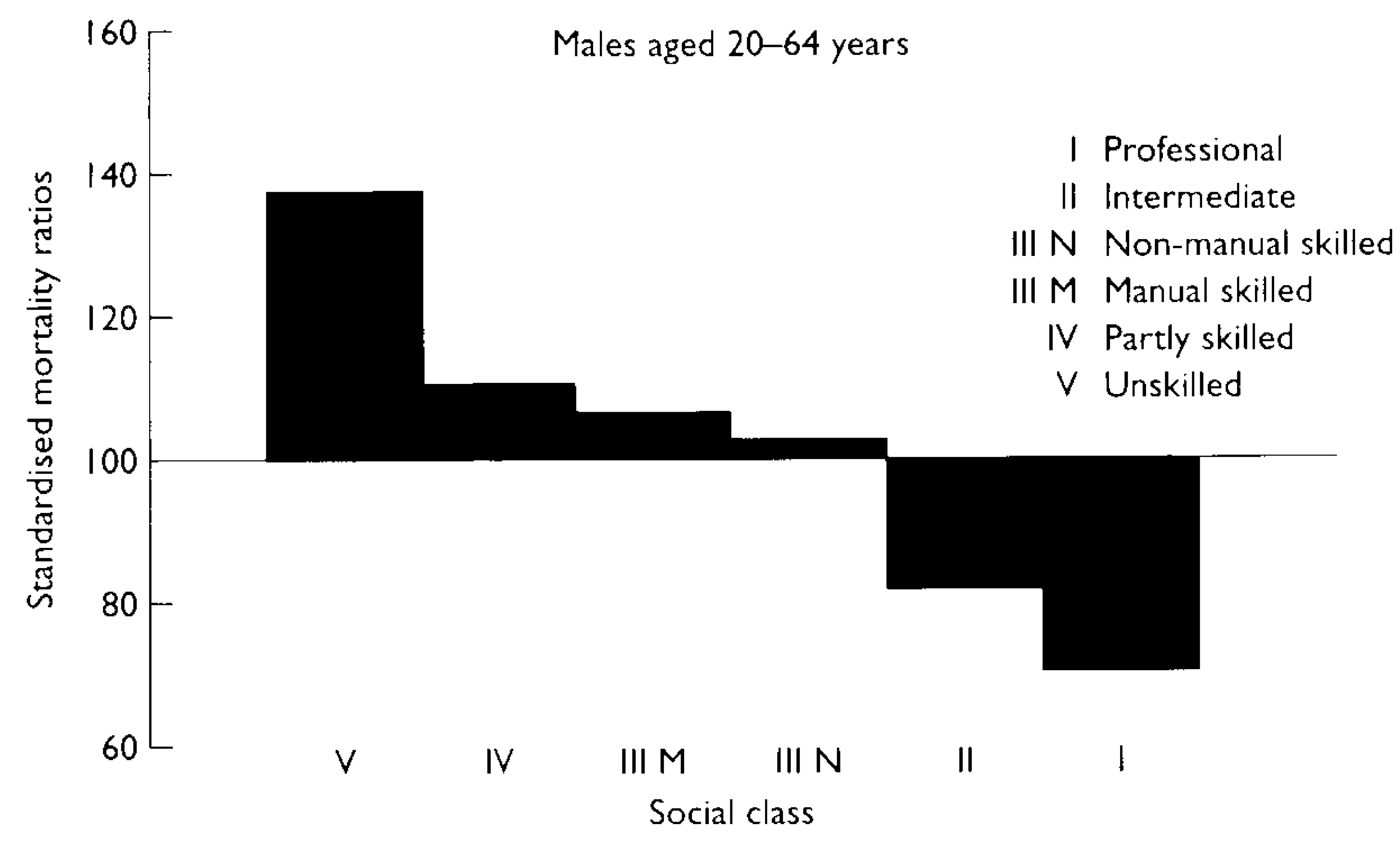
$$= \frac{\text{Total actual male deaths}}{\text{Total expected male deaths}} \times 100$$

$$= \frac{1{,}223}{1{,}361} \times 100 = 89.86 = 90.00 = 10 \text{ per cent below average.}$$

Caribbean males living alone, and so on. The Bournemouth figures are also calculated for all adults, but often what is of interest is not death, which happens to everyone sooner or later, but premature death, which happens more often to men, compared with women, and poorer people compared to richer people. Usually this is expressed as death before the age of 60 or 65.

