Length of life and wealth of retired German men in 2003

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Introduction.

Socio-economic inequality in old-age mortality is a problem of high public health significance due to rapid increase in the elderly populations and to large magnitude of associated absolute mortality differences. The international literature on socio-economic differentials in mortality is marked by a persisting absence of Germany. So far, Germany has not been present in reviews on socio-economic mortality differences in Europe [1, 2, 3, 4]. Unlike many industrialized countries, German statistical system does not produce data suitable for estimation of mortality by population group depending on socio-occupational status, educational level or income. This is a serious obstacle for evaluation of inequalities in the face of death. For old ages, this lack of information can not be filled by estimates based on follow-up of specific groups or panel surveys [5, 6, 7, 8]. These data either do not cover the elderly or suffer from low observation numbers and therefore, are problematic for mortality estimation. We are not aware of any study providing estimates of mortality or life expectancy for people aged 65 and older in Germany.

The data situation in Germany is partly related to particularly strict data-protection laws. However, it has begun to improve recently with introduction of new policies towards greater openness of micro-data for scientific use. The present study exploits the new opportunity by using data of the German pension system for evaluation of socio-economic mortality differentials among German men aged 65 and over. The data set used was produced in 2005 via the Würzburg Research Data Center (Forschungsdatenzentrum) of the German Federal Pensions' Union (Deutsche Rentenversicherung Bund called DRV hereafter).

This study provides new information about differential mortality of 5.2 millions (nearly 90%) of retired German men aged 65 and older at the beginning of 2003 across four socio-economic dimensions such as pension earning points (a cumulative measure of lifetime earnings), type of health insurance, region of residence, and broad professional group. We identify significant mortality differentials as reflected by mortality rate ratios and life expectancy values across categories of each of the socio-demographic variables and of their combinations.

Data and methods

This study exploits an unusual source of information, a data base of records on individual pensions paid to all receivers of German public pensions. A detailed description of the German pension system can be found elsewhere [9, 10]. The administration of the German public pension system is marked by a variety of statutory bodies. Traditionally, there have been regional pension insurance institutes for workers, a federal institute for salaried employees, and three profession-specific institutes. All these pension insurance institutes are required by law to report statistics of all pensioners as of the end of each year as well as statistics of those pensioners who died during that year to their umbrella association, the DRV.

The DRV data extract used in this study covers about 94% of Germans aged 65 and older at the beginning of 2003. All these people have been working in the German public sector over their life course. Main part of the data describes individuals' employment histories and corresponding accumulation of pensionable income. The data do not include information about civil servants' (about 7% of the total workforce) work and about the private business sector. Importantly, the DRV data refers to population of pensions rather than population of pensioners. The former is greater since some retired persons receive two or more pensions. The excess of pensions compared to individuals is especially important for elderly women, many of whom receive pensions for (or from) their husbands or former husbands in addition to their own pensions.

Because of this difficulty in evaluation of women's status[1], we analyze here mortality of men only. For the same reason, we had to exclude a small share of men receiving more than one pension. In interest of better completeness and integrity of the data, we also excluded men with no German citizenship and with migration background. After all these exclusions, the data set under study covered about 5.2 million German men constituting 92% of the total German male population aged 65 and older at the beginning of 2003.

The data were provided to us in the frequency format split by age, residence, health insurance, professional group, and earning points. The study data set consists of five-dimensional cells corresponding to all realized combinations of age with the four socio-demographic variables. Each cell contains two values: deaths and exposure time used as numerator and denominator in further mortality analyses.

Follow-up of the men enumerated at the beginning of 2003 during this calendar year returned information about 256 thousand deaths. In terms of mortality, the DRV population of retired men is very close to the total population of Germany. According to the DRV data, male life expectancies at ages 65 and 85 are 16.9 and 5.2 years, respectively. For the whole of Germany in 2003, the equivalent values are 16.3 and 5.2 years, respectively [11].

