Do unequal societies cause death and disease?

A study of the health effects on elderly of inequality in Swedish municipalities, 2006

Sören Edvinsson, Center for Population Studies, Umeå University, Ageing and Living Conditions Programme (soren.edvinsson@ddb.umu.se)
Gunnar Malmberg, Department of Social and Economic Geography, Umeå University , Ageing and Living Conditions Programme (gunnar.malmberg@geography.umu.se)
Erling Lundevaller, Department of Statistics, Umeå University, Ageing and Living Conditions Programme (erling.lundevaller@ddb.umu.se)

Paper presented at the 36th annual meeting of the Social Science History Association, Boston 17-20 November 2011[1]

[1] Research in this report is performed within the research program *Ageing and Living Conditions* at the Centre for Population Studies, Ume°a University, Sweden, financed by the Swedish Research Council, project number 349-2008-6592.

Abstract:
A lively public and academic debate has highlighted the potential health risk of living in regions and nations characterized by inequality (Wilkinson and Pickett 2007; 2009). It is argued that inequality may add to increasing health differentials over the life course. However, previous research provides so far an ambiguous picture. One explanation could be that the effect of living in more heterogeneous social settings may differ between levels of aggregation. A hypothesis is that homogeneity is positive on the national or regional level, while on a lower level of aggregation living in homogeneous settings could be detrimental for health, at least in poor neighborhoods.
In this paper we present the preliminary results of our examination on how residence in unequal versus homogeneous areas is associated with health outcome of elderly people in Sweden. These first results are based on municipality level data on individuals born between 1932 and 1941 and the outcome is measured for the year 2006. Furthermore, we analyze the effect on health of income inequality (measured by Gini-coefficient) as compared to the effect of individual income and the average income level in the area. We analysed the associations both with individual-level and multi-level analysis. Our main finding is that inequality has an independent effect on mortality in the way that unequal municipalities have excessive deaths even after controlling for mean income level and personal income. This result was found not only in the individual-level analysis but also in the multilevel analysis.

Introduction

In this paper we examine how residence in areas with an unequal vs. equal income distribution is associated with health outcome (mortality and morbidity) of elderly people in Sweden. We identify the effect on health of income inequality (measured by Gini-coefficient) as compared to the effect of absolute (individual) income and the average income level in the area. We analyze impact on health of the elderly at municipality level in Sweden 2006 in relation to the impact of individual socio-economic conditions (i.e. income, education, family situation) as well as other socio-economic conditions in the area of residence (i.e. income level, education level). The main questions we set out to examine are:

Is it more risky to live in municipalities characterized by inequality, i.e. has income distribution an independent effect on health?
What is the effect of mean income level within the municipalities?
How does the effect of inequality on health interact with other socio-economic conditions on individual and contextual level?

At this occasion we present the first preliminary results from a planned larger study. Based on the findings of this study, we argue that economic inequality have an independent effect also at low geographical levels such as municipalities and that the effect can be found even in a society as Sweden that is considered to be comparatively equal in economic. These results are at odds with results of several previous studies, something that may lead us to reconsider some of the accepted assumptions in the international debate. We believe that an explanation to the positive results we find is that we have access to good and rich data. The study is performed on individual-level data and the complete Swedish population is included in the database we have used.

Background

Social and economic inequality are usually considered as one of the main or perhaps the main determinant for explaining health and mortality differences. Link and Phelan (1995) even argue that social class is a ”fundamental cause of death” in itself, meaning that differences related to social class can not be explained by specific characteristics connected to the position. If major harmful circumstances causing bad health in certain classes disappear, the differences would still prevail as the lower social position and its impact on health gets expressed in other ways. Consequently we expect social health inequalities in all societies throughout history, something that has been taken for granted by many researchers (Antonovsky 1967). Recent studies in the development of social health differences from a long-term perspective have however forced us to modify the preconceived image. In a recent article Bengtsson and van Poppel (2011) argue that ”… the association between income and mortality observed today most likely is a recent phenomenon. Overall, a causal link between income and mortality is put into question.” (p 343) It has not always been the case that higher social class have had any advantage. The relation between social class and health has taken very different forms in different times places and we need to consider the particular context and its implication for living conditions, behaviour and other central determinants for health.

Yet, there is ample evidence on social health inequalities in modern societies and results even indicate that differences are increasing (Kunst et al 2004). This might seem surprising since many of the major health problems are no longer apparent in the same way as before. Most European and American societies have reached a standard well above the level where major

health threats are present. The traditional explanations have focused on material aspects, such as access to food, good housing, living conditions, working environments, aspects that were decisive in earlier history.

The somewhat surprising findings of the existence of social health differences in present-day high-income countries have forced researchers to look into alternative explanations. One such factor is social capital, being important mainly in the form of a social network but could also be interpreted as a condition on society level (Putnam 2000), much in line with the traditional sociological theories of Durkheim and others on what constitutes a society. A society characterised by large social capital takes good care of its citizens. Social capital can also provide citizens a sense of belonging. In that way, psycho-social factors is introduced in the scientific debate, factors that have received increased attention during the last years. Another exponent for this is Michael Marmot (2004) who in his studies have analysed the psychologigal effects of being in a high or low status position respectively.

It is in this scientific context that the hypotheses of Wilkinson with colleagues are to be understood. A lively public and academic debate has highlighted the potential health risk of living in regions and nations characterized by inequality. Wilkinson and Pickett (2007; 2009) argue that inequality adds to increasing health differentials. And if this is the case, the consequences of growing inequality may be severe, not least for elderly people and for the future care burden on national, regional and local levels.

