INDIVIDUAL STUDIES

The distribution of mortality from coronary heart disease in South Wales

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THERE is excess mortality from all causes, at all ages, and in both sexes in industrial South Wales, concentrated chiefly in the valleys of Glamorgan and Monmouthshire. The weighted mean-adjusted mortality in the Glamorgan valleys for 1963–67 was 29 per cent above the England and Wales rate, and the perinatal mortality was 32 per cent above; rates for the Monmouthshire valleys were 19 per cent and 42 per cent above, respectively. (Registrar General, Medical tables 1963–67).

There are known social factors in South Wales that probably operate on most causes of death, in both sexes, and at all ages; chief among these are relatively low wages and high unemployment, cultural and educational deprivation, dangerous occupations, migration of healthy young adults, and a relatively low standard of care in the health services. Established ideas on the causation of coronary heart disease (CHD), and accepted associations with social class and occupation, would not lead one to expect a raised mortality from CHD in early middle age in these circumstances. Eight years' experience as a general practitioner in a mining village led me to suspect otherwise, and to search in the Registrar General's mortality data for evidence for or against this impression.

South Wales is divisible into three socially distinct areas, which I have used throughout this analysis. The local authority areas I have allocated to each are listed in the appendix; allocations were made before calculation of rates, and not amended afterwards. The division conforms with the opinion of others familiar with South Wales, but has not been validated by statistical comparisons.

The mining valleys are steep, wet, and narrow; along them are strung industrial villages based on coal mines and, to a small extent and only in Monmouthshire, on steelworks. They have been in a state of economic decline since 1921, and have suffered drastic depletion by migration for several generations, which is again accelerating owing to the government's fuel policy. The villages are almost single-class communities, and the majority of middle-aged men are either miners or ex-miners. Those in this age group who have never been miners tend either to be professional, or to have sought other work because of physical or mental handicaps. In my own village in 1966, half the men aged 16 to 64 were miners of all sorts, and a third were working underground; a large majority of those on the surface were formerly underground. An additional 17 per cent were in other heavy labouring occupations, and most of these also were former miners. In another typical valley, the Rhondda Fach, 70 per cent of the men aged 25 to 54 in 1951 (43 to 72 now) were miners or ex-miners (Cochrane 1969). For the past 40 years there has been little migration into the area, though there was a huge influx from rural Wales, the border counties, Somerset and Ireland in the last quarter of the nineteenth century, when coal was booming and most of the villages were built. The genetic pool is therefore mixed, despite subsequent in-breeding.

The life and environment of the coastal towns and cities (hereafter called towns) do not differ substantially from most other towns in Britain. They receive migrants from

TABLE I. Male mortality from bronchitis, age 35-64, Glamorgan and Monmouthshire by social area, 1963-67

	VALLEYS				*TOWNS*				*RURAL*			
	Number	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*
Glamorgan	573	129**	422	1.84	403	74**	517	0.78	100	65**	145	0.68
Monmouthshire	278	122**	216	1.74	101	76*	125	0.80	35	43**	77	0.61

Rates differing from the mean significantly marked * at 5% level, ** at 1% level

TABLE II. Male mortality from stroke, age 35-64, Glamorgan and Monmouthshire by social areas, 1963-67

	VALLEYS				*TOWNS*				*RURAL*			
	Number	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*
Glamorgan	466	105**	367	1.50	427	78	454	1.11	88	57**	127	0.81
Monmouthshire	159	70**	187	1.00	97	73	110	1.04	56	69	67	0.98

Rates differing from the mean significantly marked * at 5% level, ** at 1% level

the valleys, and lose others to England. The rural areas lie on the coastal plain. They are still mainly agricultural, with growing suburban and commuter development; some migrants are received from the valleys, others are lost to the towns and to England, and there is migration into them from the towns.

Mortality rates presented here have been calculated from unpublished data from the Registrar General, giving deaths by cause, sex, and ten-year age-groups for local government areas for the years 1963-67. Causes are given from an abbreviated list of 36 headings. Populations have been estimated by five-year age-groups for the midpoint year 1965, from the 1961 Census and the ten per cent sample census of 1966. All rates are for deaths under 65 years of age. A widow's eligibility for concessionary coal depends on the outcome of post-mortem examination, so the post-mortem examination rate is higher in miners than in other labouring occupations.