In our analyses the socio-demographic variables are categorized as follows:

- *Age* is split by five-year age groups such as 65-69, 70-74, …, 90+;
- *Residence* according to the current place of residence has three categories: West Germany, East Germany, and foreign country;
- *Health insurance* refers to a type of medical insurance and has three categories: public, private, and foreign. The whole working population in Germany is mandatory covered by the public funds up to earnings threshold that was 75% of the maximum pensionable earnings until 2004. Individuals with higher earnings can either insure in the same public system voluntarily or chose to be insured privately. It means that pruivate health insurance stands not only for a somewhat higher quality of medical care, but also points at a high-income group. A small subgroup of pensioners is insured according to laws of foreign countries. Usually these are people, who have worked in Germany only a short time.
- *Professional group* refers to three very broad professional categories originating from the traditional sectors of the German pension insurance system mentioned above. The professional categories are: workers, employees, and miners. Unlike, socio-occupational categories in other countries [12, 13] the hierarchical aspect is less clear in the German categorization. It is simultaneously a division by branch of industry and character of labor. The group of workers mostly includes manual workers. The group of employees mostly includes people of non-manual labor, but also a small part of manual labor employees paid on the basis of salaries. Finally, there is a group of people who have worked in the mining industry.
- *Earning points* is a principal measure of individuals' earnings cumulated during the entire work career. It is a summary score of credits based on summing up of annual pensionable earnings divided by population-average pensionable earnings for the same year. For every year of work, the national mean pensionable earnings is taken as 1. If in year *t* an individual earns an amount of money, which is higher (lower) than the mean individual earnings for this year by 50%, his pensionable gain for this year is 1.5 (0.5). This simple score is further modified for individuals, who have experienced non-contributory time periods (related to unemployment, advanced education, or other reasons) and also due to early retirement (see

[1] Apart from the technical difficulty with multiple records for one person, there is a more general difficulty in evaluation of socio-economic status of women. For many of them a more adequate definition of their social status should be based on husband's and/or household's wealth characteristics in addition or instead of women's own characteristics [15].

[14] for more details). In further analyses, we operate with the earning points' deciles and quintiles.

All socio-demographic variables have known values for all individuals under study. Sizes of groups corresponding to the categories are shown in Table 1.

The data are examined by means of both non-parametric and parametric methods. On the non-parametric side, we calculate empirical life expectancies and mortality rate ratios by residence, health insurance, professional group, and credit point deciles and quintiles. In doing this, we apply conventional techniques for computation of life tables and standardized mortality ratios [16]. A bootstrap procedure (with 1000 replications) is used for calculation of confidence limits. To see the whole range of mortality variation produced by simultaneous action of all socio-demographic factors, we perform a four-dimensional analysis across 60 combinations of residence, health insurance, professional group, and earning point quintiles. The Poisson regression beta coefficients and related risk scores outline summary mortality effects of all socio-demographic variables and respective distribution mortality risk across the population.

Results

Table 1 shows population exposures, life expectancies, and mortality rate ratios[2] for the four socio-demographic variables under study. Most of the observed mortality differences are in the expected direction: mortality is slightly (by 2%) higher in East Germany than in West of Germany. It is substantially (by 46%) higher for the public insurance than for the private insurance holders, and for the workers than for the employees (by 36%). Life expectancy of workers at age 65 is 15.5 years *vs.* 17.9 years for employees, life expectancies of the public and the private health insurance holders are 16.2 and 19 years, respectively.

Extreme levels of mortality and length of life are seen in some small and selective categories constituting in total less than 2% of all individuals. Life expectancy at age 65 is 19.8 years (19.4, 20.2) among pensioners with foreign residence and is only 12.1 (12.0, 12.3) years among holders of foreign health insurances. Mortality rate ratios in these groups constitute 0.65 and 2.52, respectively.

Earning points deserve special attention. Although mortality is mostly decreasing with earning points, the relationship is not entirely monotonous (Figure 1). It appears that mortality rate ratio increases from the first to the third decile and then decreases over the remaining seven deciles. Mortality rate ratio varies between the highest value of 1.75 in the third decile and the lowest (reference) value of 1 in the tenth decile. Respective values of life expectancy at age 65 are 14.6 and 19 years, respectively.

Relatively low mortality among pensioners with the lowest earning points' scores suggests existence of additional factors biasing the credit points as a measure of cumulated income in a part of individuals. Indeed, some of men with very low earning points could have spent major part of their working lives either in in private business and could be getting additional unobserved income from alternative sources. This disadvantage of DRV data can be at least partly compensated for by using complementary socio-demographic variables. The medical insurance variable is particularly helpful. Indeed, in the two lowest earning point deciles 42% (!) of individuals have private medical insurance. In the remaining deciles this percentage is much lower and varies from 3.7% (fith decile) to 8.5% (tenth decile). It suggests that for a big part of individuals in the lowest deciles, their social status is understated by the earning points, but it could be corrected (at least partly) by additional information about the medical insurance.