Theoretical framework

Previous research provides so far an ambiguous picture on the relation between social inequality and health. Wilkinson and Pickett (2007; 2009) claim that equality is favorable for health outcome, both for the poor and the rich (see also Karlsson et al 2010 for a recent cross-national study supporting the hypothesis). However, other investigations found no association between inequality and health or found that the effect only is an effect of better health returns for increases in income among those at the lower income levels (Mackenbach 2002; Gerdtham et al 2004; Henriksson et al 2006). In a meta-analysis consisting of nine cohort studies and 19 cross sectional, Kondo et al (2009) found a modest adverse effect of income inequality. Included in the analysis were geographical units at different levels as American states, parishes, municipalities. Most scholars assume that the connections are stronger at higher geographical levels. Furthermore, the association seems to be stronger in America than in Europe (Lynch et al 2004). The effects at different levels are still unresolved and open for discussion.

It is not obvious how inequality leads to mortality and health problems (for discussion on possible mechanisms, see Lynch et al 2004; Subramanian and Kawachi 2004; Wagstaff and van Doerslaer 2000). According to the absolute income hypothesis it is the individual's economic resources that affect health, since rich people to a larger extent have access to medicine and care as well as better possibilities for a healthy lifestyle. While in line with the theory of relative deprivation, it is the income relative to the average that influences well-being and health: Poverty is more easily endured among the poor than among the rich. Yet, another effect of income differential was demonstrated by Rodgers (1979), who in a seminal article claimed that the marginal effect on improved health is stronger for the less wealthy. Thus, by raising their economic conditions the general population health would gain the most. The curvilinear associaton between income and health has been demonstrated in several

studies (for example Mackenbach et al 2005 and Fritzell et al. 2004 for Sweden), thereby providing support for this hypothesis.

However, for Wilkinson and Pickett (2007; 2009; Pickett and Wilkinson 2009), the fundamental idea is that social inequality has an independent effect on health in the population other than the pure effects of economic and material conditions. The proponents for this theory emphasize psychosocial explanations. The pathway goes from equality to increased social cohesion and social capital and further to a general health improvement in the population. Alternatively, negative or positive health effect may just be the result of social comparisons when poor people compare their living conditions with those of the wealthy. However, in the literature there is a strong and weak version of the psychosocial effect. According to the strong version, rich as well as the poor gain from increased economic equality since it increases social cohesion and social capital. While in line with the weak version, equality is mainly beneficial for those with lower income and scarce economic resources, but also for the average health status in the population.

While the classic explanations for the mortality decline emphasize the effect of better economy, improved housing or building of infrastructures, the neomaterial approach points to the influence of equality and claims that egalitarian societies may invest more in the health and economy of all groups in society. Or as expressed by Lynch et al: “Rather, it may depend on the social distribution of other health-relevant resources and exposures in a country or region and on the direct socioeconomic support of the most disadvantaged.” (Lynch s 66)

Although the literature presents a large number of theories and empirical investigations on the relations between income distribution and health, few studies have been able to empirically identify in what ways income distribution actually affect health. A key issue for further research is to sort out the relative importance of different income effects on the individual health; i.e. the importance of the absolute individual and family income, the income relative to the average in the area of residence, the income level in the region and the income inequality in region, and also to analyse the outcome in different income groups.

Previous research supporting the Wilkinson-hypothesis is mainly based on cross-national analyses or on data from larger regions such as American states. By contrast, most studies on small units such as neighborhoods, parishes or local communities have not verified the hypothesis. Wilkinson and Pickett (2007) maintain that the weaker association found on a lower level of aggregation is an expected outcome since social forces at higher levels shape spatial income distribution and may mask the impact of inequality on health outcome.

But if the influence of equality on health is explained by psychosocial effects related to social comparison and relative social position, it is crucial to know with whom we compare ourselves and to examine if the mechanisms described also appear on sub-national levels. Since most people live the major part of their lives in the same region and spend most of their time within local labor market areas, we may hypothesize that social comparisons are often made on the regional level and that the psycho-social effects of living in a more or less equal regional could be as influential for the health outcome.

On a national level, different political systems, the national political discourse and forms of resource redistribution may influence the sense of belonging and coherence. But the regional or local political administrative context may also be relevant. Swedish municipalities represent administrative units with relatively strong autonomy to design their own policy and

people may be well aware of their social position on this level and through psychosocial mechanisms their well-being may be affected by the income distribution on the municipality level.

Yet, other mechanisms related to socio-economic inequality may affect the health outcome at the local level (Stjärne et al. 2006). Evidently, living in poor neighborhoods could have an additive effect on health outcome apart from the effect from being poor, whilst the theory of relative deprivation indicates a negative effect of being poor among the rich. Whatever the effect, it is important to consider also the impact of relative income position and the absolute income level in the residential area.

In the international comparisons by Wilkinson and Pickett, Sweden represents a country with low levels of inequality and high life expectancy, thus representing a positive verification of their hypothesis. Sweden, together with other Nordic countries, have among the lowest national Gini coefficients – around .25 - in the world (Human Development Report 2011, table 3). There are however large regional economic differences within Sweden, and potentially the effect of relative deprivation and social comparison might be present also in this comparatively equal country. Previous studies concerning Sweden have however not been able to verify any independent effect of income inequality per se on health and mortality (Gerdtham et al 2004; Stjärne et al 2006). In order to sort out the possible effects of income inequality, individual level data are required and they need to be analysed nested in a multilevel analysis. Henriksson et al (2006) found that the significant association in the individual-level regression disappeared when a multilevel analysis was applied.

