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Mortality Inequality in Finland*

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Abstract

We study inequality in mortality in Finland using registry data that covers the whole population for years 1990-2018. We create municipality-level indexes of regional deprivation (poverty rate), and show how age-specific mortality rates have evolved across regions and over time. The inequality in mortality has been remarkably low over the time period for most age groups. However, among young and prime-age males the mortality rates have been persistently higher in the poorer areas. For these age groups the leading causes of death are deaths of despair (alcohol and suicides) and accidents. For the cohorts that were young during the deep early-1990's recession, we also document higher inequality in middle-age mortality than for cohorts entering the labor market in recovery periods.

Keywords: Income inequality, mortality, Finland

JEL Classification: I14; I12

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1 Introduction

Several papers have shown that life expectancy is negatively correlated with income. These correlations have been documented both at the country and at the regional level, indicating that individuals living in regions with fewer resources die earlier (Cutler et al., 2006; Chetty et al., 2016). Recently, there have been efforts to develop a methodology to compare levels and trends in mortality inequality across areas in different countries (Currie and Schwandt, 2016a,b). However, we still lack a comprehensive picture of these trends across a broader set of countries, and how these trends depend on institutional differences.

This paper documents how inequality in mortality has evolved in Finland, a country with one of the most equal income distributions in the world. Finland also has low mortality rates, especially among infants, making it an interesting benchmark when analyzing cross-country differences in mortality (Chen et al., 2016). Moreover, the study period considered here (1990-2015) is characterized by large business cycle fluctuations as Finland was hit by an exceptionally deep recession in the early 1990's. This makes Finland an interesting case study to analyze trends in mortality inequality.

Our paper builds heavily on recent work by Currie and Schwandt (2016a), Currie and Schwandt (2016b) and Currie et al. (2020) that investigates mortality inequality across different countries and time periods. Following the approach proposed in these papers, we investigate inequality in mortality by comparing mortality rates by a measure of geographical poverty, age and gender in different time periods. To our knowledge, our paper is the first to provide evidence on how inequality in mortality has developed in Finland over the recent decades.

The main results (Section 4) are divided into two parts. In part A we provide information on mortality inequality using all-cause mortality. We divide the data into ventiles (5 percentage shares of the population) by municipality-level poverty rates (based on the share of workers earning less than the median national income) and investigate how mortality rates by age groups differ across these areas over time. Next, in part B we investigate how cause-specific mortality has developed over time. In this part, we divide the data into deciles by municipality-level poverty. In Section 5, we further investigate the reasons for the main

results patterns. In particular, we examine the role of the Finnish recession in the early 1990's and focus on the cohorts that were entering the labor market at that time.

Our results show that there is little inequality in mortality among children and older age groups in Finland. In particular, mortality has decreased in all age groups over our study period, and across all cause-specific groups. This decrease has occurred evenly across all areas, so that overall there is little change in mortality inequality over the 1994-2015 period in Finland. However, among prime-age males the mortality rates are persistently higher in poorer areas. The cause-specific analysis shows that the main reasons for deaths for this group are deaths of despair and by accidents. Deaths of despair, deaths due to accidents and cancer-related deaths are all persistently higher in poorer areas among prime-age males. We further assess whether these results may reflect scars of the deep early 1990's recession that especially affected the cohorts that were graduating or were at the beginning of their career during the recession. Our analysis reveals that the cohorts that were graduating during the recession era had persistently higher mortality rates over the study period.

The paper proceeds as follows: Section 2 describes background information for Finland. Section 3 describes the data and the methods. Section 4 reports the main results that consist of two parts: A) All cause-mortality inequality and B) Cause-specific mortality inequality. Section 5 discusses the results and focuses on inequality in mortality of cohorts that were young during the early 1990's recession. Section 6 concludes.

2 Background: Inequality and health in Finland

Income distribution in Finland is among the most equal in the world. According to the OECD, Finland ranks at the top, with a 10/90 income ratio of 3.1 and a Gini coefficient of 0.27 in 2018 (OECD, 2020).

The study period 1994-2015 was characterized by significant economic cyclicality. In the early 1990's, Finland was hit by an exceptionally deep recession where the unemployment rate rose from 3% to 17% in three years as illustrated in Figure 1. While economic inequality changed little during this period, there is evidence that individuals who were hit hard by the recession had long-lasting income losses (Huttunen and Kellokumpu, 2016). Job losers

are also known to have suffered severe effects on their health in addition to earnings and employment losses (see Gathmann et al., 2020).

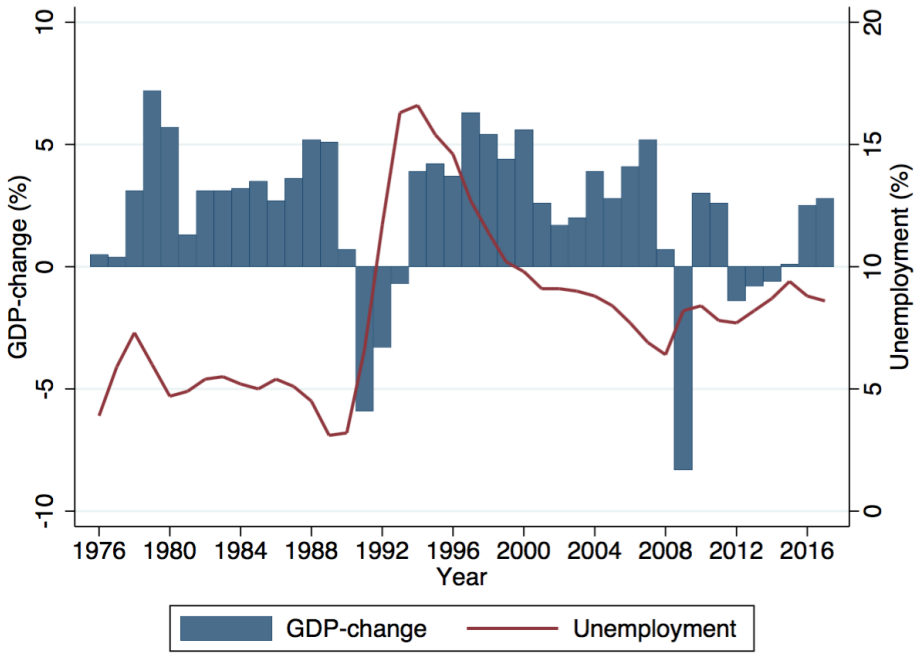

Figure 1 – Unemployment and GDP during Finland's Great Recession

Source: Statistics Finland

Finland has publicly-provided health care for all residents. In addition, all employers provide occupational health services to their employees under the Occupational Safety and Health Care Act. Quality differences between publicly-provided health care and occupational health care services are small. There is some evidence that waiting times for doctor appointments are lower in the occupational health care. However, complex procedures such as major operations are always performed in the public health care system for all patients (see Karanikolos, 2018, for a comprehensive survey of the Finnish health care system).