The two predominant factors setting the death rate for a population are age and social class. Gender is rarely important in making differences between areas, since most areas have similar ratios of males to females *within* each age group, but gender might be an important consideration in comparing death rates in two hospitals. Ethnicity seems rarely to be important in making a difference to the death rates of different areas once gender, age and socio-economic circumstances are accounted for (Smaje, 1995; Nazroo, 1997a). Thus, in making com-

Figure 11.2 Standardised mortality ratios for coronary heart disease (CHD) and social class, England and Wales 1979–80 and 1982–3 (Department of Health, 1995: 104; Office for National Statistics © Crown copyright 1995)



parisons between areas, once age is controlled through age standardisation, what differences there are are largely caused by social class differences between populations. The death rate in Bournemouth, after age standardisation, is lower than the average SMR, reflecting mainly that Bournemouth has a more affluent social class profile than England and Wales as a whole.

SMRs are often used to show social class differences, as in Figure 11.2.

The data for calculating SMRs come ultimately from the process of death certification. Studies show that ascertaining cause of death in practice is a very unreliable process, insofar as different doctors will assign different causes of death to the same case (Bloor et al., 1987, 1989; Bloor, 1991, 1994). The SMR deaths from all causes can be regarded with more confidence than the SMR for deaths from particular causes, and the more precise the diagnosis the less reliable the figures are likely to be. There is evidence also that particular doctors have their own favourite causes of death and that particular causes become and cease to be fashionable over a period of time (Bloor et al., 1987, 1989). SMRs for suicide are a particularly problematic matter since the ascertainment of suicide as the cause of death is itself so problematic. Differences in suicide rates between different areas, or occupational groups within a country may owe much to the idiosyncrasies of particular coroners, and differences between countries may relate to differences in the medico-legal procedures of investigating and classifying 'unnatural' deaths (Atkinson et al., 1975).

In addition, death certification also provides the demographic data for an SMR. The sex and age of the deceased will most likely be accurately recorded, but recording the occupation of the deceased is less straightforward. It is on the basis of this that SMRs for social classes are calculated (Figure 11.2). For example, it has been shown that some 'notable' occupations are likely to be given as the last occupation of the deceased, even if this was not his or her last occupation. These include police officer, miner and fisherman. This means that occupations of these sorts – and the social classes to which they are allocated – will show death rates in the statistics higher than those in reality. Overall there is a tendency for those kinsfolk who register deaths to elevate the occupation of the deceased, thus leading to the production of statistics which under-record the link between low social class and age of death (Bloor et al., 1989). Social class SMRs for women are particularly quirky, since it may be a woman's own or her husband's occupation which is recorded on the death certificate (Moser and Goldblatt, 1985).

Ethnicity as such is not recorded at death and researchers have to make do with the recording of place of birth and nationality which are very poor guides to ethnicity (Nazroo, 1997a). Hence SMRs comparing people from different ethnic groups are difficult to produce from death certification data and have to be derived from specially mounted research projects.

4 Deprivation indices

SMRs for age groups 16–65 (or 20–60) are sometimes used as a *deprivation indicator* for an area since premature death correlates so closely with socio-economic conditions. The deprivation *index* of an area is a single score derived from combining scores for a number of deprivation indicators. The indicators are measures such as unemployment rates, percentages of unfit houses, percentages of households dependent on benefits, age-adjusted death rates and so on, all widely regarded as indicative of the poverty or affluence of a population. One of the simpler deprivation indices is the *Townsend index* which uses just four indicators: unemployment rates, car ownership, percentage of households owner-occupied and household overcrowding (Townsend et al., 1985). However many *indicators* are used, each produces a 'league table' of areas running from the most affluent to the most deprived. A deprivation *index* combines these into a single composite league table of affluence and deprivation (see Table 11.5).

Deprivation indices are very widely used in both research and in health and welfare administration. Differences in socio-economic conditions between areas are an important research topic in their own right (Noble et al., 1994). But, in addition, illness and social problems

Table 11.5 Deprivation indices and other deprivation indicators and socio-demographic indicators for areas of Barking and Havering: rates of death by selected causes, accident rates, selected morbidity rates and Health of the Nation Targets