In this paper we focus on the population 65-74, i.e. an elderly population where most of them are retired and have left the workforce. People reaching this age group are furthermore increasingly facing health problems and have higher death risks – it is much more vulnerable age group compared to the younger ones and in these ages we start to see consequencies of health problem. They are of special interest as they are probably relying on a well-functioning society than those in working ages. Furthermore, as Sweden as well as many other countries around the world is now facing an aging population, the specific circumstances of the elderly and how they are influenced by conditions in society is a matter of vital concern for the future.

Study design, data and methods

There are strong requirements on the data and methods to be able to analyse the possible effects of income inequality and to identify the mechanisms. The analysis should preferrably be performed on individual-level data of considerable size in order to reach statistical power. Many previous studies have been based on rather small populations. Furthermore, the data should be analysed with multilevel analysis with individuals nested in their geographical locations. There is a strong advantage if the data is longitudinal. For our purpose, we have access to a unique anonymized micro dataset, the so-called Linnaeus database (Malmberg et al 2010), containing information from various registers from Statistics Sweden and the National Board of Health and Welfare (as well as local data for the county of Västerbotten not utilized here). The data include individual records of all residents in Sweden with annual information for the period 1986-2009, population censuses 1960, 1970 and 1980 and it contains rich information about socio-economic conditions for each individual as well as their place of residence. Using digitalized information of place of residence for all residents in Sweden for the period 1986 – 2006, we can aggregate data to any spatial unit and characterize any such unit by for instance level of income or education. While many previous studies are

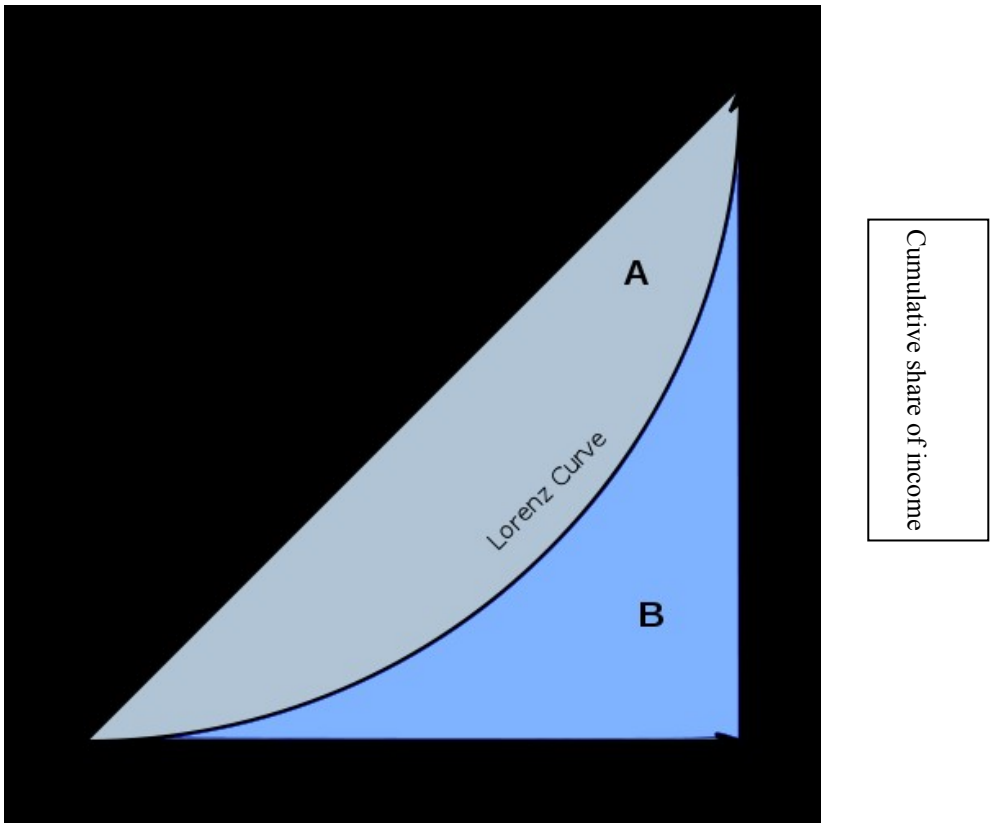
based on aggregate data at higher geographical levels we here have the possibility to analyze the relations between health and (in-)equality in smaller geographical areas. We know from previous research that the outcomes of these kinds of analyses are very sensitive to the delimitations of the spatial units of analysis (Fotheringham and Rogerson 1993).

In our case, and as a first attempt, we analyse this on municipality level. In order to get a data set of manageable size and to perform these first steps, we only analyze mortality among elderly 65-74 years in the year 2006 (thus not taking use of the longitudinal potential at this step). We have identified every person in Sweden born between 1932 and 1941 and alive at the last of December 2005. The total sum of individuals is 793,380. For each individual we have information on place of residence, sex, marital status, education level and occupational title if available at the last of December and finally the disposable income (corrected for family size) for the year 2005. Evidently we need to use the information either at the end of 2005 or for the year 2005 as there is no information or not complete information for those dying during 2006. The age group studied here have almost completely left the workforce and their income is thus based on their pensions as retired. We consider the disposable income to be a good measure for their economic situation. The outcome variable is deaths taking place during 2006, amounting to 12,326 cases.