3 Data and methods

We use several administrative registers covering individual-level information on the entire Finnish population. The FOLK databases include information on demographic characteristics for all Finnish residents that are at least 1 year old at the end of the year, and cover

the 1988-2019 period. In addition to the FOLK databases, we use the Medical birth registry which includes births of all children born in Finland between 1987-2018.[1] The death records are obtained from Cause-of-death statistics databases, which cover all deaths that occurred in Finland between 1970-2018. The detailed individual-level causes of death are based on national classification (54 categories) and are available for the years 1988-2014. Following Currie et al. (2020), we group causes of death into several broad classes, such as neoplasm, circulatory and heart disease, accidents, dementia and deaths of despair (including suicides and alcohol-related deaths).[2]

Section 4 presents our main analysis. First, in part A we analyze how age-specific mortality inequality has evolved in Finland over the recent decades (1994–2015). We follow an empirical approach as in Currie and Schwandt (2016a) and Currie and Schwandt (2016b), and classify individuals into groups by their region's poverty level. Throughout our analysis we focus on the smallest regional-level in our data, municipality, which is also the smallest administrative-level in Finland.[3,4] Our analysis starts in 1993 since the income information, which is used for ranking the municipalities, is not available earlier.

We first aggregate the information at the municipality level and compute the population size and the number of deaths in each municipality. We then calculate a poverty index for each municipality and rank municipalities according to this index in each year.[5] The poverty index is calculated as the share of 20-60 year-old individuals whose taxable income (labor income and benefits) is below the poverty line. An individual earns below the poverty line if their income is below 60 percent of the median national income in a given year. All municipalities are ranked according to the poverty index and divided into poverty ventiles, each

[1]Since the FOLK data does not have information on children under 1 year old, we compute infant mortality rates using the mother–child links from child–parent link files available until 2016.

[2]Our definition of deaths of despair differs from the definition used in other studies (e.g. Currie et al., 2020) since it does not include deaths by substance abuse. In our data, deaths by substance abuse are classified under "deaths by poisoning". This category also includes deaths by accidental poisoning, which are not related to deaths of despair. Given the small number of deaths by poisoning, results are qualitatively unaffected by a change in this definition.

[3]In 2016 Finland had 313 municipalities. The mean population size of the municipalities was 17,582 while the median size was 6,137.

[4]We did the analysis also at sub-region level. This had very little effect on the results. There are 70 sub-regions in Finland.

[5]There has been little shuffling of areas from poor to richer quantiles during the time period. As a robustness check, we also used a fixed year for ranking, 2016. This had very little effect on results.

corresponding to about 5 percent of the population (all individuals in a given municipality are in the same quantile).[6]

Next, for each ventile, and separately by gender, we calculate mortality rates per 1,000 individuals for six different age groups: 0-4, 5-19, 20-49, 50-64, 65-79, and over 80 years old, for years 1994, 2005, and 2015. For each of these base years, we average the one-year mortality rates over three consecutive years centered at the given base year.[7] To have comparable groups over time, we age-adjust gender-specific mortality rates using the 2015 population shares (using five-year age intervals).

Table 1 – Characteristics of the municipalities by poverty ventiles in 2015

Poverty ventile	Population (thousands)	Share of the population	Poverty rate	Median income (2015 EUR)
1	133.2	4.63	18.95	32,405
2	144.2	5.01	21.59	30,842
3	153.2	5.32	23.20	30,111
4	130.2	4.53	24.73	29,303
5	176.7	6.14	25.54	28,686
6	106.7	3.71	26.40	28,104
7	138.3	4.81	27.24	27,747
8	151.2	5.25	27.62	32,300
9	153.0	5.32	28.29	27,395
10	150.8	5.24	29.28	26,880
11	144.8	5.03	30.40	26,137
12	129.8	4.51	31.67	25,708
13	163.5	5.68	32.70	25,579
14	188.8	6.56	33.36	27,900
15	188.8	6.56	33.36	27,900
16	84.4	2.93	33.61	24,815
17	171.1	5.95	35.25	23,997
18	131.0	4.55	36.96	24,700
19	89.3	3.10	37.91	23,019
20	148.4	5.16	39.98	22,475

Notes: Since in 2015 the Helsinki municipality accounts for about 13% of the population, it has been split into two parts with equal mortality and poverty rates.

Table 1 shows the summary statistics for the poverty ventiles in 2015. The first ventile in the poverty distribution is characterized by a poverty rate of 18.95 percent and median income of 32,405, while the 20th ventile has a poverty rate of 40 percent and median income

[6]Since the population of Helsinki exceeds 5% of the total population, it is represented by two (identical) ventiles. Both have the same mortality rate and belong to in contiguous poverty ventiles.

[7]For instance, the mortality rate of a given age group in 1994 is calculated as the average of the 1-year mortality rates over the 1993-1995 period.

equal to around 22,500.

Next, in Part B we shift our focus from overall mortality to specific causes of death. We aim to understand to what extent certain causes of death are driving the differences in age-specific mortality rates across areas and time. For each age group, we focus on the two leading causes of death, and analyze how the cause-specific mortality has evolved from 1994 until 2013.[8] We also investigate trends in inequality in mortality for the leading causes of death by age groups.

Finally, in Section 5 we study the mortality rates of individuals entering the labor market during the early 1990's deep recession. To this aim, we restrict the analysis to more narrowly defined cohorts, and follow their mortality rates over time. To avoid mixing cohort and time effects, we compare two different age groups and their inequality in recession and boom times. Our aim is to analyze whether those who entered the labor market during the deep recession suffer long-lasting consequences on their health, and whether this could be partly reflected in persistent mortality inequality among middle-aged males.

4 Results

4.1 Part A: All-cause mortality inequality

Figure 2 reports results for all-cause mortality using the poverty index. For each age group, the mortality rates are measured on the y-axis, while the x-axis shows the poverty ventiles. If there were no inequality in mortality, the mortality rates would be similar across poverty ventiles. In the case of positive correlation between health and income, the lines should be upward sloping, indicating higher mortality rates for individuals living in the poorer areas. Table 2 reports the estimates of the intercepts and slopes of the lines in the Figure 2, along with standard errors and p-values for significance of change in slopes between periods.

Figure 2 shows a clear decrease in early-life mortality from 1994 until 2015. In the first period, 1994, the mortality rates in age group 0-4 were higher in the poorer areas, especially for females. Over time, the level of early-life mortality and the inequality in mortality has

[8] We stop in 2013 since, as mentioned, the cause of death records are available only until 2014 and the mortality rates need to be averaged over three consecutive years.

decreased for both genders. In the last period, 2015, there is no difference in mortality rates across municipalities in the youngest age group (0-4 year-olds). The changes in inequality in early-life mortality are however not statistically significant, as shown in Table 2.

