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Income distribution and mortality in Sweden

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Abstract

Background: The hypothesis that a high income inequality on a societal level is associated with poor health outcomes has been both rejected and accepted in empirical studies. Whether the influence of economic circumstances on health operates at the individual level or societal level has important implications on policy and intervention alternatives. The objective of this study was to analyse the relationship between income inequality and mortality in Swedish municipalities and if the relationship varies depending on the mean income or on the time-lag between income inequality and mortality.
Methods: The study was based on register data on mean income and income inequality (Gini coefficients) from Statistics Sweden 1982 and 1998, aggregated on the municipality level. Data on age-standardised death rates per 100,000 persons were obtained for 1983, 1988, 1993, 1998 and 2002. The analysis on 1998 was a test of the robustness of the results.
Results: The relationship between high income inequality in 1982 and mortality in 1983 was negative with a similar relationship in 1998. Using latency periods, the results show a decreasing trend of mortality in relation to higher Gini coefficients. A positive relationship between Gini and mean income implies that municipalities with larger income distribution also had a higher mean income and vice versa.
Conclusions: High income inequality does not have a negative effect on mortality in Swedish municipalities. The municipalities with high income inequality have also high mean income as opposed to many other countries. The income level seems to be more substantial for mortality than the income inequality.

Key words: income inequality, income level, mortality, Sweden

Introduction

Several empirical studies have shown a positive association between absolute income and health. Higher income is associated with positive health effects up to a certain income level but these effects subside thereafter [1-4]. However, the hypothesis that a high income inequality on a societal level is associated with poor health outcomes has been both rejected and accepted in empirical studies. Rodgers' study in 1979 was the first to bring attention to the issue of income inequality on a societal level, and its potential effects on health [5]. In fact the potential effects of income inequality on health did not attract much attention until Wilkinson published his studies in 1986 and 1992 respectively, in which he demonstrated that countries with more equitable income distribution had a lower mortality rate than those with inequitable income [6, 7]. Wilkinson's income inequality hypothesis demonstrates that not only the individual income, but also the income inequality on an aggregated level affects health. Empirical studies of a society's income distribution and its effects on public health have since given differing results [2, 8]. Judge et al performed a study in 1995 on the same material as Wilkinson but including more available data 1995 [9].They were however unable to verify Wilkinson's findings.

Reviews of studies on unequal income distribution in relation to health by Wagstaff (2000), Macinco (2002) and Lynch (2004) have each shown that income inequality seem to be associated with health in the United States. However, the authors indicated that the US results cannot be generalised to the rest of the world

with all its varying social structures [10-12]. In their review of 98 empirical studies, Lynch et al found 40 studies that indicated a relationship between unequal income distribution and increased ill-health, but 34 studies showed no relationship at all and 24 studies showed mixed results [12]. The studies that unequivocally point to an effect of income distribution on health are those that measured inequality on the state level in the United States [13,14]. Three European studies, two from the United Kingdom [15,16] and an Italian study by de Vogli et al [17] support the relationship between unequal income distribution and ill-health. De Vogli et al analysed the association between income inequality and life expectancy in 21 different countries and between different regions in Italy [17] and found that unequal income distribution had an independent effect on lower life expectancy both in the international and the regional comparisons. The other European studies presented in recent years have not been able to confirm the American findings that income inequality is associated with health.

Later studies have also reported contrasting results, with findings of a relationship between unequal income distribution and good health. The first of these was a Canadian study published in 2003 by McLeod et al [18], a finding also reported in Craig et al in Scotland [19]. An American study in Chicago also pointed in the same direction [20]. Sweden is a welfare state with relatively low income inequality compared with many other countries. Sweden has a progressive taxation system - a policy to counteract unequal income distribution. In spite of this, studies of whether the influence of economic circumstances on health operates at the individual level or societal level has important implications on policy and intervention alternatives. Given this background the question is whether income inequality in Sweden can affect health outcomes at societal level.

We sought to test this hypothesis by analysing the effect of unequal income distribution at municipality level on mortality using ecological data from 1982 to 2002. The objective of this study was to analyse the relationship between income inequality and mortality in Swedish municipalities and to see if the relationship varied depending on the mean income or on the time-lag between income inequality and mortality.