Apart from the individual variables, we construct variables describing the different residential contexts, in this case the 290 Swedish municipalities for the year 2006. The measures included are those on inequality in disposable income and mean disposable income. Since we have the information about income for each individual, we measure the level of income distribution by using Gini index. This is calculated from the population between 25 and 60 years. As this is used as a community characteristic, we prefer to calculate it for an age group active in the workforce and not for the age group we are focusing on in this study. We have used disposable family income, and separated between number of family members. The alternative to calculate the Gini index from personal income would overestimate inequality in places where only one family member is having an income. In such cases the Gini index would partly measure inequalities within families.

The Gini index is a commonly used measure for inequality and portrays the share of income cumulatively earned from those with lowest income up to the highest. In a society with complete income equality, the Gini coefficient is zero. If one person earns all the income (i.e. total inequality), the coefficient is one. In figure 1, the Gini index represents the area A.

Figure 1. Income inequality measured by Gini index.



Cumulative share of people from lowest to highest incomes

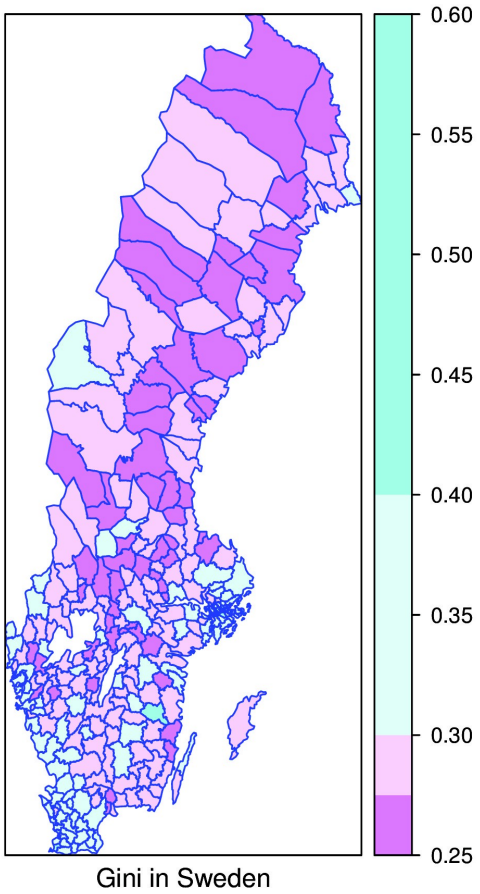
For every parish, we also calculate mean disposable income, using the same group as for the calculation of the Gini coefficient.

We perform the analysis with two different methods, one with aggregate data where the outcome is the mortality rate for the age 65-74 years and its relation to inequality levels and mean disposable income. This is how many of the studies of the impact of inequality have been performed. A drawback of this approach is that we do not control for personal income level. The other approach is based on individual information that we first analyse without having the data hierarchically organised at municipality level and then apply a multilevel analysis. Here we can control both for individual income and how this is influenced by mean income and inequality. In a first model, the effect of individual income is investigated, controlled for age, sex and marital status. Then mean disposable income is introduced and finally inequality measured by Gini coefficient in the residential areas where the person live at the last of december 2005. Consequently we can isolate possible effects of the local context in the forms of income and inequality levels.

Results

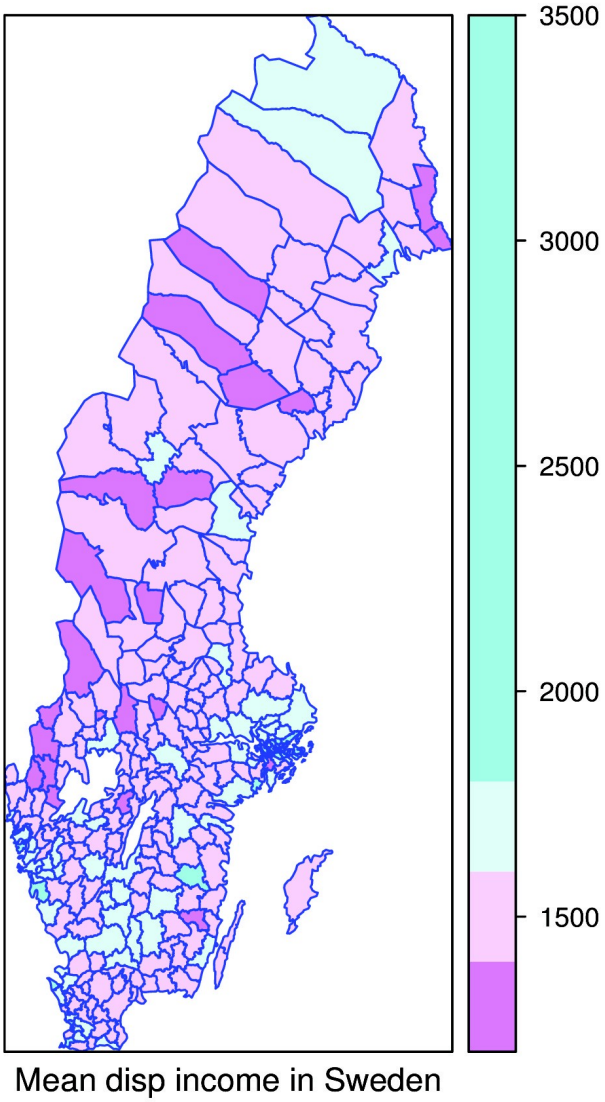
Sweden belongs to one of the equal countries in the world when it comes to income. The Gini coefficient at national level is about .25, in comparison with for example United States with a level of about .40 and the most unequal societies such as Brazil with a level of around .60 (Human Development Report 2011, table 3).