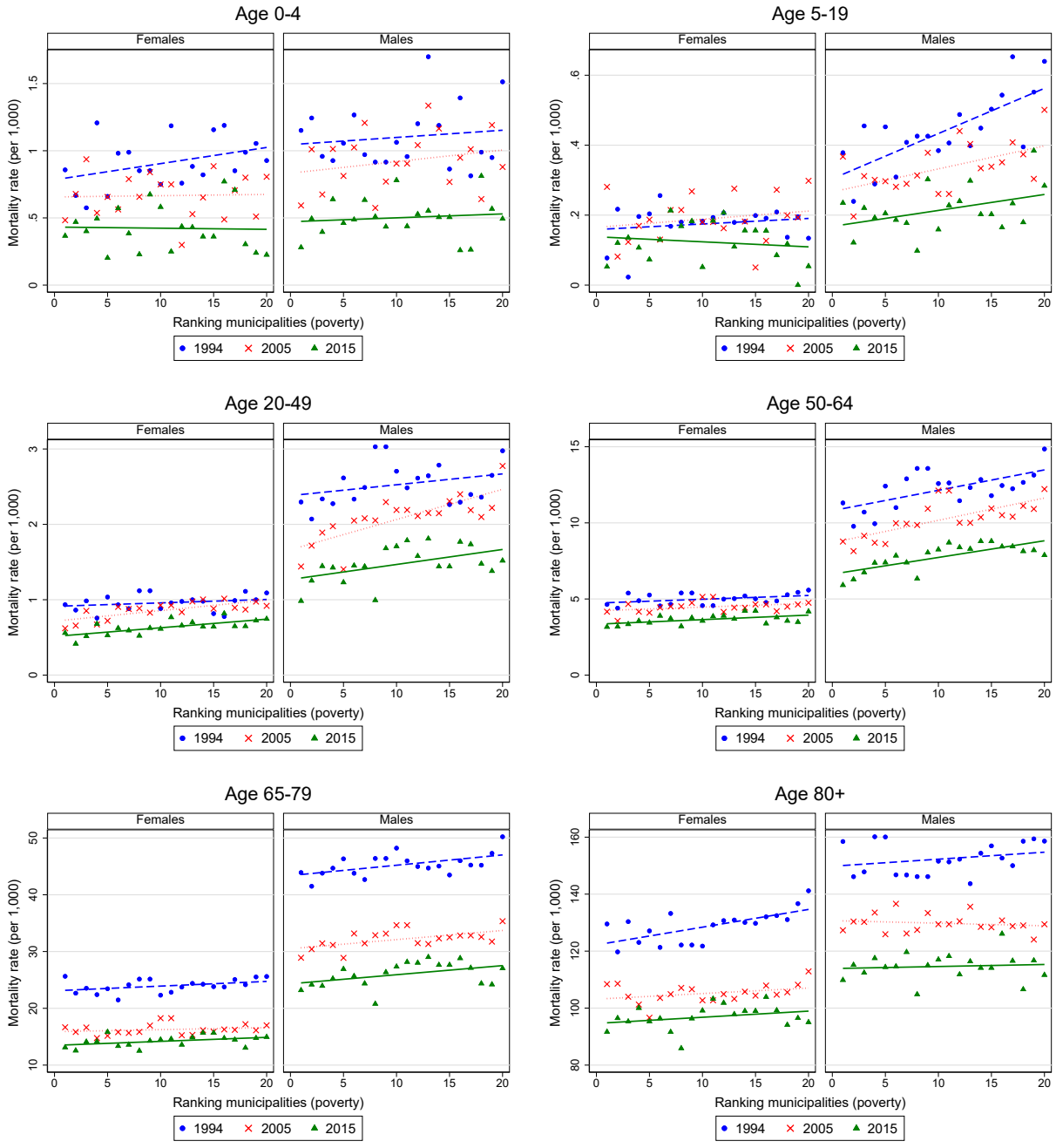

Figure 2 – Mortality rates by poverty ventiles across age groups and gender

Notes: Average 1-year mortality rates plotted across poverty ventiles. Each bin represents a group of municipalities with about 5% of the overall population in the given year.

Table 2 – Age-specific mortality in least poor and poorest areas and change in inequality

	Least poor areas			Poorest areas			Slope of regression line			P-value	
	1994	2005	2015	1994	2005	2015	1994	2005	2015	Δ^{2005}_{1994}	Δ^{2015}_{2005}
Panel A: Men											
0-4	1.151	0.593	0.280	1.513	0.879	0.493	0.005 (0.009)	0.009 (0.008)	0.003 (0.006)	0.788	0.574
5-19	0.378	0.367	0.235	0.640	0.501	0284	0.013*** (0.003)	0.007** (0.003)	0.005* (0.003)	0.146	0.590
20-49	2.297	1.441	0.984	2.976	2.775	1.518	0.014 (0.009)	0.040*** (0.009)	0.020** (0.008)	0.050	0.087
50-64	11.308	8.772	5.911	14.851	12.222	7.876	0.134*** (0.037)	0.147*** (0.022)	0.110*** (0.024)	0.772	0.260
65-79	43.911	28.912	23.181	50.219	35.344	27.043	0.182** (0.069)	0.161*** (0.052)	0160** (0.068)	0.808	0.995
80+	158.470	127.316	109.850	158.611	129.422	111.624	0.246 (0.229)	-0.091 (0.114)	0.072 (0.178)	0.189	0.443
Panel B: Women											
0-4	0.858	0.483	0.367	0.927	0.806	0.225	0.012* (0.007)	<0.001 (0.006)	<-0.001 (0.006)	0.216	0.842
5-19	0.078	0.281	0.053	0.134	0.298	0.054	0.002 (0.003)	0.002 (0.003)	-0.001 (0.002)	0.853	0.321
20-49	0.934	0.621	0.559	1.091	0.919	0.745	0.005 (0.004)	0.014*** (0.003)	0.011*** (0.003)	0.063	0.559
50-64	4.641	4.165	3.165	5.584	4.753	4.178	0.025* (0.013)	0.024* (0.012)	0.030** (0.011)	0.969	0.737
65-79	25.639	16.658	13.112	25.604	17.002	14.951	0.083* (0.047)	0.036 (0.025)	0.071* (0.034)	0.384	0.415
80+	129.535	108.426	91.667	141.179	112.891	95.043	0.622*** (0.184)	0.195 (0.157)	0.216 (0.131)	0.078	0.921

Notes: Columns (1)-(3) and (4)-(6) report the means of the smoothed mortality rates (adjusted for 2015 gender-specific age structure) by age group, gender and year, in the first and last ventile of the national poverty distribution, respectively. Columns (7)-(9) report the slope of a mortality-poverty linear regression in correspondence of each year and age-by-gender cell. Columns (11) and (12) show the p-values for the equality of the slopes in 2005 vs. 1994 and 2015 vs. 2005, respectively. *, ** and *** denote significance at the 10%, 5% and 1% levels.