A multivariate analysis of mortality can help to assess individuals' socio-economic status more precisely and to reveal a broader range of mortality variation. Table 2 shows results of the Poisson

[2] The relative mortality risk expresses relative level of mortality as compared to the reference category. It is calculated as the age-standardized mortality ratio equal to the observed number of deaths in the group of interest divided by the expected number of deaths (e.g. with death rates of the reference group).

regression of mortality on age, residence, health insurance, professional group, and credit points' quintiles. To avoid null death counts, very small categories of pensioners with foreign residence and those with foreign health insurance (about 70 thousand person-years) are excluded from this analysis. The regression beta-coefficients show effects of the four variables on mortality when they act simultaneously and independently from each other.

Table 1. Life expectancy at age 65 and mortality rate ratio at ages 65+ according to residence, type of health insurance, professional group, and pension credit points' deciles and quintiles.

	Population exposure	e(65)	Lower 95%	Upper 95%	Rate ratio	Lower 95%	Upper 95%
Total	5204700	16.89	16.86	16.92	-	-	-
Residence							
West	4087241	16.38	16.35	16.42	1.000	1.000	1.000
East	1066938	16.22	16.16	16.29	1.017	1.008	1.026
Foreign	50521	19.79	19.41	20.16	0.645	0.614	0.676
Health insurance							
Private	675128	19.04	18.94	19.14	1.000	1.000	1.000
Public	4439233	16.16	16.13	16.19	1.460	1.446	1.474
Foreign	90339	12.14	11.97	12.31	2.521	2.396	2.647
Professional group							
Workers	2752642	15.49	15.45	15.53	1.360	1.344	1.375
Employees	2133121	17.87	17.82	17.91	1.000	1.000	1.000
Miners	318937	15.18	15.07	15.29	1.391	1.348	1.435
Quintiles of the credit points distribution							
1	994742	16.11	16.05	16.18	1.332	1.320	1.343
2	1086699	14.87	14.81	14.93	1.589	1.577	1.602
3	898535	15.84	15.77	15.91	1.426	1.412	1.439
4	1172795	16.84	16.79	16.91	1.234	1.223	1.244
5	1051929	18.45	18.39	18.53	1.000	1.000	1.000
Deciles of the credit point distribution							
1	500961	16.76	16.67	16.86	1.340	1.323	1.358
2	493781	15.48	15.38	15.57	1.509	1.491	1.526
3	519250	14.55	14.47	14.64	1.747	1.728	1.767
4	567449	15.14	15.06	15.23	1.676	1.657	1.695
5	434218	15.58	15.49	15.68	1.597	1.575	1.618
6	464317	16.08	15.98	16.17	1.486	1.467	1.506
7	583599	16.54	16.46	16.63	1.384	1.367	1.400
8	589196	17.13	17.04	17.21	1.273	1.258	1.288
9	524253	17.90	17.80	17.99	1.154	1.139	1.169
10	527676	18.98	18.88	19.07	1.000	1.000	1.000

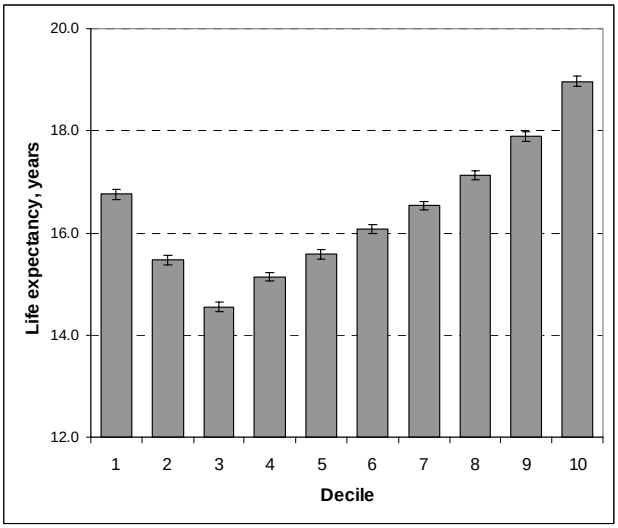

Figure 1. Life expectancy at age 65 by the earning points' deciles.