Map 1. Gini coefficients in Swedish municipalities 2006



If we instead look at the geographical distribution of Gini coefficients within the country (see Map 1), some interesting patterns can be discerned. Apparently differences in inequality levels can be large also in the Swedish context. The levels range from .25 to .55 between municipalities, thus a large dispersion from highest to lowest. The highest Gini coefficients are however outliers and the majority have levels within a more restricted range. 66% have a Gini index between .25 and .30, 31,7% between .30 and .40 and 1,5% or five municipalities reach a level higher than .40. Danderyd outside Stockholm has the highest with 55, much higher than the next highest. Hofors outside Gävle has the lowest Gini level with a coefficient of .255. The most equal municipalities are to a large extent concentrated to the northern parts of Sweden with only a few exceeding .30, while the most unequal ones are situated around Stockholm, Scania and the West coast, all presenting the opposite pattern to northern Sweden with almost all having Gini coefficients higher than .30. A closer look at the municipalities around Stockholm and in Scania (map 1) shows fairly high levels in almost all cases, but nonetheless some differences that indicate some variation in inequality patterns.

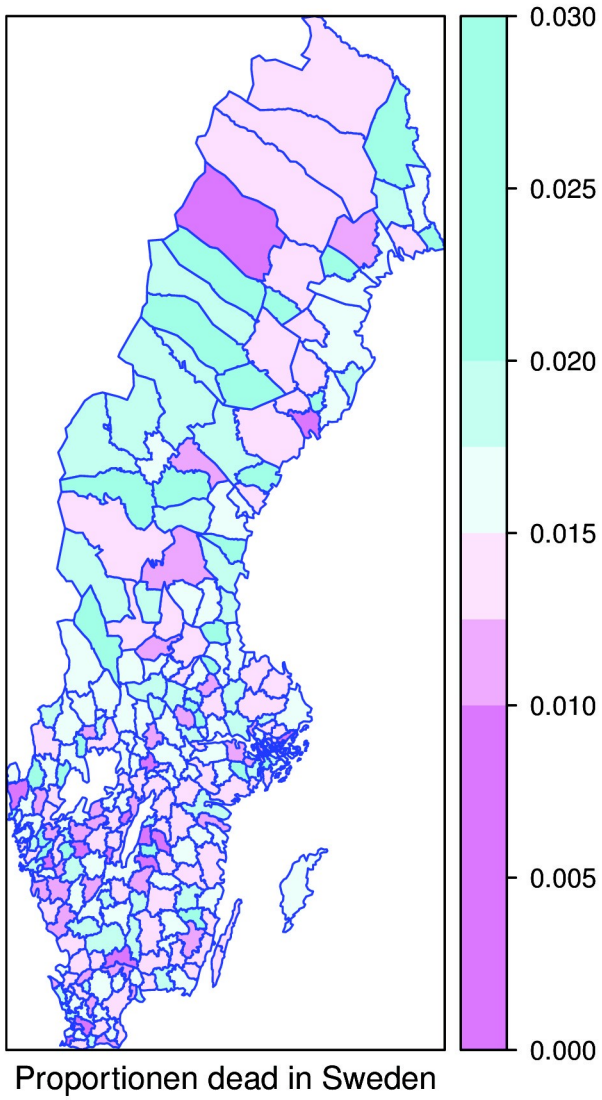
Map 2. Mean disposable income in Swedish municipalities 2006



There may however be large income inequalities between municipalities, thus the levels of inequality may represent very different income levels. Map 2 shows the mean disposable income, controlled for family size, per municipality. In accordance to what we found about the distribution of Gini coefficients, the income levels differ substantially between municipalities. The range of mean income is between 126,000 SEK and 343,000 SEK, thus the most wealthy municipality having almost three times as high income as the lowest. Resembling the pattern for income inequality, the disposable income in municipalities is concentrated to the lower levels. There is also a distinct regional pattern in how the mean income is distributed. The places with the highest levels are situated around Stockholm, Gothenburgh and in southern Sweden and the lowest to a large extent in northern Sweden. Yet, the pattern is more scattered and less unified than what we found for the distribution of Gini levels. There are those with both high income and high equality as for example the two northernmost municipalites – municipalities dominated by mining industry. The pattern is also less clear for this variable within the regions where inequality was strong. This is especially the case for the area around Stockholm where there is a distinct center-periphery pattern with higher income levels in the centrally located municipalities, something that indicate a strong residential segregation in this region. The differences are less pronounced in

Scania even if large differences appear between some municipalities in the western part and the others in particular.

Map 3. Mortality rate 65-74 in Swedish municipalities 2006



Finally, the distribution of mortality rate 65-74 years in municipalities is presented in map 3. Due to sometimes restricted numbers of deaths in single municipalities, we obviously find much more of random fluctuations in this variable. Nevertheless, there are quite large differences and we can also discern a spatial pattern even if it is not as obvious as for the other variables. The results presented gives a much more scattered picture on the spatial distribution.

To comment on our first impressions from the maps, we find that they indicate a strong connection between inequality and mean income. This is confirmed from a check on the correlation between the two variables that reaches .734 (Pearson correlation), proving that wealthier municipalities have higher inequality. Consequently, inequality within municipalities do not necessarily mean that some are poor in these places. Those with the lowest income in the rich municipalities may very well be well off in comparison with those from other parts of the country. But within these wealthy places, some have extremely high

incomes, resulting in large inequality. Differences in mean income between municipalities may be a result of residential segregation.

The correlation between mortality age 65-74 and the geographical context variables is also significant, even with lower levels of correlation. The correlation between mean income and mortality is -.311 and between Gini index and mortality -.222. This means that both a lower mean income and more equality are connected to higher mortality, thus no indication of any negative effect of income inequality.