Among the 5-19-year-olds, the patterns differ between boys and girls. We find no inequality in mortality for girls, while for boys the mortality rates are higher in poorer areas (as indicated by the upward-sloped lines). The mortality rates for boys were much higher than those for girls in 1994, but there has been a clear decrease in mortality rates for boys across all municipalities, and especially in poorer areas. As a consequence, the inequality in mortality for males in this age group has decreased over time, although the changes in inequality are not statistically significant (see Table 2).

The gender difference in mortality rates is visible among both the 20-49- and the 50-64-year-olds. Men have much higher mortality rates than women, and there is more inequality in male mortality across municipalities than in female mortality. For the 20-49 year-old

males, the inequality in mortality is highest in year 2005. For this age group, the inequality in mortality was significantly higher in 2005 than in 1994 or in 2015, as shown in Table 2. Interestingly, individuals who where 20-49 year olds in 2005, were young during the early 1990's deep recession. Thus the steeper inequality profiles in mortality for these cohorts may reflect that individuals entering labor market in recession were especially badly hit in poorer areas. In Section 5 we investigate this further and analyze how mortality rates for cohorts that entered labor market during the 1990's recession have developed over time.

For the age group 65-79 we still see a clear difference in mortality rates between genders, while the inequality in mortality is slightly less visible than in the middle-age groups. Overall, there is persistent inequality in male middle-age mortality, while on average the mortality rates for both genders have declined over time. The decline is however not statistically significant (see Table 2). Finally, for the oldest age groups (older than 80 years), there is a clear decrease in old age mortality rates across all areas for both genders. The mortality rates were higher in poorer areas (especially for females) in the first study period, 1994, while there is little difference in old-age mortality rates across areas in 2005 and 2015 for both men and women.[9]

Overall, the results indicate that there is little mortality inequality for groups other than the young and middle-aged males. For the middle-aged males, the inequality in mortality has been persistent over the study period. This is because mortality rates are persistently higher for individuals in poorer areas despite the overall decrease in mortality during the study period. Interestingly, we observe biggest inequality in mortality among the men who were young during the deep recession. This indicates that the scars of recession were especially bad for individuals entering labor market in poor areas during the deep recession. We return to this in Section 5.

4.2 Part B: Cause-specific mortality inequality

Are certain causes of death driving the differences in mortality rates across areas and over time showed in the previous section? To answer this question, we analyze the evolution of mortality by leading causes of death and age in Table 3 and in Figures 3 (under the

[9]For 80+ women the drop in inequality is statistically significant between 1994-2005 (see Table 2).

age of 50) and 4 (50 or older). Table 3 presents the mortality levels in the first and last decile of the poverty distribution (in 1994, 2005 and 2013, and by gender), the slopes of the mortality-inequality regressions, and the p-values of the equality of the slopes over time.

There is a clear decrease in mortality rates for all main causes of death, except for deaths of despair (for middle-aged men, and young and middle-aged women) and dementia (for older men and women). Figure 3 and Table 3 further show that inequality in mortality has decreased for the leading cause of death, "Other diseases", for females in the youngest age group (0-4 year olds). For males, the death rates of "Other diseases" is higher in poorer areas only in 2005, while in 1994 and 2015 the mortality rates are quite similar, or even higher, in richer areas. The differences in the slopes are clearly statistically significant, as shown in Table 3.

For the other leading cause of death for 0-4 age groups, "Congenital malformations", the death rates are slightly higher in poorer areas, but the slopes remain fairly stable over time. Overall, there is little inequality in mortality due to the leading causes of death for the youngest age group (0-4 years old).

However, for 5-19 year-old males, mortality due to accidents and deaths of despair (including alcohol-related deaths and suicides) is clearly higher in poorer areas in 1994 and 2005. The mortality rates for deaths of despair for males residing in poorer municipalities were especially high during the deep recession 1994. This again indicates, that the recession may have aggravated the health inequality among young individuals. The more recent period shows a much flatter profile, indicating no differences in mortality for this age group between individuals in poor and rich areas. Table 3 shows that the decrease in mortality by accidents for this group is statistically significant.

The picture for middle-aged males (20-49-year-olds) indicates strong inequality in the two most common causes of death (deaths of despair and deaths by accidents). Interestingly, there has been an increase in inequality in male mortality in both deaths of despair and death by accidents over time. This again may reflect scars of the recession: those who were 20-49 years old in 2005 and in 2015, were young during the deep recession of early 1990's.

Figure 4 shows the mortality rates for the age groups older than 50 years (also summarized in Table 3). For these groups the most common causes of death are neoplasm and circulatory

diseases, as well as deaths by dementia and Alzheimer for the oldest age group. The upper panel of the figure shows that there has been a clear decrease in male mortality for the two most common causes of death, neoplasm and circulatory diseases for 50-64 year-old males over the study period. The death rates for males are slightly higher in poorer areas, but the decline in mortality is fairly similar across all areas.

For the older age group, 65-79, there is no inequality in mortality for "Neoplasm", while deaths by circulatory diseases are more common in poorer areas for this age group. For the oldest age group, 80+, there are hardly any differences in death rates for circulatory diseases across areas for males, while for women the death rates were higher in poorer areas in the early 1990's. Interestingly, the death rates for dementia and Alzheimer have increased over time for both males and females. This increase is more pronounced in poorer areas. Table 3 shows that this the increase in inequality in mortality due to dementia for males over the last decade (2005-2015) is clearly statistically significant.