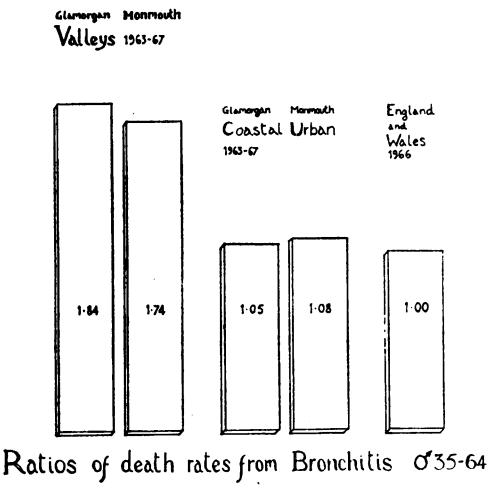

Figure 1

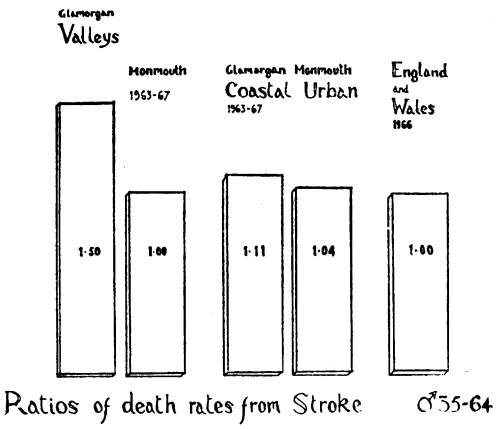

Figure 2

Principal causes of death in men under 65

Nearly half the male deaths 35–64 in the Glamorgan valleys from 1963–67 were due to CHD (31 %), bronchitis (9 %), and vascular lesions of the central nervous system—stroke—(8 %). Tables I, II, and III, and figures 1, 2, and 3, show the distribution of deaths from these causes in the three social divisions of South Wales, compare divisional rates with South Wales rates, with England and Wales rates, and with those for East Anglia, the standard region with lowest mortality.

Death rates for bronchitis were 84 per cent higher than England and Wales in the Glamorgan valleys, and 74 per cent higher in the Monmouthshire valleys. This excess is already known, but unexplained. With few exceptions the valleys show little atmospheric pollution (Warren Spring Laboratory 1968), and what there is is more smoke than sulphur dioxide (Clifton 1969). There is no evidence that valley men smoke more than town men (discussed in detail below). They certainly inhale more coal dust, and what is perhaps more important, cough it out; but the Medical Research Council's Committee on Chronic Bronchitis and Occupation has reported that "the evidence so far does not point to the inhalation of dust as being a major factor in causing bronchitis" (Medical Research Council 1966). This view has been contested, notably by Lowe (1969), and conflicts with the clinical impressions of those who live in and care for mining communities.

Mortality from strokes shows an excess of 50 per cent over the England and Wales

TABLE III. Male mortality from coronary heart disease, by age-groups, and social areas of Glamorgan and Monmouthshire, 1963-67

	VALLEYS				*TOWNS*				*RURAL*			
	Number	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per 100,000*	*Expected*	*Proportion England & Wales rate*
AGE 35—44												
Glamorgan	176	114**	136	1.75	156	82	169	1.26	38	65	51	1.00
Monmouthshire	67	87	68	1.34	41	85	43	1.31	10	43	20	0.66
AGE 45—54												
Glamorgan	494	327*	442	1.32	546	289	554	1.16	126	235*	157	0.95
Monmouthshire	226	291	227	1.17	139	302	135	1.22	50	221	66	0.89
AGE 55—64												
Glamorgan	1,197	866**	1,056	1.22	1,386	847**	1,251	1.20	319	764	318	1.08
Monmouthshire	577	797	553	1.13	293	783	286	1.11	140	730	146	1.03

Rates differing from the mean significantly marked * at 5% level, ** at 1% level

rate, concentrated in the Glamorgan valleys. The abbreviated list does not separate cerebral embolism, thrombosis and haemorrhage, nor does it separate rheumatic heart disease from "other heart disease" (that is, other than CHD). Rheumatic heart disease, though diminishing, is still an important cause of death in the valleys, and this is bound to contribute to the deaths from stroke. It seems unlikely that this could account for the whole of this excess.