Model based on aggregate numbers
Table 1 presents the results from the analysis where both mean disposable income and income inequality are included in the same model. This model shows that mortality is primarily determined by the income level. It has a clear significant effect, while the introduction of the inequality measure do not change this effect and have neither a significant positive nor negative effect. According to this analysis, there is nothing to support that inequality leads to higher mortality. Before we exclude this possibility we must however investigate the question with individual data where we can control for the individual income level.

Table 1 Linear regression. Mortality rate 65-74 years dependent on mean disposable income and Gini-coefficient. Swedish municipalities 2006.

	B, parameter estimate	Beta	P value
Constant	,025		,000
Mean disposable income	-6,281E-6	-,321	,000
Income inequality, Gini coefficient	,002	,014	,866

Models with individual data
Our next step is to analyze the effect of mortality with individual data. In this way, we can control for individual disposable income. From previous research and many studies, we assume the economic situation to be a very strong determinant for survival. In the first model, as presented in Table 2 where except for income only the variables sex and marital status are included, this is confirmed. Less access to economic resources lowers the survival chances substantially. Birth year is a control for age at the beginning of the year, and as expected the risks rise for each additional age year. Sex is highly significant with much lower mortality for women. The results also indicate that being married or living in partnership was beneficial for health. There was no difference between those living together if they were formally married or not. Unmarried people had substantially higher mortality, while those widowed were in-between.

Table 2. Logistic regression. Deaths age 65-74 years, Sweden 2006.

	Model 1		Model 2		Model 3	
	B	P value	B	P value	B	P value
Sex (ref. female)	.566	.000	,566	,000	,567	,000
Birth year	-.094	.000	-,094	,000	-,094	,000
Marital status (ref. widowed)						

Married	-,362	,000	-,361	,000	-,360	,000
Unmarried	,286	,000	,287	,000	,285	,000
Divorced	,196	,000	,198	,000	,196	,000
Education (ref. second stage, tertiary education)						
No information	,793	,000	,783	,000	,777	,000
Primary education	,629	,000	,614	,000	,626	,000
Lower second. Educ.	,587	,000	,576	,000	,583	,000
Upper second. educ.	,459	,000	,448	,000	,457	,000
Tertiary education	,206	,100	,198	,112	,205	,100
Disposable individual income	-,071	,000	-,069	,000	-,070	,000
Mean disposable income in municip.			-,096	,059	-,264	,000
Income inequality in municip. (Gini)					1,072	,001
Constant	177,587	,000	177,917	,000	177,709	,000

Then, does personal income explain all or are there independent effects of economic characteristics of the municipality. In the second model we introduce mean income in the municipality. Mean income have a strong effect. Living in a more wealthy leads to better survival. It does however not change the effect of own disposable income.

Finally, does income inequality have an independent effect on mortality? This is analyzed in the last model. The result is that the hypothesis that inequality have an independent effect is confirmed. A higher Gini coefficient leads to a significantly higher mortality. It does however not change the effect of own disposable income, but it even increases the effect of mean income. It means that the connection between higher inequality and mean income leads to smaller differences if we do not consider the inequality in the model. Part of the advantage of higher income is disguised by the negative effects of their large inequality. The effects on the other variables are not changed.

Table 3. Estimated expected death risks for four hypothetical individuals, Sweden 2006

Sex	Marital status	Disp/1000	Education	MeanDisp/ 1000	Gini	Birth year	***Death risk***
Female	Married	1,63	Upper sec.	1,63	0,3	1936	***,00899***
Male	Married	1,63	Upper sec.	1,63	0,3	1936	***,01575***
Male	Single	1,63	Upper sec.	1,63	0,3	1936	***,02714***
Male	Married	1,63	Upper sec.	1,63	0,4	1936	***,01750***

Compared to other studies, this investigation is based on a much larger population. A consequence is that we easily get significant results that have marginal impact in reality. In order to evaluate the possible impact, we have calculated the effects measured in death risks depending on different personal as well as municipality characteristics (see Table 3). The variables personal disposable income, mean disposable income in municipality, education and birth year are fixed, while sex, marital and Gini coefficient can vary. The death risks increase from 9/1,000 for females to 15,7/1,000 for males, a substantial increase. Being an unmarried male compared to a married increased the risk even more. An increase in Gini coefficient in the municipality did not have equally strong effect, but still an increase from 15,7/1,000 to 17,5/1,000 as the comparison between line two and four shows. This is not a negligable difference. That corresponds to more than a fourth of the well-known male/female difference.

Then, do these result hold when we perform a multilevel analysis on the data? As mentioned above, Henriksson et al (2006) found that the effect disappeared when the data was analysed hierarchically with a multilevel approach, as seen in Table 4. In our case, the multilevel analysis do not change the identified impact of inequality. Why our results deviate from the one of Henriksson et al is an interesting question that requires further investigation.

Table 4. Multi-level regression. Deaths age 65-74 years, Sweden 2006.

