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Deaths from ischaemic heart disease and infant mortality in England and Wales

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SUMMARY Death rates from ischaemic heart disease (IHD) in English and Welsh counties are correlated, in both men and women, with the infant mortality rates of those counties when the individuals whose deaths are considered were young, thus confirming previous findings in Norway. In England and Wales, however, there is an equally good correlation between deaths from IHD and infant mortality patterns up to and including that for the same time period as the IHD deaths. The British data provide no grounds for concluding from these relationships that living conditions during early life *per se* bear a causal relationship to deaths from IHD.

Forsdahl (1977) has reported that, for Norway, there is a close correlation between the recent county death rates for IHD and the infant mortality rates pertaining to those counties when the individuals whose deaths are considered were young. This correlation exists in both males and females but it is more marked in the former. Thus, the county death rates for IHD in men aged 40 to 69 years at death between 1964 and 1967 correlate with the infant mortality rates for the same areas in the years 1896 to 1925 (Spearman's $\rho = 0{\cdot}79, P < 0{\cdot}001$). The value of ρ for this comparison in women is 0·61 ($P < 0{\cdot}01$). The correlation with more recent infant mortality rates is, in general, less marked.

A high infant mortality rate is widely regarded as an indicator of poor living conditions, so Forsdahl concluded from his findings that individuals who experience poor living conditions during childhood and who subsequently achieve a more affluent way of life are more likely to die of IHD than individuals exposed to these better living conditions throughout life. Furthermore, from a study of the population of Finmark, the most northerly Norwegian county and the one with the highest rate of deaths from IHD, Forsdahl (1978) went on to argue that the change from poverty in childhood and adolescence to prosperity in adult life produces its effect on IHD death rates by the elevation of serum cholesterol.

Rapid social change has been regarded as deleterious to health in general (Tyroler and Cassel, 1964) as a result of incongruities between the culture of the group exposed to this change and the demands and expectations created by the new social situation. More specifically, mortality from IHD has been found to be excessive in men who actively seek upward social change by moving house or changing their jobs (Syme *et al.*, 1964), or who have such change thrust upon them by the advent of rapid industrialisation in their areas of residence (Cassel and Tyroler, 1961). The Norwegian results thus seem to accord with these sociological findings, although the specific pathophysiological mechanisms for the excess mortality are unclear.

We decided to determine whether the relationship between recent IHD death rates and past infant mortality observed in Norway also obtained in England and Wales. The results of this investigation are presented here, together with a discussion of the difference between the situation in England and Wales and that in Norway.

Materials and methods

The numbers of deaths from IHD (8th revision of the *International Classification of Diseases* (World Health Organisation, 1967) codes 410–414) for the five years 1969 to 1973, and the 1971 census populations for English and Welsh counties, were supplied by the Office of Population Censuses and Surveys (OPCS, 1978). Five-year death rates (age- and sex-specific) were calculated for each county for persons dying at ages 25–34, 35–44, 45–54, 55–64, 65–74, and 75 and over.

Deaths during the first year of life and the number of live births for each county for the years 1885 to 1948 were obtained from the Registrar General's annual reports, 1885 to 1948; and, for each age group of IHD deaths, a mean annual infant mortality

rate was calculated for the years in which the members of that cohort were infants. Thus, death rates for individuals aged 25–34 at death were compared with the mean annual infant mortality for the years 1935 to 1948; death rates for the 35–44-year-old group were compared with infant mortality between 1925 and 1938, and so on. Death rates in the age group 75 and over were compared with infant mortality rates between 1885 and 1898.

Before 1903 the infant deaths are not given separately for each Welsh county but for South Wales, for North Wales, and for Monmouthshire, so that, for the periods 1885 to 1898 and 1895 to 1905, mean annual infant mortality rates are compared with IHD death rates for the age groups 65–74 and 75 and over based on these larger subdivisions of Wales.