Distribution of male deaths from coronary heart disease by age

The much larger number of CHD deaths can be analysed by 10-year age-groups. The excess in the Glamorgan valleys is greatest in the youngest group examined, 35–44, where it exceeds the England and Wales rate by 75 per cent and is almost three times as high as in East Anglia. The difference diminishes progressively in the higher age-groups. The Monmouthshire valleys, which appear to be socially identical with the Glamorgan valleys except for a lower proportion of miners and ex-miners, show rates no higher than the towns. This was true also of deaths from stroke.

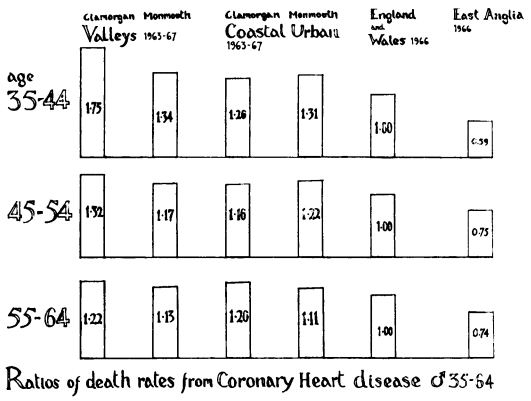

Figure 3

Data for CHD and stroke have been examined for evidence of secular change from 1963 to 1967; there was no convincing trend either way.

The possibility that the difference is semantic has been considered. Deaths from CHD might be attributed to the other abbreviated list categories 'hypertension with heart disease' or 'other heart disease' (which includes the obsolete term 'myocardial degeneration'). The number in the first group (11 in the 35–44 group throughout Glamorgan) is too small to affect the result either way; the second (81 in the same

TABLE IV
Deaths from coronary heart disease and stroke in women
Glamorgan and Monmouthshire valleys and urban areas 1963-67

	VALLEYS				*URBAN*			
	Number	*Rate per* 100,000	*Expected*	*Proportion England & Wales rate*	*Number*	*Rate per* 100,000	*Expected*	*Proportion England & Wales rate*
STROKE								
Glamorgan	397	83	345	1.41	368	63	420	1.07
Monmouthshire	163	76	150	1.29	81	61	93	1.03
CORONARY HEART DISEASE 35—54								
Glamorgan	113	35	108	1.43	128	32	135	1.32
Monmouthshire	45	32	44	1.28	28	29	29	1.19
CORONARY HEART DISEASE 55—64								
Glamorgan	393	249	371	1.30	420	223	442	1.16
Monmouthshire	178	247	160	1.29	67	174	85	0.99

Only the Glamorgan valley deaths from stroke differ significantly (5 per cent) from South Wales rates.

population) shows higher rates in the valleys than the towns, and is therefore likely to diminish differences in CHD mortality rather than increase them. The large excess in CHD deaths in early middle age in the men of the Glamorgan valleys appears to be real, and so far as I know has not been noted before.

Coronary heart disease in women

The number of CHD deaths in women is small; table IV shows their distribution together with deaths from stroke. The mortality rate from stroke in Glamorgan valleys, 41 per cent higher than England and Wales, is the only difference to reach the five per cent level of significance. There is no difference between the CHD mortality rates in Glamorgan and Monmouthshire valleys.

Distribution of known risk factors for coronary heart disease in South Wales

Many risk factors are known for CHD, and associations that may or may not be causal. They have been reviewed by recent authors (Meade 1968, Oliver 1968, Morris 1969), and the principal risk factors are also associated with deaths from stroke (Paffenbarger and Wing 1967).