On the basis of the estimated regression coefficients, regression-based mortality risk scores and rate ratios can be computed for each combination of the four variables. For example, for the group of West German workers with public health insurance belonging to the fourth earning points' quintile the point estimate of the risk score equals (0+0.373+0.193+0.117)=0.683 (see Table 2) and the mortality rate ratio equals exp(0.683)=1.980. Figure 2 portrays a profile of relative mortality across the population. It shows regression-based and empirical mortality rate ratios across 60 four-dimensional combinations of the variables' categories. Respective population shares are presented on the *x* axis. Corresponding quantitative values as well as life expectancies can be found in Annex. The maximal regression-based rate ratios, close to 3, are seen among East and West German miners with public health insurance belonging to the 1st or 2nd earning points' quintiles. The minimal mortality value (taken as 1) is observed among West German employees with private health insurance belonging to the 5th earning points' quintile. Regression-based rate ratios from 2.5 to 3 are characteristic of about 24% of men. Their life expectancy is about 14 years. Regression-based rate ratios of 1 to 1.5 are characteristic of 17% of men. Life expectancy in this advanced fraction is close to 19 years. This life expectancy is higher than that in Japan, the word leader in longevity, whereas life expectancy of the disadvantaged 24-percent fraction is close to level of the Czech Republic (see Figure 3).

Table 2. Poisson regression beta coefficients and mortality rate ratios for residence, health insurance, professional group, and earning points' quintiles.

	Beta	95% Lower	95% Upper	Rate ratio	95% Lower	95% Upper
Residence						
West	0	-	-	1	-	-
East	0.037	0.027	0.047	1.038	1.027	1.048
Health insurance						
Private	0	-	-	1	-	-
Public	0.3729	0.3576	0.3882	1.452	1.430	1.474
Professional group						
Workers	0.193	0.184	0.202	1.213	1.202	1.224
Employees	0	-	-	1	-	-
Miners	0.346	0.330	0.362	1.413	1.391	1.437
Credit points, quintiles						
1	0.361	0.347	0.376	1.435	1.415	1.456
2	0.359	0.346	0.372	1.431	1.413	1.450
3	0.219	0.205	0.233	1.244	1.227	1.262
4	0.117	0.104	0.130	1.124	1.110	1.139
5	0	-	-	1	-	-

Note: The mortality effects are age-adjusted. Effects of age groups are not shown here.

Similar life expectancy comparison between the lower and the upper population fractions can be performed separately for East and West Germany. It appears that the range of life expectancy variation is almost the same. In East Germany life expectancies at age 65 for lower 23% and upper 29% are 14.3 and 18.5 years, respectively. For West Germany the equivalent figures for lower 24% and upper 20% are 14.1 and 18.7 years.

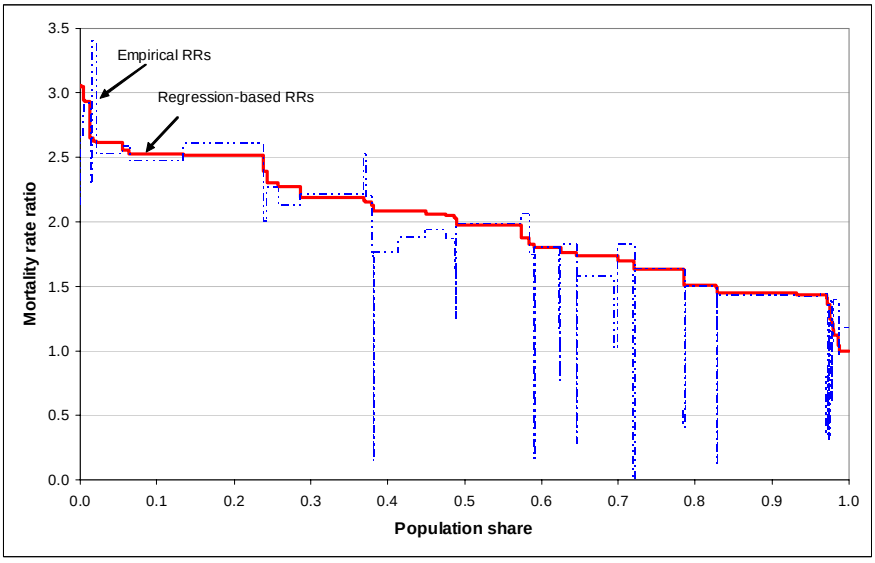

Figure 2. Regression-based and empirical mortality rate ratios across all combinations of residence, type of health insurance, occupational group, and credit point quintiles.