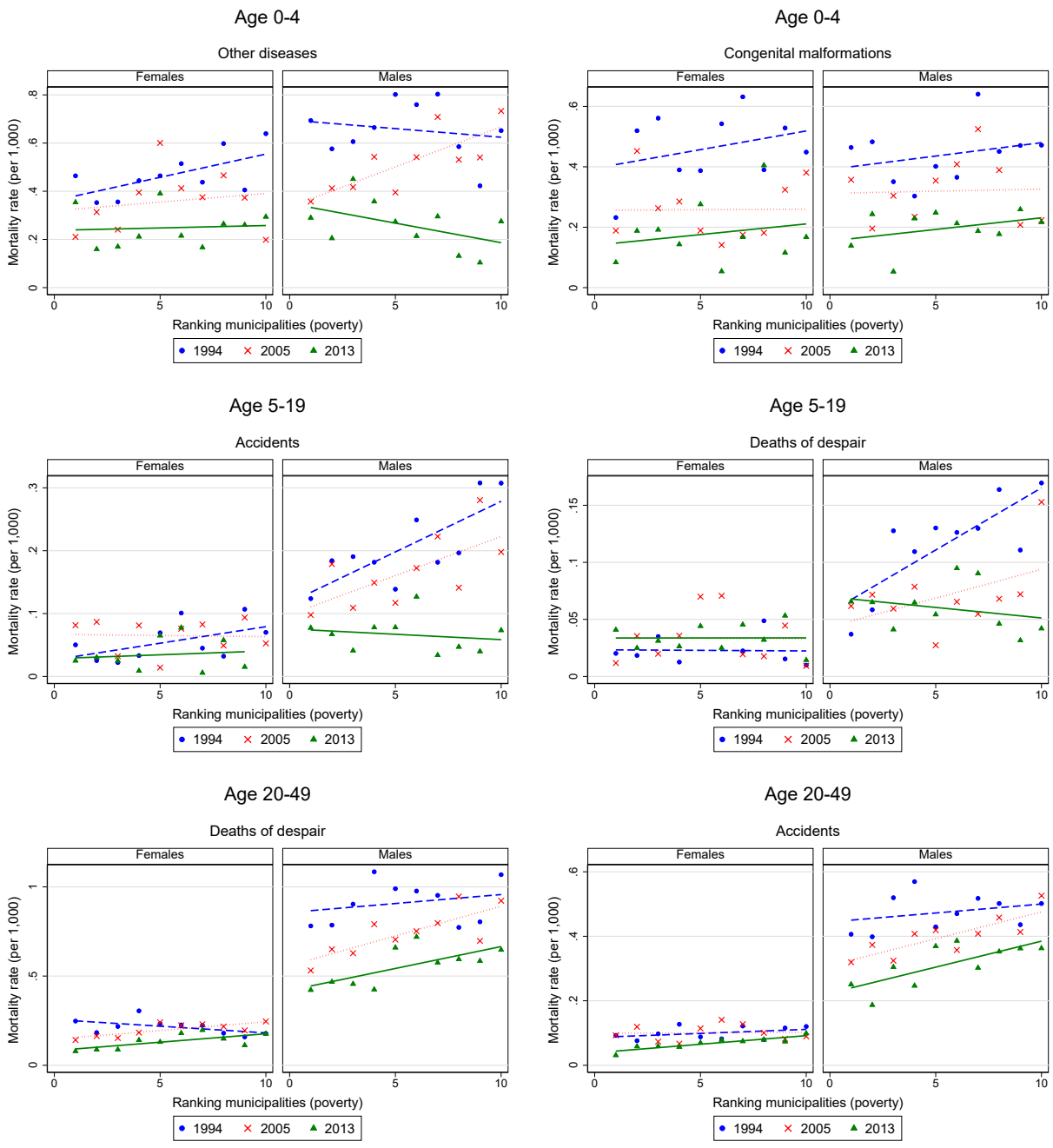

Figure 3 – Mortality rates for two leading causes of death (age groups under 50)

Notes: Average 1-year mortality rates plotted across poverty deciles. Each bin represents a group of municipalities with about 10% of the overall population in the given year.

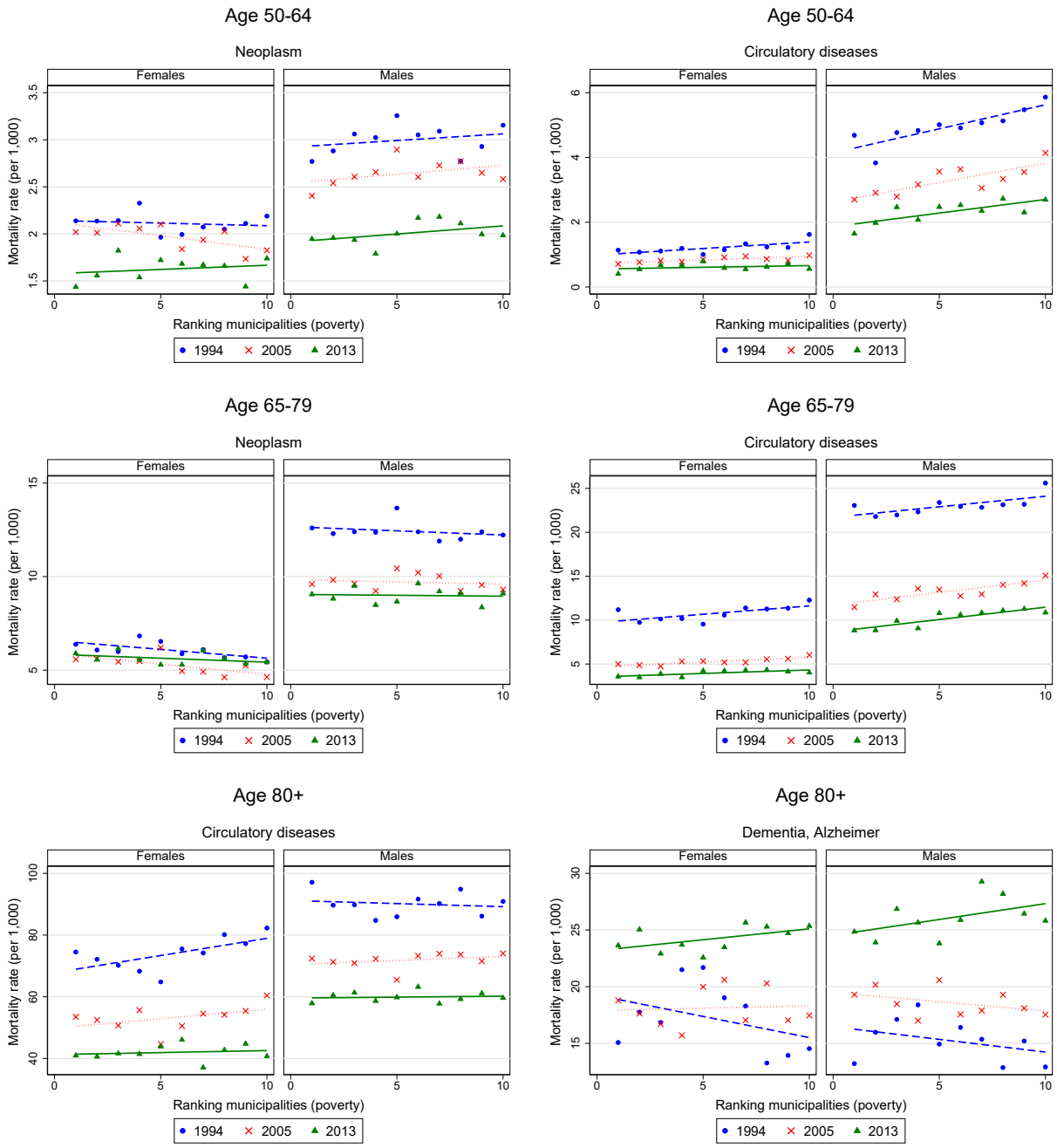

Figure 4 – Mortality rates for two leading causes of death (age groups above 50)

Notes: Average 1-year mortality rates plotted across poverty deciles. Each bin represents a group of municipalities with about 10% of the overall population in the given year.