Of these, levels of blood pressure and of serum cholesterol are of greatest predictive value, and may be final common pathways through which are exerted the effects of other factors such as diet and occupation. Cigarette smoking is a high risk factor. The highest predictive value of all has been claimed by American workers for what they call the 'A' personality pattern. This includes driving ambition, pre-occupation with time-schedules and deadlines, competitiveness, and a persistent desire for recognition; the opposites of each of these things, together constitute what they call the 'B' personality. Careful study of the other characteristics of the two groups as described by the authors (Friedman *et al* 1968, Rosenman *et al* 1966) shows that they differ in important respects other than personality; but the difference in CHD morbidity between the two groups was large, and difficult to explain on these grounds alone. One of the compensations of work in the valleys is that there are so few of the awful 'A' people (perhaps because of selective migration), and if this really is an important risk factor anywhere (which from experience both here and in London I greatly doubt) it certainly cannot explain the high valley rates in Glamorgan. For the rest, there is some evidence on the distribution of known risk factors as between the valleys and the Vale of Glamorgan from the work of the Medical Research Council Epidemiological Research Unit under Professor A. L. Cochrane. This does not suggest any substantial differences in respect of serum cholesterol (Higgins, Cochrane and Thomas 1963) or blood pressure (Miall and Oldham 1958, Miall 1959). Male height and body-weight for height were lower in the valleys, female body-weight for height was higher (Ashcroft *et al* 1967). While it may be reasonable to accept the Rhondda Fach as typical of all the valleys, the area of the Vale used in these surveys is quite unlike the towns. However, the absence of differences is interesting because the rural areas have the lowest CHD mortality in South Wales. Until similar comparisons are available for representative samples of the population in other valleys, and in Swansea and Cardiff, it will remain possible that the excess CHD mortality in the Glamorgan valleys depends on differences in blood pressure or serum cholesterol; but so far the evidence is against this.

The distribution of smoking habits can be studied directly by surveys, or indirectly by analysis of deaths from lung cancer, but the latter is complicated in mining areas by evidence that simple pneumoconiosis reduces mortality from lung cancer (Goldman 1965, Crofton 1969). Standardized mortality ratios to the England and Wales rate in men 35–64 for lung cancer 1963–67 were as follows: Glamorgan valleys 0.83, Monmouthshire valleys 0.88, Glamorgan towns 1.00, Monmouth towns 1.02. It is difficult to believe that an excess of smoking sufficient to raise CHD mortality 75 per

cent and bronchitis 84 per cent above the mean, would fail to raise lung cancer at least to the England and Wales rate, despite the higher prevalence of pneumoconiosis.

It is also possible that Welsh miners simply smoke less than other workers, and a complete survey of the male population aged 20–64 by five-year age-groups in my own village in 1966 bore this out. There was lower mean cigarette consumption, and a higher proportion of non-smokers, in every age-group except one, compared with national figures (Todd 1966) and a similar population sample in Lambeth (Holland 1969). Evidence on the smoking habits of miners generally is contradictory, but the balance of the evidence appears to show a lower average consumption of cigarettes by miners than non-miners (*British Medical Journal* 1967), as one would expect from the fact that no miner can smoke at work, even in meal breaks.

Physically active occupations may have a protective effect against CHD (Morris *et al* 1953). Without doubt the proportion of men in heavy labouring occupations is greater in the valleys than the towns. Considering the arduous nature of coal mining, miners are surprisingly prone to CHD. The last published occupational mortality tables (Registrar General 1951) show a CHD mortality only four per cent below the mean for men aged 20–64 (238 deaths); and even this is probably an under-estimate, as the diagnosis 'myocardial degeneration' was 67 per cent above the mean (90 deaths). This interpretation is supported by the mortality of miners aged 20–64 from stroke, which was 15 per cent above the mean (116 deaths). It seems clear that either the protective effect of exercise does not operate in miners, or that it does so against a considerable contrary force. Young miners probably work harder than any other occupational group except trawlermen, but most of them are forced by ill-health, injury, or waning physical strength to leave work at the coal face between 45 and 55 years of age, or to leave the industry. Alternative work above or below ground is still usually more arduous than most other manual occupations, and, of those leaving, most have to take labouring jobs, as they have no transferable skill.