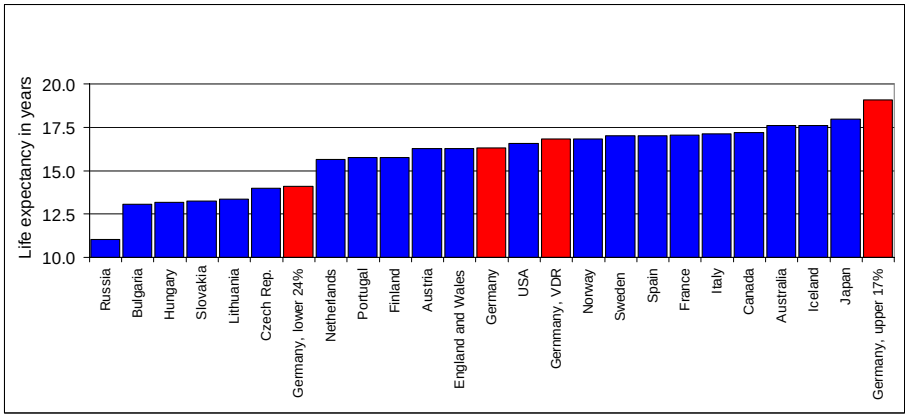

Figure 3. Life expectancies of men at age 65 in Germany, total VDR population and its upper and lower fractions in 2003 in comparison to selected industrialized countries in 2002-2003.

Summary and discussion

Information on mortality differentials constitutes a decisive part of evidence on health inequalities. It is a final proof on the extent to which in a given country social status and related differences in life chances and lifestyles transform in a given country into differences in survival and longevity. Although Germany has reach sources of survey information linking reported health conditions with socio-economic status [4, 17], estimates of socio-economic differences in old-age mortality are virtually non existent. The main reason is that the German statistical system does not produce mortality data linked to census or micro-census information about individuals' education, income, and occupation.

This study provides estimates of socio-economic mortality differentials for 5.2 million men aged 65 years and older in 2003 on the basis of data set of a register of German public pensions. It is well known that information about occupation, education and current income, which is sensitive enough

at working ages could be not sufficient for measuring socio-economic status in the elderly [18]. This study uses information about individuals' cumulated income as reflected by earning points, type of health insurance (e.g. public vs. private), occupational group (workers vs. employees), and residence (East *vs.* West Germany). Although these variables provide valuable information on various aspects individuals' social status, some of them can not be interpreted in straightforward way. In particular, a big share of wealthy people, receiving income from alternative sources, can be found among individuals with very low earning points' scores.

Our results generally confirm that the socio-economic gradient of mortality continues into older age in Germany. This result completely agrees with the recent findings in other eleven Western European countries [3]. The mortality rate ratios reach 1.6 and 1.8 in low earning points' quintiles and deciles, respectively. The mortality rate ratio is 2.5 for the public insurance holders (compared to the privately insured), and 1.4 for workers compared to employees. The equivalent absolute differences in life expectancy at age 65 vary from 2.5 to 4 years. Analysis of the multivariate mortality variation reveals a 3.5-fold relative mortality differences and 6-7 year differences in life expectancy at age 65 between the most advanced and the most disadvantaged categories.

Mortality of East German pensioners only slightly exceeds mortality of their West German counterparts, while socio-economic mortality differences are almost the same in both parts of Germany. This result is generally consistent with what was found by others from information on self-reported health status and morbidity [20, 21].

Significant mortality inequalities at old ages can be attributed to influence of different life chances and behaviors of people belonging to different parts of the social spectrum. People with higher income and education tend to smoke less, to eat less of unhealthy food, and are rarely involved in hazardous alcohol drinking. They can afford better housing, nutrition, safer living environments, and have easier access to the quality health care. The latter could be a matter of particular concern in Germany. This classic country of universal population coverage by medical care has introduced during the last decade several reforms bringing new inequality to the medical care provision and untilization.

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Annex. Population sizes and mortality indicators for combinations of the residence, health insurance, occupational group, and credit point quintile.