Method

The study was based on register data from Statistics Sweden from 1982 to 2002, aggregated on the municipality level. Data on income level (mean income) and income inequality (Gini coefficients) for the municipalities was obtained for 1982 and 1998, while data on mortality (death rates) were obtained for 1983, 1988, 1993, 1998 and 2002.

Data on income was available for the mean income and included earned income, state transfers (unemployment and social security benefits) and income from capital gains. The mean income in Sweden was SEK 60,600 (48,400 – 106,600 SEK), estimated € 5,400 (4,400-9,600€) in 1982 and SEK 173,200 (143,000 – 479,300 SEK), estimated € 15,600 (12,900-43,150€) in 1998. The individual incomes have been aggregated and the mean income has been calculated for each municipality. The calculations of the Gini coefficients were based on individual incomes for each municipality. The variation in the Gini coefficients between the municipalities ranged between 0.29 to 0.44 in 1982 and from 0.28 to 0.66 in 1998.

Mortality was based on age-standardised death rates per 100,000 persons. The death rates were obtained from the death register and age-standardised by Statistics Sweden in accordance with the age composition of the population in 2000.

The total number of municipalities in Sweden was 284 in 1982 and 289 in 1998. Corrections have been made for the variation in number during the follow-up period using a translation table provided by Statistics Sweden.

Data analyses

The SAS procedure CORR was used to obtain correlations and p-values for the Gini coefficients and subsequent age-standardized death-rates on municipality level [21].

The municipalities have been categorised according to their Gini coefficient in quartiles (Q1-Q4), where Q1 contains the municipalities with the lowest Gini. They have been categorised in the same way with regard to mean income, where Q1 contains the municipalities with the lowest mean income.

The death rate per 100,000 persons has been calculated separately for men and women in each municipality. Linear regression models have been used to analyse the effects of income inequality and mean income on mortality. The effects of income inequality and mean income in 1982 on the age-standardised death rate have been calculated with a latency period of 1, 6, 11, 16, and 20 years (1983, 1988, 1993, 1998 and 2002) [22,23]. To test the robustness of the result, data

on income inequality and mean income in 1998 was used. The effect on mortality has only been calculated for a latency period of 1 and 4 years respectively (1999 and 2002).

Results

Generally mortality decreased in Sweden between 1983 and 2002, however, there is considerable variation between the municipalities (Table 1).

Table 1. Nationally age-standardised death rate per 100 000 inhabitants as an average (lowest and highest death rate) for the municipalities. Gini coefficient at national level.

		Death rate for the municipalities		
	Gini	Total	Men	Women
1983	0.210	1332 (581–2528)	1619 (928–2528)	1045 (581–1929)
1988	0.221	1316 (671–2355)	1602 (1094-2355)	1030 (671–1500)
1993	0.257	1231 (548–2238)	1484 (767–2238)	978 (548–1478)
1998	0.280	1121 (591–2031)	1351 (897–2031)	890 (591–1345)
2002	0.258	1104 (573–1956)	1304 (786–1956)	905 (573–1289)

The death rates vary between municipalities. Figure 1 shows the relationship between mortality and the Gini coefficient in the municipalities. Excluding municipalities which were outliers did not alter these results. Figure 1 therefore shows all the results, including those from the outlier municipalities. The regression curve shows an association between lower Gini in 1982 and a higher death rate in 1983. This association was stronger for men ($r = -0.29$; p-value < 0.0001) than for women ($r = -0.19$; p-value $= 0.0016$). The correlation coefficient shows a negative relationship between Gini and mortality (Figure 1).

We found a stronger negative relationship between the Gini coefficient 1998 and mortality 1999 in the municipalities (Figure 2). Results in 1980s and 1990s showed a similarly strong association between less income inequality and high mortality rates, indicating robustness of the results.