The massive migration from the valleys has been selective for some factors influencing mortality—notably bronchitis—but there is no reason to suppose that it has been selective for blood pressure, serum cholesterol, or cigarette smoking. However, these assumptions should be tested, as our present views on the health of migrants rest on little evidence. CHD mortality rates are unlikely to be related to migration, since between 1951–61 the migrational loss from Monmouthshire valleys (7.9%) was higher than that for Glamorgan (5.6%). I have not studied previous inter-censal periods.

Mortality rates for diabetes may bear some relation to prevalence though probably most deaths under 65 will be recorded as CHD. The rates for male mortality from diabetes 35–64 in the Glamorgan valleys (53 per 100,000) are lower than in the towns (61 per 100,000), and both were lower than the England and Wales rate. Diabetes is unlikely to be a determining factor in the distribution of CHD in South Wales.

Relation to the hardness of water

A relation between cardiovascular mortality (CHD and stroke) in males aged 45–64 and soft water supplies has been established in many parts of the world (Crawford, Gardner and Morris 1968), though whether this is causal, and if so, how it operates, is still unknown. Crawford *et al* found a high correlation ($r = -0.65$) between cardiovascular mortality and total hardness of water, on British populations, but also found correlations with infant mortality ($r = -0.55$) and bronchitis mortality in males 45–64 ($r = -0.45$). An association of soft water supplies with a raised prevalence of mural atheroma and coronary lumen stenosis, restricted to men in the 30–44 age-group, has also been demonstrated (Crawford and Crawford 1967).

Water supplies in South Wales are of great complexity. Many communities draw mixed water from different sources, in varying proportions at different seasons and

different states of water reserve. Though the upland (valley) sources are generally very soft, hard water from disused collieries is used as a supplementary supply in some places, often intermittently, and the extent of this is difficult to ascertain. Sources in the Vale of Glamorgan and the eastern and coastal parts of Monmouthshire are mostly in limestone and hard or very hard. It is therefore substantially true that all the valleys have soft water, and all the coastal towns and rural areas have hard water.

So far as possible without field studies, I have estimated the mean hardness of the water in each local authority area in Glamorgan and Monmouthshire, and these are shown together with CHD mortality in the appendix. Data have been supplied by the engineers and chemists of the water undertakings concerned, supplemented by material published in the Water Engineer's Handbook for 1968. Allowance has been made for the varying proportions from different sources, and the sizes of the different populations supplied. More information was available for Glamorgan valleys than for Monmouthshire valleys, and where guesswork was involved I have chosen low rather than high values for hardness in Monmouthshire valleys, since my hypothesis was that the difference between the valleys in CHD might depend on differences in water hardness. All hardness has been expressed as total hardness in parts per million.

The results of calculation of correlation coefficients of hardness of water with standardized general mortality, infant mortality, CHD mortality by age-groups, and mortality from bronchitis and stroke are shown for all Glamorgan and Monmouthshire in table V. The highest correlation is with standardized general mortality, followed by

TABLE V

Correlation between total hardness of water and standardized mortality from all causes, perinatal mortality, coronary heart disease, bronchitis and stroke mortality (males 35—64). Glamorgan and Monmouthshire 1963-67.

Glamorgan and Monmouth 1963—67	*Correlation*	*Regression*
Ratio local adjusted death rate to national rate	—0.614	——
Perinatal mortality	—0.577	——
Coronary heart disease mortality		
males 35—44	—0.280	—0.172
males 45—54	—0.297	—0.359
males 55—64	—0.092	—0.223
males 35—64	—0.458	—0.454
Bronchitis mortality		
males 35—64	—0.535	—0.361
Stroke males 35—64	—0.265	—0.116

infant mortality and bronchitis, all above 0.5. Correlation with CHD mortality is significant only in the age-group 35–54, and is much lower than that found by Crawford *et al*; the same applies to mortality from stroke.