	Model 1		Model 2	
	B	P value	B	P value
Sex (ref. male)	-,64	.00	,64	,00
Birth year	-,09	.00	-,09	,00
Marital status (ref. widowed)				
Married	-,34	,00	-,34	,00
Unmarried	,22	,00	,22	,00
Divorced	,16	,00	,16	,00
Education (ref. No information)				
Primary education	-,13	,04	-,12	,07
Lower second. educ.	-,16	,03	-,14	,05
Upper second. educ.	-,28	,00	-,26	,00
Tertiary education	-,48	,00	-,47	,00
Second stage, tertiary education	-,65	,00	-,65	,00
Disposable individual income (ref. High)				
Highhigh	-,16	,00	-,17	,00
Low	,38	,00	,38	,00
Lowlow	,23	,00	,23	,00
Mean	,18	,00	,17	,00
Mean disp. income in municip.				
Mean1000	,68	,04	,53	,11
Mean10002	-,19	,03	-,20	,00
Income inequality in municip. (Gini)			1,09	,00
Constant	165,59	,000	165,39	,00

Discussion

In this paper we have presented the first results of our studies of socioeconomic determinants for health differences in Sweden. Sweden provides an interesting example, where economic differences are smaller than in most other places, and thus Sweden represents a setting where social inequality have less effect on health. On the other hand, there are distinct differences within the country, both in economic levels and in levels of inequality. Hypothetically, we could expect to find the phenomenon even in this country.

Previous research supporting the Wilkinson-hypothesis is mainly based on cross-national analyses or on data from larger regions such as American states. By contrast, most studies on small units such as neighborhoods, parishes or local communities have not verified the hypothesis. Wilkinson and Pickett (2007) maintain that the weaker association found on a lower level of aggregation is an expected outcome since social forces at higher levels shape spatial income distribution and may mask the impact of inequality on health outcome.
A neighbourhood or a municipality is not the adequate level to look at effects of social comparison or relative deprivation. But if we believe that social comparison have an effect, nothing says that it should not be present also at lower levels. The difficulty is rather how to identify it.

Our results based on aggregate data did not show any effect of economic inequality. It was only the mean disposable income that counted. Most studies have been restricted to analyses of similar character by using aggregate statistical data. Our first result is thus discomforting in the way that it does not provide any support for the social inequality hypothesis. On the other hand, it conforms fully to what others have found.

The analysis on individual-level data do however deepen our understanding of the problem. As expected we found clear effects of own individual income. This is in line with most studies, and even if there are different opinions on if socioeconomic inequality in health prevails into old age or if the differences diminish these results clearly document that it continues to have strong effect in younger retirement age. Furthermore, the effect of income is not modified by mean disposable income in the municipality. Higher income levels do not alleviate the income disadvantages on individual level. On the other hand, the mean income has a strong effect in itself regardless of personal income. It is certainly better to live in a place with high income levels.

The most interesting findings appear when introducing the inequality measure in the model. The analysis show a strong and significant effect from the Gini index. This contrasts fundamentally from that of the aggregate level analysis. Our results illustrate the importance of using individual data. Inequality in municipalities also alters the effect of mean disposable income.

Our results differ from Henriksson et al. who found that, analysed properly in a multilevel analysis, the effect of inequality disappeared. In our case, the multilevel analysis did not change the negative effects of inequality levels in the municipalities. The explanation for the different results require further investigation but one important aspect that may have been crucial for this is that Henriksson et al. restrict their analysis to the age group 40-64, i.e. an age group where mortality is lower and where different risk factors are at hand than among the elderly that is the object in this study. Obviously, we must take diverging patterns in different age groups into consideration and that the risks of inequality varies depending on if

we are studying. The lower number of fatal cases may also have impact on the results. Furthermore, they apply a different measure for income inequality, the quotient between incomes of the 10% with the highest income and the 10 % with the lowest. They did however also check with the Gini coefficient but that did not alter the results.

We would like to emphasize two important aspects of our findings. The first one is that we find effects of income inequality in one of the most equal countries in the world. The evidence so far has primarily been taken from societies with much more unequal income distributions. The findings here show that this effect can be observed even in a society with strong income redistribution and institutions that should take care of much of the disadvantages of belonging to a group with smaller economic resources. The other exceptional result that contradicts many of the previous assumptions and earlier studies is that the effect is established also on local levels, something that has been questioned with the assumption that there are other processes of segregation taking place in local places and that these processes would make it impossible to identify any effect. We believe that these findings forces us to reconsider the issue, something that constitutes a challenge to develop study designs to disentangle the problem.

Still, the exact pathway is not known. Several alternatives have been discussed in the literature. The psycho-social effect described as relative deprivation suggested by Wilkinson and Pickett is only one alternative. Another alternative is the observation made by Rodgers (1979) and further discussed by Fritzell (2005) that the marginal effect on health is stronger for the poorest groups. Consequently, societies where conditions for those with lowest incomes are improved and thus inequality decreases will present better health results. What speaks against such a conclusion is however that the analysis showed that inequality in fact disguise some of the effects of mean income. When the Gini index was introduced, the differences related to mean income increased.

Another possible pathway refer to effects of local municipality politics, i.e. a neomaterial explanation. Swedish municipalities tax its citizens and have decision power in many matters related to health care and care of the elderly. Different municipalities may spend differently on infrastructure. An unequal municipality may be less interested to allocate resources for the most needy. On the other hand, they may gain from a general good infrastructure and good quality. From these preliminary findings we must however admit that we cannot distinguish the effects of the possible pathways. We need to develop a design for analysing this in our future studies.

Then, how shall we proceed? Our plan is to continue with investigations at different geographical level. The assumption we started with was that the effect would rather be observed within local labour market regions. They are in many cases more natural and coherent environments where people have their sense of belonging and where social comparisons are more easily made. We also need to expand the investigation in time and not only restrict it to effects of one year. Maybe it will be possible to find changing effects over time as well as changes in the spatial pattern in this respect. Data will be available for the period 1986 to 2009.