A comparison between the regression curves in Figures 1 and 2 clearly shows that the relationship between less income inequality and higher mortality strengthened in the 1990s as compared to 1980s, especially for women. More municipalities had a lower death rate in 1999 than in 1983. At the same time, the outlier municipalities had larger Gini coefficients in 1998 than in 1982. The correlation coefficient between income inequality (1998) and mortality (1999) was -0.32; p-value < 0.0001) for men and -0.33; p-value < 0.0001) for women (Fig 2). All in all, the relationship between income inequality in 1998 and mortality in 1999 showed a much clearer trend than in 1982. Analyses excluding outlier municipalities showed a similar trend.

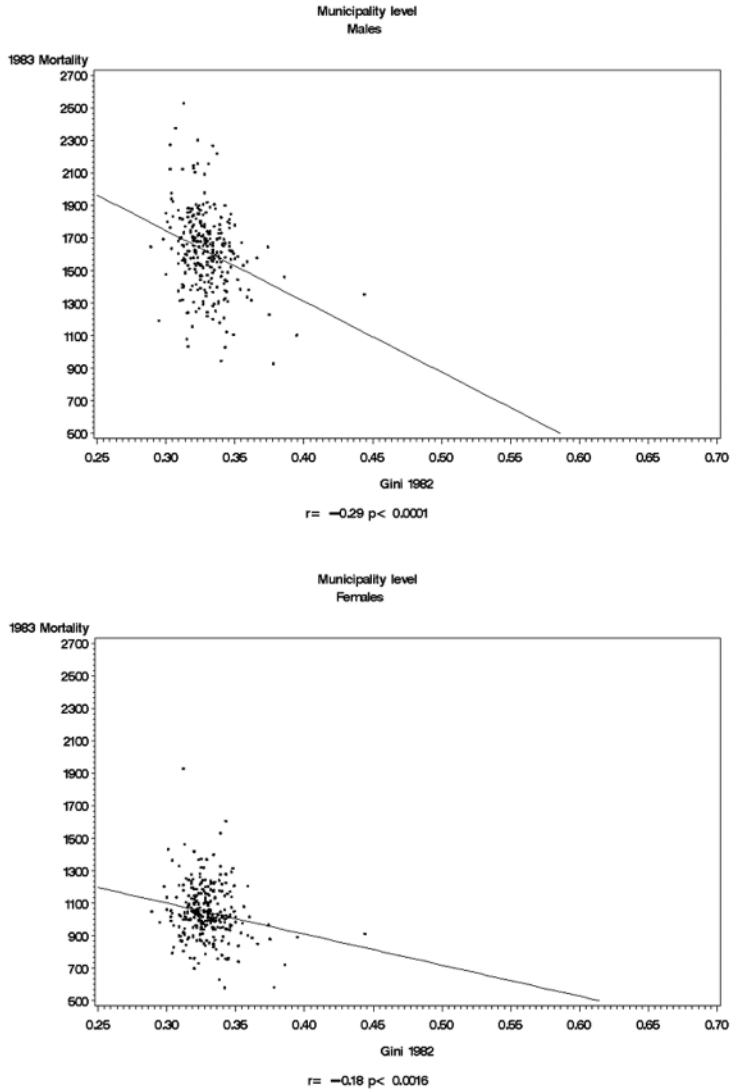
Further analyses based on categories of Gini-coefficient distributions (as quartiles) and mortality rates were done using latency periods of 1, 6, 11, 16 and 20 years (1983, 1988, 1993, 1998 and 2002), and are presented in Table 2.

The results show a decreasing trend of mortality in relation to higher Gini coefficients over these years. They also show a clear graded association between unequal income distribution and mortality. Death rate was highest in municipalities with the least income inequality and lowest in the municipalities with the greatest income inequality. This relationship was true for men and women for all years, i.e. regardless of the length of the latency period between the income inequality and mortality. Irrespective of the year, the death rate in the municipalities was higher among men than among women (Table 2).

According to Table 2, the greatest differences in death rates were between municipalities with the greatest and the least income distribution. A significance test of the differences in death rates between the municipalities with the greatest and least income distribution showed a p-value of <0.0005 with a latency period of 6, 16, and 20 years and a p-value of <0.05 with a latency period of 1 and 11 years respectively. The differences were also significant in the 1998 with a p-value of < 0.0005, showing the robustness of results not related to any particular periodic effect.