The valleys are quite different socially from either the towns or rural areas, and it appears clear from these correlations that in South Wales at least, they are simply reflecting other known social and environmental differences. The only way to test the water hypothesis here is to compare like with like; that is, to compare the Glamorgan valleys with their high CHD mortality in young men, with Monmouthshire valleys, whose rates do not differ from the town rates. Calculation of the correlation coefficient on this basis gives a value of 0.173. This figure as it stands, cannot account for the difference in mortality. However, more detailed study could alter these figures and substantially change this conclusion.

Conclusions

The exceptionally high CHD mortality in the Glamorgan valleys requires further

study, to save lives among these quite young men, and to search for hitherto unknown factors in the causation of CHD. Too little is known of the distribution of known risk factors, notably cigarette smoking. It is remarkable that an industry that continues to promote the sale of a known poison does not spend the fraction of its profits that would be required to give us a complete picture of the geographical and occupational distribution of smoking habits. The data are inadequate and should be supplemented by surveys using the techniques of market research. More data on the distribution of serum lipids could be obtained by the blood transfusion service; though donors are a selected group, it would seem unlikely that the basis of selection differs much as between the valleys and the towns. Another step that is long overdue is to make coronary occlusion under the age of 65, with or without death, a notifiable disease throughout Britain; we should be at least as interested in CHD as in measles. The present situation regarding notification of infectious disease is so farcical that few general practitioners take it seriously; I am sure this would not apply if CHD, and other serious non-infectious diseases, were included. More attention should be given to CHD in young men (35–54), and the Registrar General's annual reports might usefully be modified to make this material more readily accessible.

Other local studies should be made, where local authority boundaries coincide with social, geographical and economic divisions, notably in the area of the Tyne, Wear and Tees, which might usefully be compared with South Wales. Such studies can be done only by those with a thorough knowledge of the locality involved, and it is surprising that so few public health departments appear to have published work on these lines, in the areas of highest mortality.

The water hypothesis deserves more detailed inquiry in the South Wales valleys than I have been able to give it in this paper; this might best be done by sampling of tap water throughout the valleys during the whole of one year by science sixth forms in the local schools. Both the design, estimation of water hardness, and statistical calculations would be within their competence, and would give many young people a scientific research project of recognizable value. If further studies should show that I have underestimated the effect of water hardness, the opportunities for controlled trial of changes in the water would be immense. Water supplies for most of the valleys are in the course of revision and simplification, and study of this question is an urgent matter, if this opportunity is not to be missed.

The association of soft water supplies with such a wide and apparently unconnected variety of mortality (CHD and stroke, bronchitis, infant mortality and general mortality), of which three have themselves high correlations with poverty and social class, makes one sceptical of the validity of Crawford's separation of these social factors from the water factor; but South Wales may be exceptional in this respect.

Much hard work has gone into point-prevalence studies of CHD, but the yield has been disappointing. A study comparing the prevalence of electrocardiographic changes in the Rhondda Fach and the Vale of Glamorgan showed almost no difference (Higgins, Cochrane and Thomas 1963) despite a 75 per cent difference in male mortality from CHD in the 35–44 age-group of the populations from which the samples were drawn. It seems clear that substantial advances in the epidemiology of CHD will not be obtained in this way but by the continuous study of defined male populations on a basis of initial complete screening for known risk factors, followed up at regular intervals, together with normal continuing care. This can best be done in general practice, and those younger epidemiologists who are dissatisfied with the lack of clinical and human content in their work should consider entering this field. The Glamorgan valleys, with their compact, well-defined industrial populations, offer unique opportunities for anyone with a real interest in clinical epidemiology.

Summary

Evidence is given to show that there was an unexpectedly high mortality from coronary heart disease in men aged 35–54 in the valleys of Glamorgan in the period 1963–67. The excess over expected rates was highest in the youngest group examined, 35–44, where it was 75 per cent above the England and Wales rate. Evidence is given on the distribution of known risk factors for coronary heart disease in Glamorgan and Monmouthshire; none of these appears to explain this excess. It was not found in the apparently similar population and environment of Monmouthshire. Suggestions are made for further study of this problem.