Furthermore, we think it is very important to include a time dimension also on the individual level. One of the larger problems in studies of health and social inequality is the risk of reverse causation. For instance, health conditions influence social positions and may concurrently affect residential segregation. On a regional and even more so on a

neighborhood level, residential mobility will strongly influence the socio-economic composition and it is vital to consider the effect of mobility in order to identify the effect of equality on health outcome, especially on lower levels of aggregation. By applying a longitudinal perspective with information about previous places of residence and their contextual income distribution as well as previous individual income, this will at least partly be possible to consider. Another improvement would be to analyze the data with a multilevel approach. We are aware of the need for this and that will be the next step in our work.

References

Antonovsky, Aaron 1967, "Social class, life expectancy and overall mortality", *Milbank Memorial Fund Quarterly* 45 (2): 31-73.

Bengtsson, Tommy and Frans van Poppel 2011, "Socioeconomic Inequalities in Death from Past to Present: An Introduction", *Explorations in Economic History* 48 (3), 343-356.

Fotheringham, A.S.; Rogerson, P. 1993, "GIS and spatial analytical problems". *International Journal of Geographical Information Systems*. 7:3-19.

Fritzell, Johan 2005, "Commentary: On form, comparability, and levels in the income and health relationship", *International Journal of Epidemiology* 34:293-294.

Fritzell, Johan and Olle Lundberg 2007, "Health and inequalities in Sweden: long and short-term participation", In Johan Fritzell and Olle Lundberg (eds), *Health Inequalities and Welfare Resources. Continuity and Change in Sweden*, Policy Press, Bristol

Gertdham, Ulf-G. and Magnus Johansson 2004, "Absolute income, relative income, income inequality, and mortality", *The Journal of Human resources* 29 (1):228-247

Henriksson, Göran, Peter Allebeck, Gunilla Ringbäck Weitoft and Dag Thelle 2006, "Income distribution and mortality: Implications from a comparison of individual-level analysis and multilevel analysis of Swedish data", *Scandinavian Journal of Public Health* 34:287-294.

Human Development Report 2011, United Nations Development Programme (UNDP), Palgrave Macmillan, New York.

Karlsson, Martin, Therese Nilsson, Carl Hampus Lyttkens, George Leeson 2010, "Income Inequality and Health: Importance of a cross–country perspective", *Social Science and Medicine* 70 (6):875-885.

Kondo, Naoki, Grace Sembajwe, Ichiro Kawachi, Rob M. van Dam, S. V. Subramanian and Zentero Yamagata 2009, "Income inequality, mortality and self rated health: meta-analysis of multilevel studies", *British Medical Journal* 339:b4471 doi:10.1136/bmj.4471

Kunitz, Stephan 2007, *The Health of Populations*, Oxford; Oxford University Press.

Kunst, Anton E., Vivian Bos, Otto Andersen, Mario Cardano, Giuseppe Costa, Seeromanie Harding, Örjan Hemström, Richard Layte, Enrique Regidor, Alison Reid, Paula Santana, Tapani Valkonen, Johan P. Mackenbach 2004, "Monitoring of trends in socioeconomic inequalities in mortality: Experiences from a European project", *Demographic Research* Special Collection 2, Article 9: 229-254.

Lynch, John, George Davey Smith, Sam Harper, Marianne Hillemeier, Nancy Ross, George A. Kaplan and Michael Wolfson 2004, "Is income inequality a determinant of population health? Part 1. A systematic review", *The Milbank Quarterly* 82 (1):5-99.

Mackenbach, Johan P. 2002, “Income inequality and population health”, *British Medical Journal* 234:1-2.

Malmberg, G., Nilsson, L-G. and Weinehall, L., 2010, ”Longitudinal data for interdisciplinary ageing research. Design of the Linnaeus Database”. *Scandinavian Journal of Public Health*, 2010; 38: 761–767.

Marmot, Michael 2004, *Status syndrome: how your social standing directly affects your health and life expectancy*, London: Bloomsbury

Mellor, Jennifer M. and Jeffrey Milyo 2003, “Is exposure to income inequality a public health concern? Lagged effects of income inequality on indvidual and population health”, *Health Services Research* 38(1):137-151.

Pickett, Kate E. 2009, “Greater equality and better health”, *British Medical Journal*, 339:b4320

Pickett, Kate and Richard G. Wilkinson 2009, “Greater equality and better health”, *British Medical Journal*, 339:b4320 doi:10.11.1136/bmj.b4320.

Rodgers, G. B. 1979, “Income and inequality as determinants of motrtality: An international cross-section analysis”, *Population Studies* 33(2):343-351.

Stjärne, Maria K., Johan Fritzell, Antonio Ponce De Leon and Johan Hallqvist for the SHEEP Study Group 2006, “Neighborhood Socioeconomic Context, Individual Income and Myocardial Infarction”, *Epidemiology* 17 (1):14-24.

Subramanian, S. V. and I. Kawachi 2004, “Income inequality and health: what have we learned so far”, *Epidemiologic reviews* 26:78-91.

Wagstaff and van Doerslear 2000, “Income inequality and health: What does the literature tell us?” *Annual Review of Public Health* 21:543-567

Wilkinson, Richard G. 1996, *Unhealthy societies: the afflictions of inequality*. London: Routledge.

Wilkinson, Richard G. and Kate Pickett 2007, “The problems of relative deprivation: Why some societies do better than others”, *Social Science and Medicine* 65:1965-1978.

Wilkinson, Richard G. and Kate Pickett 2009, *The Spirit Level: why more equal societies almost always do better*, London: Allen Lane.