			Localities in						
			Barking			Havering			
Socio-demographic indicators									
Rank order for Jarman score, 1991 1st = most deprived			1st	2nd	3rd	4th	5th	6th	7th
Jarman score, 1991			39.1	16.3	15.5	6.9	−2.3	−4.2	−13.3
Jarman score, 1981			31.1	6.5	9.5	−2.5	−2.7	−4.2	−16.9
Townsend score, 1991			5.48	2.08	2.81	0.17	−2.12	−2.25	−4.19
Per cent population over 75, 1991			5.8	7.8	7.7	6.8	6.5	5.1	6.4
Per cent population over 85, 1991			1.2	1.6	1.5	1.1	1.4	0.9	1.5
Per cent non-white ethnic groups, 1991			16	4.6	4.3	2.3	3.5	4.1	2.6
Per cent households at >1 person per room, 1991			4.1	3.6	4.3	2.5	1.8	1.7	0.9
Per cent households owner-occupied, 1991			36.8	57.6	54.0	62.7	79.6	81.6	88.7
Per cent households in local authority/housing association tenure, 1991			57.7	37.9	42.8	33.0	14.4	14.7	5.5
Unemployment, 1991 (census definition)			10.3	7.0	7.3	6.4	5.4	5.4	3.9
Per cent households no car, 1991			51.1	39.6	41.6	32.7	26.0	25.6	20.2
Mortality rates (rates per 100,000 of relevant age group)	**National Rates 1990**	**National targets 2000**							
Ischaemic heart disease: ages 0–64, 1987–91	58.0	35.00	71.1	63.2	68.4	55.0	49.6	61.5	38.6
Ischaemic heart disease: ages 65–74	899.0	629.0	1078.2	973.9	1005.0	958.8	750.0	843.2	865.2
Stroke, ages 0–64, 1987–91	12.5	7.5	12.3	11.2	13.9	13.2	10.7	12.1	6.8
Stroke, ages 65–74, 1987–91	265.0	159.0	289.9	210.4	279.8	252.8	203.0	244.6	158.7
Lung cancer, ages 0–74 (males), 1987–91	60.0	42.0	72.0	85.5	78.2	78.3	50.6	62.3	39.9
Lung cancer, ages 0–74 (females), 1987–91	24.1	20.5	26.4	29.9	24.0	26.5	18.5	27.0	15.8
Suicide rate, all ages, 1987–91	11.1	9.4	12.3	12.0	8.7	11.7	7.9	10.2	8.2
Accident rate, ages under 15, 1987–91	6.7	4.5	6.5	3.9	11.5	7.1	6.2	9.8	6.5
Accident rate, ages 15–24, 1987–91	23.2	17.4	12.5	13.9	19.6	26.0	23.3	16.5	23.6
Accident rate, ages 65 and over, 1987–91	56.7	38.0	52.8	26.1	27.8	34.2	31.8	40.4	32.6
Cirrhosis males, ages 55–74, 1987–91	18.8	—	26.5	11.0	18.6	15.4	12.2	4.0	12.9
Infant mortality, 1983–92 (per 1,000 live births)	7.9	—	12.3	8.1	8.4	6.8	7.0	7.5	5.4
Hospital admissions per 100,000 of relevant age group									
Asthma, ages 0–14, 1991–3	593		498.6	700.7	458.9	777.5	534.5	550.1	557.9
Diabetes, ages 15–64	85.5		597.2	91.1	53.5	69.5	64.4	45.4	49.5
Dementia, ages 65+, 1991–3	544		567	418	404.7	624	376.4	373.5	416.3

Source: Based on Congdon, 1995: Tables 1 and 2: 1185–6 are so closely associated with an area's affluence or deprivation that knowing its rank order in a deprivation league table is a good basis for predicting the extent and kinds of illness and handicap likely in the area, its crime rate and so on. In turn this means that a deprivation index is also a proxy measure of the pressure on health and social services and of the need for services. The study by Payne and Saul in Chapter 9 is an example of this kind of usage.

Table 11.5 gives a picture of the way in which indices (in this case the Townsend and the Jarman-8) predict differences in mortality rates and hospital admissions. The localities in this table are not administrative territories, but areas composed such that each is fairly homogeneous in terms of its deprivation or affluence (Congdon, 1995). For some causes of death the indicators are good predictors. This can be seen to some extent without statistical analysis where rank order on the index is the same as rank order for rates of death from particular causes. For example, on Table 11.5 the rank order of areas for the Townsend index comes very close to accurately predicting the rank order of areas for ischaemic heart disease 0–64 and stroke 65–74, and the Jarman index is a fairly good predictor of these as well. Or again, locality 5 in Havering has a just below national average deprivation score. Comparing its death rates with those for England and Wales, shows that it has just below average death rates as well. For other conditions the predictive ability of these indices is less good, because differences between areas in terms of age or ethnicity complicate the picture. For example, Locality 1 in Barking has a massively higher rate of hospital admissions for diabetes than all the other areas, much higher than might be explained by differences in social deprivation, even though it is the most deprived locality in the table. Most ethnic minorities of colour have higher rates of diabetes than do white people and some difference remains even after controlling for the effects of social deprivation (Nazroo, 1997a). Table 11.5 also shows that Locality 1 in Barking has the highest percentage of minority ethnic people.

Deprivation indices are used in the following ways:

- Charting change in affluence or deprivation in an area between two points in time using the same index (for example Green, 1994; Phillimore et al., 1994).
- Charting the effects of government policy on poverty in terms of changes in index scores (Green, 1994; Phillimore et al., 1994).
- Investigating the relationship between deprivation and ill-health, or deprivation and social problems such as children at risk or crime (Townsend et al., 1985; Jarman et al., 1992; Abbott et al., 1992).
- Prioritising areas for expenditure in the local strategic planning of services (Congdon, 1995; see also Chapter 9 of this volume).