Table 3 – Age-specific mortality by two most common causes of death in least poor and poorest areas and change in inequality over time

	Least poor areas			Poorest areas			Slope of regression line			P-value	
	1994	2005	2013	1994	2005	2013	1994	2005	2013	Δ^{2005}_{1994}	Δ^{2013}_{2005}
Panel A: Men											
Age 0-4											
Other diseases	0.693	0.357	0.290	0.652	0.733	0.275	-0.007 (0.012)	0.033*** (0.007)	-0.016 (0.011)	0.005	< 0.001
Congenital malformations	0.464	0.357	0.139	0.472	0.223	0.217	0.009 (0.007)	0.001 (0.012)	0.008 (0.006)	0.588	0.632
Age 5-19											
Accidents	0.124	0.098	0.077	0.307	0.198	0.073	0.016*** (0.004)	0.012** (0.005)	-0.002 (0.002)	0.566	0.010
Deaths of despair	0.037	0.062	0.066	0.170	0.153	0.042	0.011*** (0.003)	0.005 (0.004)	-0.002 (0.002)	0.257	0.109
Age 20-49											
Deaths of despair	0.781	0.531	0.422	1.068	0.922	0.647	0.010 (0.014)	0.033*** (0.010)	0.025*** (0.004)	0.168	0.417
Accidents	0.406	0.320	0.251	0.502	0.526	0.363	0.006 (0.006)	0.017*** (0.004)	0.016*** (0.004)	0.118	0.931
Age 50-64											
Neoplasms	2.770	2.405	1.946	3.155	2.582	1.984	0.014 (0.017)	0.019 (0.014)	0.017* (0.009)	0.832	0.925
Circulatory diseases	4.686	2.700	1.647	5.865	4.140	2.695	0.149*** (0.041)	0.121*** (0.025)	0.084** (0.028)	0.564	0.327
Age 65-79											
Neoplasm	12.600	9.595	9.054	12.224	9.307	9.099	-0.045* (0.023)	-0.025 (0.030)	-0.010 (0.038)	0.612	0.749
Circulatory diseases	23.058	11.470	8.819	25.604	15.071	10.860	0.240* (0.123)	0.284*** (0.059)	0.280*** (0.048)	0.749	0.962
Age 80+											
Circulatory diseases	97.115	72.393	57.871	90.913	74.043	59.596	-0.201 (0.472)	0.261 (0.151)	0.063 (0.152)	0.352	0.357
Dementia, Alzheimer	13.207	19.295	24.846	12.912	17.533	25.822	-0.224 (0.226)	-0.161* (0.078)	0.280* (0.144)	0.794	0.007

Continues on next page

Notes: Columns (1)-(3) and (4)-(6) report the means of the smoothed mortality rates (per 1,000 individuals, adjusted for 2013 gender-specific age structure) by two most common age-specific causes of death, gender and year, in the first and last decile of the national poverty distribution, respectively. Columns (7)-(9) report the slope of a mortality-poverty linear regression in correspondence of each year-, cause of death- and age-by-gender cell. Columns (11) and (12) show the p-values for the equality of the slopes in 2005 vs. 1994 and 2013 vs. 2005, respectively. *, ** and *** denote significance at the 10%, 5% and 1% levels.

Table 3 – continued from previous page

	Least poor areas			Poorest areas			Slope of regression line			P-value	
	1994	2005	2013	1994	2005	2013	1994	2005	2013	Δ^{2005}_{1994}	Δ^{2013}_{2005}
Panel B: Women											
Age 0-4											
Other diseases	0.464	0.211	0.354	0.639	0.199	0.294	0.019 (0.010)	0.007 (0.015)	0.002 (0.009)	0.501	0.761
Congenital malformations	0.232	0.189	0.083	0.449	0.381	0.167	0.012 (0.014)	<0.001 (0.013)	0.007 (0.010)	0.535	0.683
Age 5-19											
Accidents	0.050	0.081	0.025	0.070	0.053	0.015	0.005* (0.003)	<-0.001 (0.002)	0.001 (0.003)	0.117	0.660
Deaths of despair	0.020	0.012	0.041	0.010	0.009	0.014	<-0.001 (0.001)	<-0.001 (0.002)	<0.001 (0.002)	0.999	0.967
Age 20-49											
Deaths of despair	0.248	0.142	0.079	0.178	0.246	0.176	-0.007* (0.004)	0.010*** (0.002)	0.009*** (0.003)	<0.001	0.955
Accidents	0.092	0.093	0.031	0.120	0.090	0.099	0.003 (0.002)	<0.001 (0.002)	0.005*** (0.001)	0.395	0.035
Age 50-64											
Neoplasm	2.139	2.019	1.436	2.189	1.836	1.739	-0.006 (0.008)	-0.029** (0.010)	0.009 (0.016)	0.069	0.052
Circulatory diseases	1.138	0.710	0.403	1.623	0.976	0.558	0.040** (0.017)	0.022*** (0.006)	0.011 (0.013)	0.313	0.437
Age 65-79											
Neoplasm	6.381	5.582	5.893	5.445	4.630	5.422	-0.094*** (0.027)	-0.111*** (0.027)	-0.042* (0.022)	0.660	0.052
Circulatory diseases	11.187	5.000	3.573	12.274	6.024	4.020	0.191* (0.091)	0.108*** (0.024)	0.080** (0.024)	0.379	0.405
Age 80+											
Circulatory diseases	74.503	53.490	40.939	82.276	60.421	40.711	1.112** (0.440)	0.619 (0.350)	0.131 (0.199)	0.381	0.226
Dementia, Alzheimer	15.071	18.784	23.638	14.533	17.460	25.357	-0.374 (0.295)	0.040 (0.138)	0.192* (0.086)	0.206	0.350

Notes: Columns (1)-(3) and (4)-(6) report the means of the smoothed mortality rates (per 1,000 individuals, adjusted for 2013 gender-specific age structure) by two most common age-specific causes of death, gender and year, in the first and last decile of the national poverty distribution, respectively. Columns (7)-(9) report the slope of a mortality-poverty linear regression in correspondence of each year-, cause of death- and age-by-gender cell. Columns (11) and (12) show the p-values for the equality of the slopes in 2005 vs. 1994 and 2013 vs. 2005, respectively. *, ** and *** denote significance at the 10%, 5% and 1% levels.

5 Discussion: Recession cohorts

The results reported in Part A and Part B indicate clear inequalities in mortality rates for individuals who were young during the exceptionally deep recession that hit Finland in the early 1990's. Mortality rates among the young, the age group 5-19, were clearly highest and more unequal during the deep recession (1994). Similarly, mortality among 20-49 year-old

males in 2005 (who were young during the downturn) is more unequal in 2005 than in any other year during the study period. The results may thus reflect that the deep economic downturn may have had lasting health effects on young individuals entering labor market, especially in poorer areas.

This motivates us to take a closer look at the cohorts that were young during the 1990's recession. The upper panel of Figure 5 and Table 4 show the mortality rates for males by areas for two different cohorts: those that were 18-29-years-old during the early 1990's recession (recession cohorts), and those that were 18-29 in 2005 (boom cohorts). These two cohorts (blue lines) are then followed 5 and 10 years later (red and green, respectively). The mortality rates of the recession cohort are higher in level compared to those of the boom cohort. Over time, the mortality rates increase as the cohorts get older, but this increase is disproportionately larger for the recession cohort. For the recession cohort, there is also a clear and statistically significant increase in inequality by the period 3, when the cohorts are 30-41 years old (last column of Table 4).