In the analyses of income inequality and mean income on the municipality level, we found a statistically significant positive relationship between the two. This implies that municipalities with larger income distribution also had a higher mean income and vice versa. For 1982, the correlation coefficient between income

Figure 1. The relationship between the Gini scores of Swedish municipalities in 1982 and the death rate (death per 100,000 persons) 1983 for men and women respectively.



inequality and mean income was 0.22 (p-value < 0.001) and this increased to 0.77 (p-value < 0.0001) for 1998. The stronger relationship in 1998 suggests that high-income municipalities also had greater income inequality to a larger extent than previously. Further, the mean income level of the municipalities was analysed in relation to Gini coefficients categorised into quartiles. It was evident that the highest mean income level was to be found in the municipalities that had the highest income inequality. In 1998, there was a clear gradient from low mean income and less income distribution to high mean income and large income distribution (not shown here).

We performed regression models and found that the relationship between Gini and mortality reported above was statistically significantly explained by mean income. However, the differences in death rates between municipalities with higher and lower Gini coefficients in 1982, remained statistically significant even after control for mean income. Similar findings were observed for latency periods of 6, 16 and 20 years. The death rate was highest in municipalities with a lowest mean income irrespective of income inequality.

Discussion

High income inequality was associated with lower mortality rates in Swedish municipalities. Municipalities with high income inequality also had high mean income level and vice versa. However, adjustment for mean income level only partially reduced the magnitude of the association between income inequality and mortality, but this association remained statistically significant. Irrespective of the degree of income inequality, mortality was lower in high mean income municipalities than in low mean income ones. Results were similar regardless of the length of latent period.

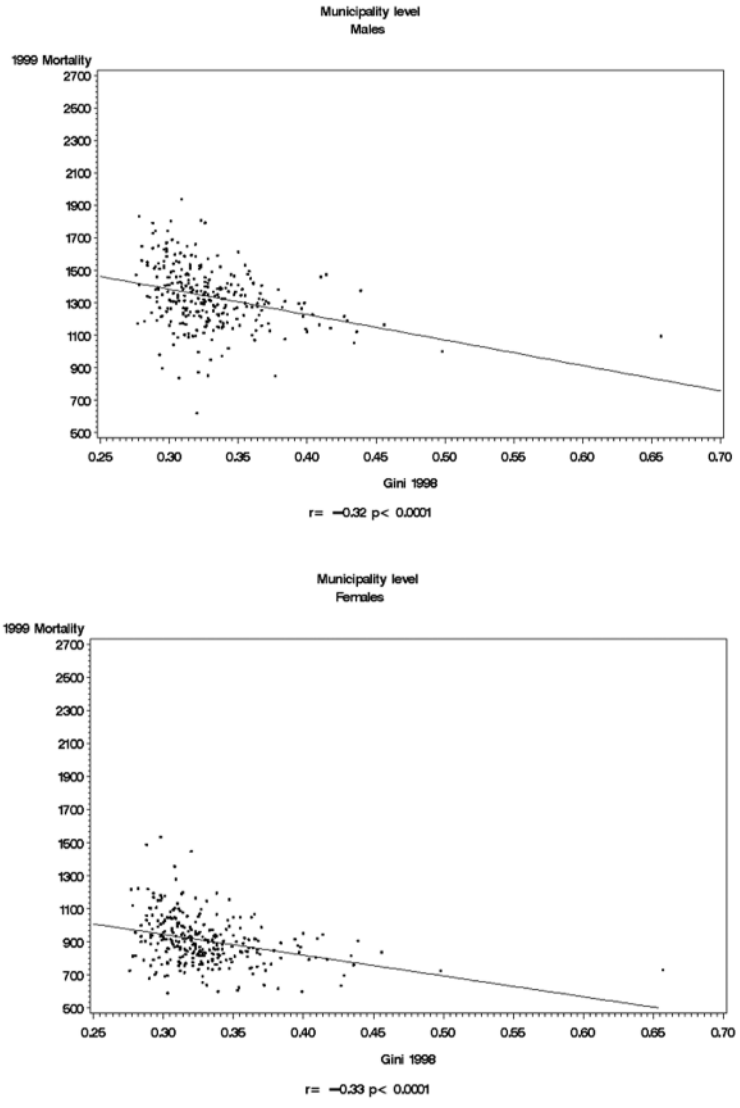
This finding is in contrast to the observations from many other countries whereby low-income earners dominate in areas where there is wide income distribution [19]. The results indicate that the relationship between mean income and income inequality contributes to the association between income inequality and mortality. Results in the present study were robust regardless of whether income inequality and mean income were measured in 1982 or 1998 and were independent of the length of the latency period.