- Evaluating the availability of services between localities to judge whether those with greatest need are offered greatest provision (see Chapter 9).
- Weighting central government funding for local authorities, health authorities and primary health care to adjust it to differences of socio-economic circumstances (Judge and Mays, 1994; Senior, 1991).
- Setting or interpreting service performance indicators so that agency performance can be judged in terms of local socio-economic circumstances (see Box 11.4).

Studying deprivation at first hand would be prohibitively expensive for the purposes above, and for these purposes it is important to use a common scale of deprivation. This is especially so when fairness of treatment has to be demonstrated, as with the use of a deprivation index to weight the allocation of central government funding. Thus the data for such indicators are either drawn from bureaucratic data sets, such as welfare benefits data, or drawn from the 10-year censuses. The cheapness and availability of data for calculating a deprivation index are also important for applying research findings to another area. For example, many diseases show a close relationship with poverty (see Table 11.5 and Chapter 9). The results of a study demonstrating this which cites area deprivation indices can be extrapolated to another area with a similar deprivation index figure (making some adjustments for the age profile of the area as well – see section 1). Accuracy here cannot be guaranteed, but such extrapolation is more likely to be accurate than one from a study which makes vague comments about the 'poverty' of an area, to another area where people have different ideas about what 'poverty' means and different ways of measuring it. Extrapolation on this basis may be less easy with the Townsend index. This is because the scores on this index are calculated as deviations from the average for the overall area being studied, and standardised into so-called *z-scores* (Abbott et al., 1992). If the original study was about deprivation in the North East of England, then deprivation scores for the North East cannot be equated directly with scores for other areas of England. Typically, studies using Townsend scores cite their results for percentiles of the local area: for example, 'most deprived 10 per cent of wards', 'next most deprived 10 per cent of wards' and so on. Payne and Saul in Chapter 9, for example, contrast the poorest 30 per cent of wards with the most affluent 30 per cent of wards. What are the most deprived 30 per cent in one area, according to the Townsend index, may be more or less deprived than the most deprived 30 per cent in another. The index figures from most other deprivation indices, by contrast, mean the same wherever they are applied (Jarman, 1983).

For any practitioner in England, the index score for one of the major deprivation indices is readily available. This is the 1998 Index of Local Deprivation which is available for every local authority and local health authority in England based on 12 indicators, and available for every ward and census enumeration district for four indicators. (Department of the Environment, Transport and the Regions, 1998).

Different indices are used for different purposes. In research, the two most commonly used are the Townsend index, which features in Chapter 9, and the Jarman Under-Privileged Area (UPA) Score (see Table 11.5). The Jarman comes in two versions: the Jarman-8 and the Jarman-10, depending on how many separate indicators are combined for the final index figure (Jarman, 1983; Jarman et al., 1992). The Jarman-8 is also used by central government to calculate deprivation payments for GP practices in deprived areas (Senior, 1991). For adjusting health authority/board funding to socio-economic circumstances yet a different index is used (Judge and Mays, 1994). And yet another, the Index of Local Deprivation, referred to above, is used to adjust the Standard Spending Assessment which determines central government funding for social services, housing and education in England. The other nations of the UK have various but similar kinds of deprivation-weighted funding.

The different indices have their own strengths and weaknesses. On the whole the Jarman index has proved to be both a sensitive predictor of disease patterns and to produce results which can be generalised from one area to another. Partly because of its simplicity, the Townsend index has been used most often to investigate geographical patterns and temporal changes in inequality within an area. The indices chosen for administrative purposes are based on indicators which seem best to reflect the demand for services in a local area, different facets of deprivation having different implications for general practice, health authority expenditure and social work.

Different indices rank areas differently; compare the Jarman and the Townsend indices in Table 11.5 for example. This can have implications worth tens of millions of pounds of income from central government. Unsurprisingly, the appropriateness, accuracy and fairness of the indices used for administrative purposes is a highly controversial matter. The controversy is heightened by the fact that so many components of these indices derive from census data which is collected only once in each 10-year period. There is a rural/urban dimension to controversy here. In rural areas poverty is often 'hidden' in small pockets in otherwise affluent areas and hence not reflected in the area's deprivation index figure (Abbott et al., 1992). While this is much less true of index figures for rural wards and enumeration districts, deprivation data at this smaller level are less available. What there is, is more dependent on census data and hence more likely to be out of date. But because it includes car ownership, the Townsend index is considered a more sensitive indicator of rural poverty.