These results may reflect the fact that the cohort that graduated during the recession suffered long-lasting health consequences, in addition to the earnings and employment losses that have been previously documented (see Päällysaho 2017 for Finnish evidence, and Oreopoulos et al. 2012 for evidence for the US).

Of course, the difference in mortality between these cohorts may reflect an overall decrease in mortality over time. To further investigate this, we repeat the exercise for slightly older cohorts: those who were 36-47 in 1994 (middle-aged in recession) and in 2005 (middle-aged in boom). The lower panel of Figure 5 and the second half of Panel A of Table 4 show that for these older male cohorts, mortality increases as the cohorts age. There is some evidence that inequality in mortality increased between the first two periods (1994 and 2005). However, the increase in inequality is similar to those who were middle-aged during the recession time and those that were middle-aged during the boom time. Thus, the clear difference in mortality patterns across areas that existed between the cohorts that were young in recession and young in boom does hold for these older age groups[10]. Hence, the differences in mortality

[10]The cohort that was 36-47 years old (middle-aged) in boom may have also been affected by the deep recession, as they were were 25-36 in 1994.

patterns that we saw in the upper panel of Figure 5 are unlikely to be driven by differences in the time when mortality is measured.

Figure 6 and the bottom panel of Table 4 repeat the exercise for women. Women's mortality rates are much lower than men's. The upper panel of Figure 6 shows that the cohorts that were young during the recession (those 18-29 years old in 1994) have much higher mortality rates when they are 30-41 years old, as compared to the cohorts that were young during the boom (the 18-29 year-olds in 2005). Again, this can reflect the scars of recession. The figure also shows that the inequality in mortality increases considerably over time for the cohort of women that were young during the deep recession. As for males, the inequality in mortality increases significantly for these cohorts by the time they are 30-41 years old (last column of Table 4). Hence, even if in the overall 1994-2015 study period most of the inequality in mortality is observed for males, Figure 6 shows that inequality in mortality is also observed among women who were hit by the deep recession.

The lower panel shows the results for older women in the same time periods (women who were 36-47 years old in 1994 and 2005). As with males, the differences between these age groups in recession and boom periods are less striking than for the groups that were younger during the recession. This suggests that we may interpret the differences between cohorts as shows in the upper panel of Figure 6 as evidence that recessions can have long-lasting health effects on young individuals.

Overall, the results for both genders are in line with the recent paper by Schwandt and von Wachter (2020), which shows that adverse initial labor market conditions raise long-term mortality.

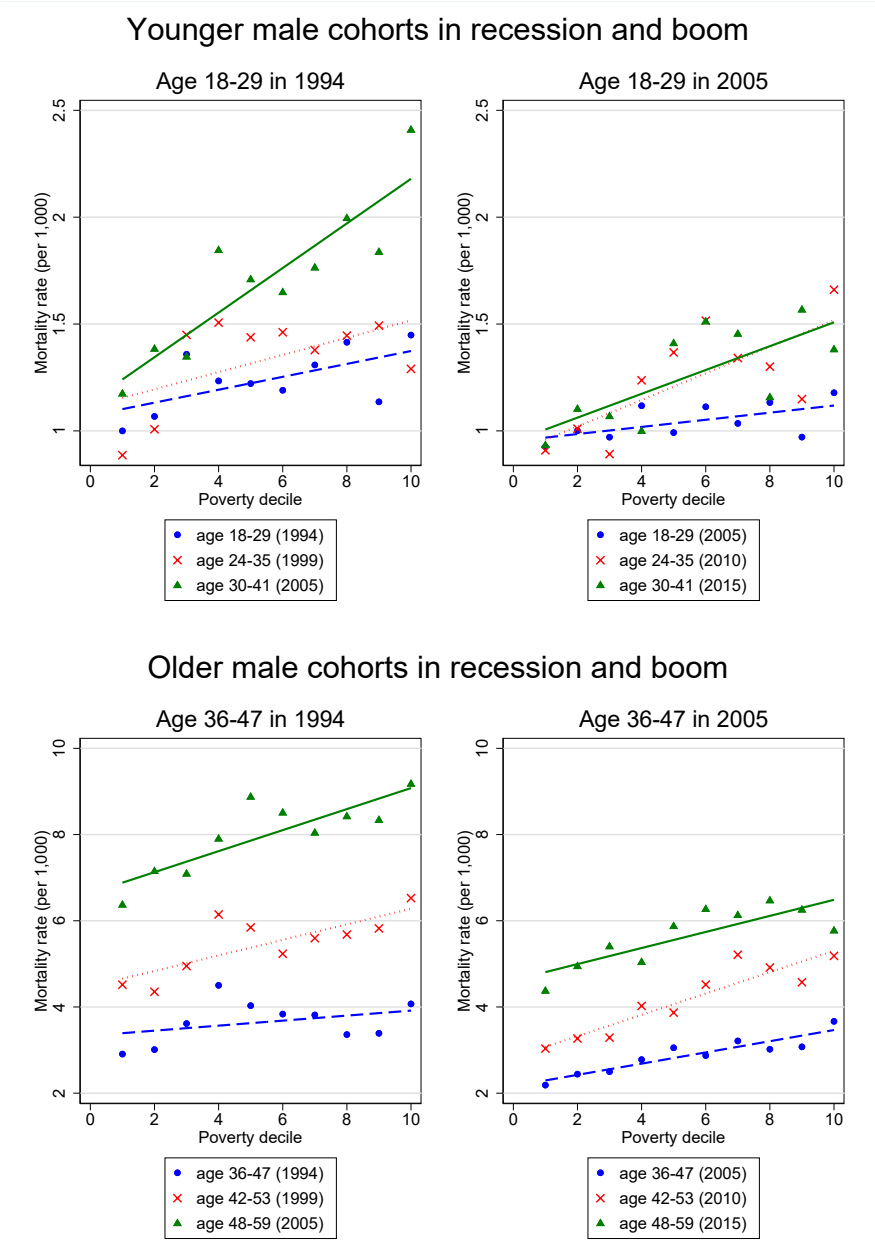

Figure 5 – Mortality rates for Males in recession (left) and boom cohorts (right)

Notes: Average 1-year mortality rates plotted across poverty deciles. Each bin represents a group of municipalities with about 10% of the overall population in the given year.