A methodological concern is whether the size of the geographical area (in this case municipality level) is good enough to capture the effects of income distribution on health. Although generally Swedish municipalities are small (compared to US states) they can be considered large enough to be able to detect income inequality between the subordinated parish levels. The choice of municipality as the unit of analysis in the present study is due to the fact that it is the level at which administrative responsibility and political decisions take place, and where the nature and structure of both social and physical environment are clearly reflected.

Table 2. Death rate for men and women in municipalities broken down into Gini Q1-4 (Q1 = lowest Gini) with a latency period of 1, 6, 11, 16 and 20 years between the Gini and the death rate (per 100,000 persons).

	Death rate 1983, 1988, 1993, 1998, 2002									
	Latency period									
Gini 1982	1 year		6 year		11 year		16 year		20 year	
Quartile 1–4	Men	Wom	Men	Wom	Men	Wom	Men	Wom	Men	Wom
0,289–0,320	1681	1064	1642	1046	1526	1007	1408	911	1324	929
0,321–0,327	1637	1061	1643	1042	1484	999	1354	896	1346	915
0,328–0,337	1574	1036	1590	1040	1467	961	1336	865	1289	893
0,338–0,444	1520	974	1429	931	1412	892	1235	878	1189	842

Figure 2. The relationship between the Gini scores of Swedish municipalities in 1998 and the death rate (death per 100 000 persons) in 1999 for men and women respectively.



Another concern is that the measure of income (mean income) used in the present study is based on aggregated incomes at municipality level. In fact, the median income would have been preferred. However, variations in measures were tested in another dataset and found to differ only slightly implying that our results would have not been substantially altered by the type of measure in any significant direction.

A drawback of an ecologic study such as the present one is that it is not possible to account for individual-level factors. Explanations and the underlying causes behind the results could not be analysed and thus their importance could not be evaluated. In addition, other local conditions and the social and economic nature and structure of the area, such as, high unemployment rate, high percentage of low-educated people, high number of people on social security benefits and low social capital, can explain why municipalities with low income inequality have high mortality rates. Based on official statistics, for example the municipality with the greatest income inequality had the lowest proportion of unemployed, low-educated inhabitants and those on social benefits, but these proportions were much higher for municipality with the least income inequality.Thus it is not surprising to find that municipalities with the greatest income inequality have the highest and not the lowest mean income. However, the pathways to these results need further study.

There is support for our results in three previous studies, which have shown higher self-rated health in areas with wide income distribution.These findings were demonstrated in the metropolitan areas in Canada (2003),

neighbourhood areas in Chicago (2003) and municipalities in Scotland (2005) [18-20]. In the Canadian study, a neo-materialistic explanation (such as differences in access to healthcare, education, public transport) of the differences in results between counties was suggested [18]. The study of neighbourhoods in Chicago also included an evaluation of contextual factors in addition to the effects of individual factors on self-rated health [20]. The results showed that areas with greater income inequality had a positive effect on self-rated health, which could be explained by the area level of education. Education and income are two closely related measurements of socioeconomic position, which would suggest that the area socioeconomic differences may be reflected in income distribution.

In conclusion, in spite of the limitations associated with ecological studies, results from the present study demonstrate that high income inequality does not have a negative effect on mortality in Swedish municipalities and that mean income level seem to substantially contribute to this finding. Swedish municipalities with high income inequality have a high mean income level and not a low one as has previously been shown in other countries. The present study also shows that there is clearly a strong relationship between high mean income and low mortality independent of income inequality at municipality level, indicating that mean income may be more substantial for mortality than the income inequality in itself. Results of the present study need to be followed up by further in depth analyses using multilevel models to explore the contribution of both individual-level and contextual-level effects of income inequality on mortality and other health outcomes.

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