Deprivation indices are predictors, either of the prevalence of diseases and social problems, or of the need for services in an area. What components go into a deprivation index and how different components are weighted to get the final score, has been arrived at by a long period of trial and error to see which particular combination best predicts differences between areas in terms of premature death, poverty-related disease, educational under-achievement, or crime rates. Hence they are validated by how accurately the index predicts – construct validity in terms of Chapter 6, section 7. For example, the Jarman index has been widely used in research on the need for mental health services. It seems to be a good predictor of the number of admissions to mental hospital at a district (though not at a ward) level. The higher the Jarman score, the higher the number of admissions (Jarman et al., 1992; Harrison et al., 1995). And again, the Jarman index has been validated as a predictor of GP workload: the higher the index score, the greater the pressure on GP surgeries (Senior, 1991).

The major problem in using deprivation indices comes from their reliance on census data. This means that their base data become increasingly out of date between census publication dates. This is particularly true of the Townsend index, which is entirely based on census data. There is a considerable degree of continuity in area poverty and affluence between censuses. The poorest areas in 1981 were usually the poorest areas in 1991 (Green, 1994). But inevitably there is much small-scale change in rank ordering and occasionally some more extensive changes. For example, with the expansion of higher education in the 1990s, some deprived inner urban areas have changed from housing poor families to housing students. The latter may not be affluent, but they certainly have different patterns of disease and social problems compared with the populations displaced.

Social fragmentation or *anomie indices* are similar to deprivation indices in using easily available data to predict problems or needs for services, but selected as a closer reflection of social exclusion or lack of community capacity; for example, numbers of single person households (Congdon, 1996), or non-participation in voting (Whitley et al., 1999). Such indices have been claimed to be better predictors of suicide than deprivation indices *per se*. It is almost certainly the case that each kind of illness, disability, social problem or service demand would be best predicted from its own custom-built deprivation or social fragmentation index. However, having separate indices for predicting separate problems would undermine the main functions of these indices which are:

- to serve as a general purpose predictor of the extent of need for services broadly defined;

- as a simple measure of inequality in order to demonstrate causal links between patterns of inequality and patterns of ill-health;
- as a basis for adjusting epidemiological data given for a reference area (see Section 2 above) to the socio-economic realities of a particular area. For example, while the national annual prevalence of psychosis might be 4/1,000 (Meltzer et al., 1995), it is likely to be twice if not three times this in an area with a high deprivation score (Harrison et al., 1995).

For reasons of expediency, the fewer the components of an index the better. Sometimes, as noted, the Standardised Mortality Ratio (SMR) is used as a single indicator index. For global comparisons infant mortality rates are often used as a single indicator index of national poverty and affluence, but infant deaths in the UK are now so rare that they are a poor discriminator of differences between areas within the UK, unless accumulated over a 10-year period. Kammerling and O'Connor (1993) have claimed that unemployment rates are almost as accurate predictors of mental health needs as the Jarman-8. For each index there comes a point where adding another component makes very little difference to the way areas are ranked. For example, the 1998 Index of Local Deprivation has no component taking account of the ethnic composition of populations. However, adding such a component makes very little difference to the rank ordering of areas by deprivation. Because people from minority ethnic backgrounds tend to be concentrated in poorer areas, other measures of area deprivation already put areas with large minority ethnic populations towards the top of the deprivation league table.

For planning purposes, deprivation indices and indicators are particularly powerful tools when incorporated into geographical information systems. These are software packages which allow for matters such as clients, diagnoses, accidents, burglaries and so on to be mapped to their location, usually to post code areas (Noble and Smith, 1994). The Office of Population, Censuses and Surveys is able to provide deprivation data for post codes which then map onto the enumeration districts of the census.