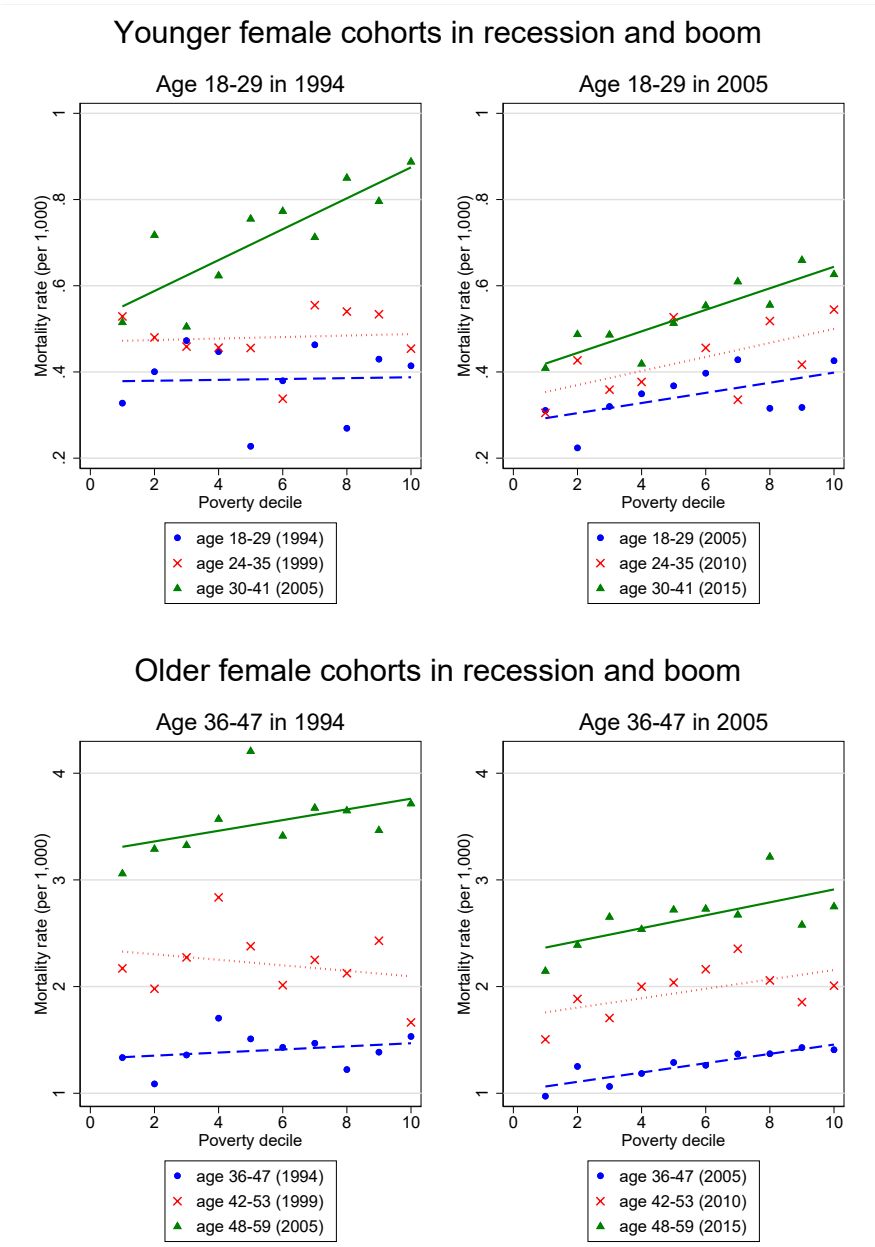

Figure 6 – Mortality rates for Females in recession (left) and boom cohorts (right)

Notes: Average 1-year mortality rates plotted across poverty deciles. Each bin represents a group of municipalities with about 10% of the overall population in the given year.

Table 4 – Mortality over time for cohorts aged 18-29 and 36-47 in boom and recession

	Least poor areas			Poorest areas			Slope of regression line			P-value	
	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3	Period 1	Period 2	Period 3	$\Delta_{t_1}^{t_2}$	$\Delta_{t_2}^{t_3}$
Panel A: Men											
Cohorts aged 18-29 in boom and recession											
Recession	1.000	0.886	1.173	1.448	1.290	2.407	0.030^{*} (0.015)	0.040 (0.025)	0.104^{***} (0.020)	0.727	0.045
Boom	0.926	0.909	0.931	1.178	1.661	1.380	0.017^{*} (0.008)	0.062^{**} (0.019)	0.056^{***} (0.014)	0.029	0.789
Cohorts aged 36-47 in boom and recession											
Recession	2.908	4.517	6.364	4.072	6.526	9.168	0.058 (0.050)	0.180^{***} (0.038)	0.244^{***} (0.043)	0.054	0.271
Boom	2.187	3.035	4.367	3.666	5.185	5.776	0130^{***} (0.020)	0.248^{***} (0.030)	0.186^{***} (0.054)	0.001	0.325
Panel B: Women											
Cohorts aged 18-29 in boom and recession											
Recession	0.328	0.529	0.515	0.414	0.454	0.887	0.001 (0.007)	0.002 (0.005)	0.036^{***} (0.008)	0.933	< 0.001
Boom	0.311	0.305	0.409	0.426	0.545	0.626	0.012^{*} (0.006)	0.016^{**} (0.007)	0.025^{***} (0.004)	0.611	0.256
Cohorts aged 36-47 in boom and recession											
Recession	1.335	2.171	3.058	1.532	1.664	3.714	0.015 (0.017)	-0.026 (0.037)	0.050^{**} (0.021)	0.323	0.076
Boom	0.973	1.505	2.145	1.408	2.009	2.749	0.044^{***} (0.010)	0.044^{*} (0.024)	0.061^{**} (0.026)	0.986	0.642

Notes: Smoothed, age-adjusted mortality rates by gender and cohort, in the first and last decile of the national poverty distribution. Recession cohorts are aged 18-29 (younger cohorts) or 36-47 (older cohorts) in 1994. Boom cohorts are aged 18-29 or 36-47 in 2005. Each cohort is followed over two subsequent time periods (t_2 and t_3) when they are 24-35 and 30-41 (younger cohorts) and 42-53 and 48-59 (older cohorts). Columns (11) and (12) show the p-values for the equality of the slopes in t_2 vs. t_1 and t_3 vs. t_2. *, ** and *** denote significance at the 10%, 5% and 1% levels.

6 Conclusion

While several studies have documented a clear link between economic resources and health, we have relatively little comprehensive cross-country evidence on these patterns across different countries in the world. We investigate the level and trends in mortality inequality in Finland, a country that is characterized by low mortality rates, equal income distribution and a universal health care system. Our results on mortality patterns suggest that there is little inequality in mortality among children and older individuals. However, we find persistently higher mortality rates for young and middle-aged men in poorer areas. When focusing on the most common causes of death for these age groups (deaths of despair and deaths by accidents), we find that the mortality rates for these causes are more common in poorer municipalities.

Over time, mortality has declined in Finland. However, when zooming into cohorts that were young during the deep recession of the early 1990's, we find that individuals in these cohorts have consistently higher mortality rates over their life cycle. This is especially true for young people living in poorer areas during the recession. This is consistent with the fact that economic conditions at the start of one's working life can have long-lasting consequences.

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