Boundary changes in this period have been most marked in the South-east of England, with London expanding to take in parts of Kent, Surrey, and Essex, and engulfing Middlesex completely. Short of making detailed and complex estimates of population change in each local authority separately over the years, there is no satisfactory way in which these areas can be taken into account. Therefore, in the results given here, London (later Greater London) and Middlesex have been excluded from the analysis. Although these areas represent large numbers of deaths, their consistent exclusion is unlikely to produce significant bias. The changes wrought in Kent, Surrey, and Essex have been ignored, and no attempt has been made to consider the effect of migration by linking county of birth with county of death.

Results

Table 1 shows the values of Spearman's ρ for the rank correlations between IHD death rates in males and females of each age group and the mean annual infant mortality rates during the period when these individuals were young. Significant correlations ($P < 0{\cdot}05$) are demonstrated in all but the youngest group of females. The relationship is stronger in all cases for males than for females and strongest for the age groups 55–64 years in both men and women.

Discussion

The results presented in Table 1 support the Norwegian findings previously published (Forsdahl, 1977) and the relationships demonstrated can be interpreted in the same way, that is, that individuals who spent their early years in areas of high infant mortality (the poorer areas) suffer a greater risk of dying from IHD in later life than do individuals who grew up in the richer areas. This excess mortality could, very reasonably, and in accord with earlier work (Cassel and Tyroler, 1961; Syme *et al.*, 1964), be attributed to the greater social change experienced during the lifetime of the person from the poorer areas.

This interpretation is strengthened in Norway by the statement that recent infant mortality rates do not show significant variation from county to county (Forsdahl, 1978); in other words, present living conditions seem to be homogeneously prosperous. These Norwegian infant mortality rates are based on comparatively few deaths, however. The annual numbers of such deaths for the whole of Norway in the period 1971–75 (that considered by Forsdahl) are all less than 850 (United Nations, 1976) compared with the range for England and Wales, in the same period, of between 11 000 and 13 000. When the comparatively few Norwegian deaths are apportioned between counties, the lack of statistically significant difference between recent county infant mortality rates could be a reflection solely of the small number of deaths.

The English and Welsh county infant mortality rates for the period 1969 to 1973 are far from homogeneous, ranging from 9·4 deaths per thousand live births (Montgomeryshire) to 20·8 deaths per thousand live births (Lancashire). The geographical variation in infant mortality during this period is significantly correlated with IHD death rates in the

Table 1 *Rank correlations between county five-year death rates from IHD (1969-73) and county infant mortality rates during the period when the cohort from which the deaths are drawn were infants*

Age groups of IHD deaths (years)	*Period considered for infant mortality*	*No. of counties considered*	*Spearman's ρ (male deaths)*	*Spearman's ρ (female deaths)*
25–34	1935–1948	53	0·3620 **	0·2435
35–44	1925–1938	53	0·6441***	0·5902***
45–54	1915–1928	53	0·6680***	0·5893***
55–64	1905–1918	53	0·7150***	0·6873***
65–74	1895–1908	43	0·4729***	0·4175***
75 and over	1885–1898	43	0·2757 **	0·2226 *

*** $P \leq 0{\cdot}001$
** $P \leq 0{\cdot}01$
* $P \leq 0{\cdot}05$

same period (Table 2). The correlation is again more marked in males than in females and more marked in older than in younger groups.

Although, in each county, there has been a marked reduction in infant mortality from 1885 to the present day, the relative rankings of the counties have stayed largely the same (Table 3). Application of the Friedman test (Conover, 1971) to these rankings at seven different periods shows a high correlation between them. This gives $T = 249{\cdot}35$ with a distribution which is approximately chi-square with 42 degrees of freedom ($P < 0{\cdot}001$).