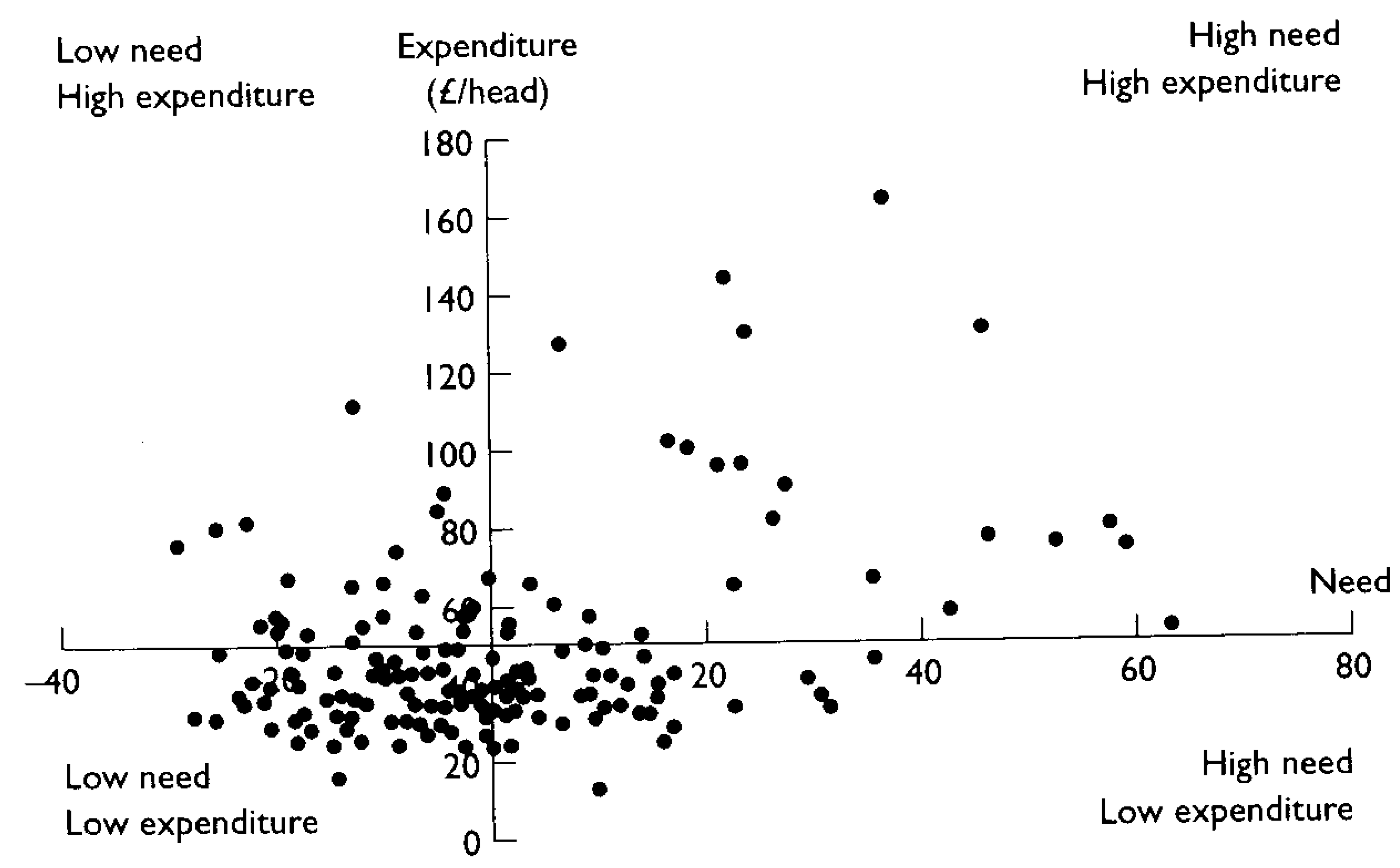
Insofar as deprivation indices are proxy measures of need for services, they are also useful for interpreting agency performance. This is the point of the study in Chapter 9. Box 11.4 provides another example.

Table 11.5 also provides some target figures: those derived from the Health of the Nation strategy. But these take no account of local differences in deprivation (nor do they take much account of age differences between areas). This raises a question of whether it is appropriate to set the same targets for improving health for different areas irrespective of their affluence or deprivation. As Table 11.5 shows, for many conditions the most affluent localities were already much closer to

Box 11.4 Comparing service expenditure with need using a deprivation index as a proxy measure of need

Figure 11.3 comes from an Audit Commission report on adult mental health services. It would have been prohibitively expensive for the Audit Commission to investigate the need for mental health services directly. Instead, they used the well-demonstrated high correlation between deprivation and need for mental health services in order to judge whether London health districts were allocating resources commensurate with need. The horizontal axis differentiates districts according to their score on the Jarman UPA index (high score = high deprivation). The vertical axis measures expenditure on mental health services *per head* of the population, thus standardising for different district population sizes. If the differences in district spend were commensurate with differences in district need then all the dots should cluster around a diagonal line running from bottom left to top right. There is actually very little relationship between need and spend. The same exercise might be done for spending on child protection services, drug and alcohol services and most other health services, insofar as in each case a deprivation index score differentiates areas in terms of need for services.

Figure 11.3 Expenditure on mental health services and need for mental health services: need estimated in terms of the Jarman-8 Underprivileged Area Index: London Health Districts (Audit Commission, 1994: 12 'Exhibit 6'; Crown copyright, reproduced with permission)



meeting the targets for AD 2000 than the poorer ones. In this case these are not the kinds of localities for which Health of the Nation targets are set, but the table does illustrate the fact that where a

Primary Care Group area has a population a large percentage of which has the characteristics like Localities 1, 2 and 3, it will find it much more difficult to meet the targets than one where more of the population is like those in Localities 6 and 7. Central government tends to take the line that because poorer areas receive more resources, this compensates them for their greater deprivation, and hence that standard national targets are appropriate for all authorities. Authorities way below target usually argue that additional resources do not compensate them enough, or that the extent of their deprivation has been under-estimated. The issue of how far it is reasonable to assume that service activity is able to overcome the effects of deprivation at given levels of expenditure is a matter for economic research of the cost-effectiveness kind (see Chapter 3).