Range of regression-based RRs	Resi-dence	Health insurance	Occupat-ional group	Credit points, quint.	Popula-tion	RR, empirical	Lower 95%	Upper 95%	e(65)	Lower 95%	Upper 95%
2.50-3.00	East	Pub	Miner	2	16935	2.7	2.5	2.8	14.0	13.5	14.4
	West	Pub	Miner	1	11382	2.8	2.6	3.0	13.1	12.5	13.6
	West	Pub	Miner	2	32884	2.9	2.8	3.0	13.1	12.8	13.3
	East	Pub	Miner	3	23345	2.3	2.2	2.4	15.1	14.6	15.4
	East	Pub	Worker	1	19309	3.4	3.2	3.6	11.7	11.3	12.1
	East	Pub	Worker	2	184800	2.5	2.5	2.6	14.5	14.4	14.7
	West	Pub	Miner	3	42492	2.6	2.5	2.7	14.1	13.8	14.4
	West	Pub	Worker	1	363014	2.5	2.4	2.5	14.2	14.1	14.3
	West	Pub	Worker	2	546462	2.6	2.6	2.6	14.1	14.0	14.1
	Total 2.50-3.00 (24% of the total pop)				1240623	2.6	2.6	2.6	14.1	14.1	14.2
2.00-2.50	East	Pub	Miner	4	28749	2.0	1.9	2.1	16.0	15.6	16.4
	West	Pub	Miner	4	67877	2.3	2.2	2.3	15.3	15.0	15.5
	East	Pub	Worker	3	153692	2.1	2.1	2.2	15.6	15.4	15.8
	West	Pub	Worker	3	428315	2.2	2.2	2.2	15.4	15.3	15.5
	East	Pub	Employee	1	6863	2.5	2.3	2.7	13.4	12.7	14.1

	East	Pub	Employee	2	42334	2.2	2.1	2.3	15.0	14.7	15.3
	East	Pub	Miner	5	20134	1.7	1.6	1.8	17.2	16.7	17.6
	West	Pub	Employee	1	170931	1.8	1.7	1.8	17.1	16.9	17.3
	West	Pub	Employee	2	179752	1.9	1.8	1.9	16.5	16.4	16.7
	East	Pub	Worker	4	137889	1.9	1.9	2.0	16.6	16.5	16.9
	West	Pub	Miner	5	56291	1.9	1.8	1.9	16.8	16.5	17.0
	West	Priv	Miner	1	8539	1.6	1.4	1.8	17.6	16.3	18.9
	Total 2.00-2.50 (25% of the total pop)				1301366	2.0	2.0	2.0	16.0	16.0	16.1
1.50-2.00	West	Pub	Worker	4	440903	2.0	2.0	2.0	16.3	16.2	16.4
	East	Pub	Employee	3	51345	2.1	2.0	2.1	15.9	15.6	16.2
	East	Pub	Worker	5	39016	1.7	1.7	1.8	17.4	17.0	17.8
	West	Pub	Employee	3	164706	1.8	1.8	1.8	16.9	16.8	17.1
	West	Pub	Worker	5	109344	1.8	1.8	1.9	17.1	16.9	17.3
	West	Priv	Worker	1	245282	1.6	1.5	1.6	18.0	17.9	18.2
	West	Priv	Worker	2	35736	1.0	1.0	1.1	21.7	21.3	22.6
	East	Pub	Employee	4	105289	1.8	1.8	1.9	16.8	16.6	17.0
	West	Pub	Employee	4	338892	1.6	1.6	1.7	17.8	17.7	17.9
	East	Pub	Employee	5	203359	1.5	1.5	1.5	18.5	18.4	18.7
	Total 1.50-2.00 (33% of the total pop)				1733872	1.7	1.7	1.7	17.3	17.3	17.4
1.00-1.50	West	Pub	Employee	5	542173	1.4	1.4	1.4	18.7	18.6	18.8
	West	Priv	Employee	1	164645	1.4	1.4	1.5	18.7	18.5	18.9
	West	Priv	Employee	2	36957	1.4	1.4	1.5	18.7	18.3	19.1
	West	Priv	Employee	3	15935	1.4	1.3	1.5	19.1	18.5	19.9
	West	Priv	Employee	4	30347	1.4	1.3	1.5	18.9	18.6	19.5
	West	Priv	Employee	5	62579	1.2	1.1	1.2	20.0	19.7	20.4
	Total 1.00-1.50 (17% of the total pop)				852236	1.4	1.4	1.4	18.7	18.7	18.8

Note: Only 37 groups out of 60 are shown in the table. Small groups with numbers of observed deaths less than 200 are not included.