Thus, in England and Wales, past infant mortality rates are highly correlated with recent infant mortality rates, and recent IHD death rates are correlated with both past and present infant mortality rates. Therefore, it is unreasonable to conclude that in these two countries poor living conditions in infancy and childhood *in particular* give rise to an increased risk of dying from ischaemic heart disease, since the poorer areas have remained relatively poor and yet still possess, in general, the higher rates of death from IHD. All that can be said is that populations in which a high death rate for IHD

Table 2 *Rank correlations between county death rates for IHD and county infant mortality rates for the quinquennium 1969-1973 (number of counties considered = 53)*

Age groups of IHD deaths (years)	*Spearman's ρ (male deaths)*	*Spearman's ρ (female deaths)*
25–34	0·2878 **	0·2363 *
35–44	0·4630***	0·4174***
45–54	0·4311***	0·3745***
55–64	0·5167***	0·5094***
65–74	0·5698***	0·5916***
75 and over	0·5809***	0·4549***

*** $P \leq 0{\cdot}001$
** $P \leq 0{\cdot}01$
* $P \leq 0{\cdot}05$

Table 3 *Rank ordering of counties by infant mortality at various dates (low rank denotes low infant mortality)*

County	*1969-73*	*1935-48*	*1925-38*	*1915-28*	*1905-18*	*1895-1908*	*1885-98*
Beds	16	11	11	21	19	17	23
Berks	1	9	9	9	8	11	6
Bucks	5	3	3	4	6	8	12
Cambs	2	15	18	13	16	15	19
Cheshire	33	31	29	30	29	32	33
Cornwall	24	22	24	20	23	23	31
Cumberland	35	33	34	37	32	25	21
Derbyshire	29	29	30	29	28	29	32
Devon	12	24	22	22	22	22	20
Dorset	22	7	8	7	3	2	2
Durham	38	42	43	43	43	41	39
Essex	4	6	19	18	21	27	25
Glos	23	17	21	24	24	19	24
Hants	13	16	13	12	14	18	17
Hereford	25	25	20	14	12	6	8
Herts	6	1	2	1	1	5	5
Hunts	9	28	15	25	11	10	7
Kent	8	8	12	10	17	21	18
Lancs	43	41	42	32	36	43	43
Leics	32	27	27	28	31	34	41
Lincs	31	23	25	27	27	30	27
Norfolk	19	14	16	23	25	28	28
Northants	21	18	14	19	20	20	26
Northumberland	27	40	41	42	39	42	34
Notts	30	32	38	38	41	38	36
Oxon	20	2	1	2	4	7	13
Rutland	10	19	17	17	13	4	11
Salop	18	20	23	15	15	12	15
Somerset	14	10	6	3	5	9	9
Staffs	39	34	40	39	42	40	42
Suffolk	11	5	10	16	18	16	16
Surrey	3	4	4	5	9	14	14
Sussex	7	13	5	6	10	13	10
Warwicks	41	30	32	31	34	39	38
Westmorland	15	26	26	11	7	3	4
Wilts	28	12	7	8	2	1	3
Worcs	26	28	28	26	26	24	29
Yorks, E	37	36	35	36	35	36	37
Yorks, N.	40	39	39	41	31	31	30
Yorks, W	42	43	36	40	37	37	40
Monmouth	36	38	33	35	33	33	1
S. Wales	34	35	37	34	35	35	35
N. Wales	17	37	31	33	26	26	22

Because of repeated boundary changes it proved necessary to omit Middlesex and London.
Friedman test statistic $T = 249{\cdot}35$ ($P < 0{\cdot}001$)

prevails are characterised by high infant mortality both now and in the past. It may not be possible to identify this relationship in the case of Norway, where infant deaths in recent years are very few. The aetiology of ischaemic heart disease is widely regarded as multifactorial and complex. It may well be that areas with high rates of infant mortality and concurrently high rates of death from ischaemic heart disease share certain factors that are important in the aetiology of both groups of diseases, but this study has failed to support the hypothesis that, in England and Wales, the transition from poverty in early life to prosperity in middle age is a causal determinant of death from IHD.

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