Important questions to ask about studies using deprivation indices include the following:

- For what purpose is the index being used, and has it been validated for that purpose?

Some such studies will themselves be validation studies. Chapter 6 of this volume is relevant here.

- What are the component indicators of the index? How are they weighted to get the final score and how out of date are they?

And for the purpose of applying the results from a study in one place to a practice area:

- Are data available for calculating the score for the local area on the same index? If so, findings about the relationship between deprivation, disease, social problems or need for services elsewhere can be extrapolated to the local area.
- And if so, how accurate is the local index likely to be? Being based on out-of-date data is the major problem, but there are also difficulties of extrapolating from urban areas to rural ones and vice versa.

5 Further reading on age standardisation and deprivation indices

For age standardisation and SMRs, see Jones and Moon (1987: Chapter 2), or Unwin et al. (1997: 32–5) or Marsh (1988) (various chapters). For examples of the use of SMRs in relating ill health to social class, see Townsend, Davidson and Whitehead (1992). For deprivation indices a classic paper is Jarman (1983), which describes the development of the Jarman UPA index. Abbott et al. (1992), Phillimore et al. (1994) and Townsend et al. (1985, 1988) are all examples of the use of deprivation indices as research tools, as is Payne and Saul in Chapter 9 of this volume. Congdon's use of a social fragmentation index is also worth reading about (1996).

References and further reading

Abbott, P., Bernie, J., Payne, G. and Sapsford, R. (1992) 'Health and material deprivation in Plymouth', in P. Abbott and R. Sapsford (eds) *Research into Practice: a Reader for Nurses and the Caring Professions*. Buckingham: Open University Press. pp. 129–55.

Atkinson, M., Kessell, N. and Dalgaard, J. (1975) 'The comparability of suicide rates', *British Journal of Psychiatry*, 127: 427–56.

Audit Commission (1994) *Finding a Place: a Review of Adult Mental Health Services*. London: HMSO.

Benzeval, M., Judge, K. and Whitehead, M. (1995) *Tackling Inequalities in Health: an Agenda for Action*. London: King's Fund.

Bloor, M. (1991) 'A minor office: the variable and socially constructed character of death certification in a Scottish city', *Journal of Health and Social Behaviour*, 32: 273–87.

Bloor, M. (1994) 'On the conceptualisation of routine medical decision-making: death certification as an habitual activity', in M. Bloor and P. Taraborrelli (eds), *Qualitative Studies in Health and Medicine*. Aldershot: Avebury Ashgate Publishing. pp. 96–109.

Bloor, M., Robertson, C., and Samphier, M. (1989) 'Occupational status variations in disagreements on the diagnosis of causes of death', *Human Pathology*, 30: 144–8.

Bloor, M., Samphier, M., and Prior, L. (1987) 'Artefact explanations of inequalities in health: an assessment of the evidence', *Sociology of Health and Illness*, 9(3): 231–64.

Congdon, P. (1995) 'Localities for epidemiological monitoring and health policy', *Urban Studies*, 32 (7): 1175–98.

Congdon, P. (1996) 'Suicide and parasuicide in London: a small area study', *Urban Studies*, 33: 137–58.

Cooper, J., Goodhead, D., Craig, T., Harris, M., Howat, J. and Korer, J. (1987) 'The incidence of schizophrenia in Nottingham', *British Journal of Psychiatry*, 151: 619–26.

Department of the Environment, Transport and the Regions (1998) *Index of Local Deprivation*. London: DETR.

Department of Health (1993) *Health of the Nation: Key Area Handbook: Mental Illness*. London: Department of Health.

Department of Health (1995) *Variations in Health: What Can the Department of Health and the NHS Do? Report Produced by the Variations Sub-group of the Chief Medical Officer's Health of the Nation Working Group*. London: Department of Health.

Department of Health and Social Services (Northern Ireland) (1982) *Northern Ireland Census 1981*. Belfast: HMSO.

Fernando, S. (1988) *Race and Culture in Psychiatry*. London: Croom Helm.

Giggs, J. and Cooper, J. (1987) 'Ecological structure and the distribution of schizophrenia and affective psychoses in Nottingham', *British Journal of Psychiatry*, 151: 627–33.

Gomm, R. (1996) 'Mental health and inequality', in T. Heller, J. Reynolds, R. Gomm, R. Muston and S. Pattison (eds), *Mental Health Matters: A Reader*. Basingstoke: Macmillan. pp. 110–20.