APPENDIX

Local authority area deaths from coronary heart disease

	35—44		45—54		55—64		*Arithmetic mean ratio of local adjusted death rate to national rate*	*Estimated total hardness of water supply*
	Number	*rate*	*Number*	*rate*	*Number*	*rate*		
TOWNS								
Glamorgan								
Cardiff C.B.	62	78	218	282	549	809	1.082	110
Swansea	41	73	160	291	429	921	1.194	95
Barry	10	117	38	301	82	737	1.052	110
Bridgend	4	76	13	272	34	844	1.014	265
Neath M.B.	13	142	28	259	95	935	1.226	35
Penarth	3	45	21	288	47	724	1.062	110
Porthcawl	4	125	8	209	27	793	0.988	265
Port Talbot	19	101	60	350	123	872	1.220	61
Monmouthshire								
Newport	29	80	115	323	234	785	1.124	100
Chepstow M.B.	3	150	3	139	11	560	0.848	100
Cwmbran	9	89	21	253	48	849	1.108	100
VALLEYS								
Glamorgan								
Merthyr Tydfil	22	113	52	288	143	828	1.338	33
Aberdare	18	151	38	297	108	860	1.352	36
Caerphilly	8	62	42	359	90	1025	1.214	42
Gelligaer	12	115	26	272	71	766	1.304	42
Glyncorrwg	6	198	11	354	24	1062	1.362	22
Llwchwr	7	82	34	407	68	794	1.194	20
Maesteg	5	68	16	225	55	833	1.254	50
Mountain Ash	9	88	20	232	80	1018	1.304	65
Ogmore and Garw	11	158	26	390	56	799	1.294	50
Pontypridd	12	98	34	315	76	793	1.162	46
Rhondda	33	103	108	340	233	801	1.340	44
Neath R.D.	17	173	48	417	110	1018	1.248	26
Pontardawe	16	166	39	355	83	953	1.284	25
Monmouthshire								
Abercarn	5	81	14	235	38	722	1.194	45
Abertillery	7	104	25	323	58	688	1.204	42
Bedwas and Machen	3	80	10	369	25	865	1.108	42
Bedwellty	7	81	24	279	58	859	1.218	53
Blaenavon	2	75	9	392	23	786	1.260	47
Ebbw Vale	11	138	32	364	72	806	1.242	50
Mynniddislwyn	9	163	14	290	29	654	1.216	114
Nantyglo and Blaina	2	45	9	263	37	1106	1.308	42
Pontypool M.B.	11	100	30	229	103	807	1.148	160
Rhymney	1	45	8	264	20	800	1.308	35
Risca	2	40	17	336	45	894	1.038	110
Tredegar	5	79	17	257	43	743	1.282	95

RURAL									
Glamorgan									
Cardiff R.D.	11	57	36	200	107	692	0.976	110
Cowbridge M.B. & R.D.	3	40	19	269	42	1011	1.108	265
Gower	3	69	9	196	31	813	0.980	95
Llantrisant and Llantwit Fardre	8	76	22	242	49	655	1.110	42
Penybont	13	79	40	270	90	807	1.036	265
Monmouthshire								
Abergavenny M.B.	2	71	12	338	26	990	1.170	100
Caerleon	2	125	1	662	12	1048	0.922	100
Monmouth M.B.	1	57	5	288	8	578	1.002	239
Usk	1	136	1	198	6	1446	0.934	200
Abergavenny R.D.	1	27	7	236	22	657	0.790	100
Chepstow R.D.	1	23	6	145	27	688	0.948	100
Magor and St. Mellons	1	16	15	239	33	764	1.018	110
Monmouth R.D.	1	51	3	155	6	299	0.876	180
Pontypool R.D.	2	28	17	327	26	777	0.988	180

Male deaths from coronary heart disease in Glamorgan and Monmouthshire 1963-67 by local authority areas, with total hardness of water supplies in parts per million. All rates are mean annual rates per 100,000.

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