Green, A. (1994) *The Geography of Poverty and Wealth: Evidence on the Changing Spatial Distribution and Segregation of Poverty and Wealth from the Census of Population 1991 and 1981*. Warwick: Institute for Employment Research.

Hall, J. and Dornan, M. (1990) 'Patient sociodemographic characteristics as predictors of satisfaction with medical care: a meta-analysis', *Social Science and Medicine*, 30: 811–18.

Harrison, J., Barrow, S. and Creed, F. (1995) 'Social deprivation and psychiatric admission rates among different diagnostic groups', *British Journal of Psychiatry*, 167: 456–62.

Jarman, D. (1983) 'Identification of underprivileged areas', *British Medical Journal*, 286: 1705–79.

Jarman, B., Hirsh, S., White, P. and Driscoll, R. (1992) 'Predicting psychiatric admission rates', *British Medical Journal*, 304: 1146–51.

Jones, K. and Moon, G. (1987) *Health, Disease and Society: an Introduction to Medical Geography*. London: Routledge and Kegan Paul.

Judge, K. and Mays, N. (1994) 'Allocating resources for health and social care in England', *British Medical Journal*, 308: 1363–6.

Kammerling, R., and O'Connor, S. (1993) 'Unemployment rate as a predictor of psychiatric admission', *British Medical Journal*, 307: 1536–9.

King, M., Coker, E., Leavey, G., Hoare, A. and Johnson-Sabine, E. (1994) 'Incidence of psychotic illness in London: comparison of ethnic groups', *British Medical Journal*, 306: 1115–19.

London Research Centre (1992) *Census Research Information Notes 92–93*. London: LRC.

Marsh, C. (1988) *Exploring Data: an Introduction to Data Analysis for Social Scientists*. Cambridge: Polity Press.

McGovern, D. and Cope, R. (1987) 'First admission rates for first and second generation Afro-Caribbeans', *Social Psychiatry*, 22, 139–49.

Meltzer, D. (1992) *Dementia: Epidemiology Based Needs Assessment: Report No. 5*. London: Department of Health.

Meltzer, D., Gill, B., Petticrew, M. and Hills, K. (1995) *The Prevalence of Psychiatric Disorders Among Adults Living in Private Households*. OPCS Surveys of Psychiatric Morbidity in Great Britain. Report No. 1. London: HMSO.

Moser, K. and Goldblatt, P. (1985) *Mortality of Women in the OPCS Longitudinal Study: Differentials by Own Occupation and Household and Housing Characteristics: Working Paper No. 26*. London: Social Statistics Research Unit, City University.

NHS Management Executive (1993) *Local Target Setting: a Discussion Paper*. London: Department of Health.

Nazroo, J. (1997a) *The Health of Britain's Ethnic Minorities*. London: Policy Studies Institute.

Nazroo, J. (1997b) *Ethnicity and Mental Health: Findings from a National Community Survey*. London: Policy Studies Institute.

Noble, P. and Smith, T. (1994) 'Children in need: using geographical information systems to inform strategic planning for social services provision', *Children and Society*, 8 (4): 360–76.

Noble, M., Smith, G., Avenall, D., Smith, T. and Sharland, E. (1994) *Changing Patterns of Income and Wealth in Oxford and Oldham*. Oxford: Department of Applied Social Studies and Social Research, University of Oxford.

Open University (1975) *Data Collection Procedures*. Milton Keynes: Open University Press.

Phillimore, P., Beattie, A. and Townsend, P. (1994) 'Widening inequality in health in Northern England 1981–91', *British Medical Journal*, 308: 1125–8.

Senior, M. (1991) 'Deprivation payments to GPs', *Environment and Planning*, 9: 79–94.

Smaje, C. (1995) *Health, 'Race' and Ethnicity: Making Sense of the Evidence*. London: King's Fund.

Stevens, A. and Raftery, J. (1994) *Health Care Needs Assessment: the Epidemiological Needs Reviews*. Oxford: Radcliffe Medical Press.

Townsend, P., Davidson, N. and Whitehead, M. (eds)(1992) *Inequalities in Health: the Black Report and the Health Divide*, new edition. Harmondsworth: Penguin Books.

Townsend, P., Phillimore, P. and Beattie, A. (1988) *Health and Deprivation: Inequality in the North*. Beckenham: Croom Helm.

Townsend, P., Simpson, P. and Tibbs, N. (1985) 'Inequalities in the City of Bristol: a preliminary review of the statistical evidence', *International Journal of Health Services*, 15: 637–43.

Unwin, N., Carr, S., Leeson, J. with Pless-Mulloli, T. (1997) *An Introductory Guide to Public Health and Epidemiology*. Buckingham: Open University Press.

Whitley, E., Gunnell, D., Dorling, D. and Davey Smith, G. (1999) 'Ecological study of social fragmentation, poverty and suicide', *British Medical Journal*, 319: 1034–7.