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Economic inequality and population health: looking beyond aggregate indicators

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Abstract This paper studies the sensitivity of various health indicators to income inequality as measured by regional Gini coefficients, using individual microdata from Finland over the period 1993–2005. There is no overall association between income and health at the regional level. We discovered that, among men, there are no significant associations between income inequality and several measures of health status. Among women or among both sexes combined, there are some indications of associations in the predicted direction between income inequality and physical health, disability retirement, sick leave, and consumption of medicines, but none are robust to different model specifications. Only among the population aged less than 30 there is some indication that mental health is associated with inequality. Our findings confirm that income inequality in small populations (not large enough to measure the overall class pyramid of the society) is often immaterial for health outcomes.

Keywords: economic inequality, income inequality, Gini coefficient, health, health behaviour

Introduction

Economic inequality is said to have an influence on health along with the level of income. Increasing income inequality is associated with increased morbidity and premature mortality in the population (*e.g.* Rodgers 1979, Wilkinson 1992, 1996, Kaplan *et al.* 1996, Kennedy *et al.* 1996, Deaton 2001, Machenbach 2002, Ross 2004, Subramanian and Kawachi 2004, Dahl *et al.* 2006, Wilkinson and Pickett 2006, Neckerman and Torche 2007). Wilkinson and Pickett (2006) conclude in their survey of the literature that a majority (70%) of the studies suggest that health is less good in societies where income differences are larger.

The above finding has gained a great deal of interest both in research and policy debates, because there has been a substantial increase in earnings inequality in several OECD countries during the past few decades (*e.g.* Atkinson 2007). Consequently, negative health effects may add significantly to the social costs of increasing economic inequality. The question also has high policy relevance, because income inequality across the developed countries is heavily affected by tax policies and income transfers by the public sector. That being said, the effect of income transfers on the health of both high- and low-income

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persons will depend on whether the income-health relationship is linear or not (Gravelle 1998). In particular, the non-linearity of the health-income relationship can cause a negative correlation between inequality and health at the aggregate level, because income transfers from high-income to low-income persons both reduce income inequality and increase average health in the population.

The income inequality hypothesis is distinct from the relative income hypothesis (*e.g.* Gravelle and Sutton 2009). For example, a person with idiosyncratically low income could be relatively deprived even though the distribution of income is quite equal. It might even be that reducing income inequality would have no impact on health outcomes; unless everyone had exactly the same income, there would always be individuals on the left and individuals on the right of the income distribution. In this paper, we study the income inequality hypothesis according to which an individual's health is affected by the overall distribution of income in a reference group.

The effect of economic inequality on health is usually identified by using information on regional measures of income inequality that are combined with some other, often survey-based, data that record health at the individual level. The robustness of the relationship has been questioned. For example, Deaton and Lubotsky (2003) have argued that there is no relationship between income inequality and mortality across the US states once the models have taken the racial composition into account. More recent studies, however provide the opposite findings (*e.g.* Ram 2005, 2006, Subramanian and Kawachi 2003a, 2003b, 2004). Gravelle *et al.* (2001), Gravelle and Sutton (2009), and Lorgelly and Lindley (2008) report that income inequality is generally not associated with adverse health effects in the UK.[1]

The findings reported differ because of the dissimilarities in the data used, and because of discrepancies in methodology, and in the underlying reference groups' definitions. The reference group in the US studies is usually the State. The idea is that the US States are (economically and institutionally) homogeneous groups, but each has its own particularities. Deaton (2001) argues that a good proxy for true reference groups is one where the ratio of 'relevant to irrelevant reference people' is high, compared with the general population.

Research on economic inequality and health has typically focused either on the overall mortality of the population (*e.g.* Gerdtham and Johannesson 2004), or on respondents' general self-rated health by the use of household surveys such as the US Current Population Survey (*e.g.* Mellor and Miloy 2002), or on general indicators of objective health through the use of household surveys such as the European Community Household Panel (ECHP) for the EU countries (*e.g.* Etienne *et al.* 2007). There is also some research about the effects of economic inequality on cardiovascular disease risk factors and mental problems (*e.g.* Diex-Roux *et al.* 2000, Kahn *et al.* 2000, Sturm and Gresenz 2002).

Most of the available evidence originates from the United States (Subramanian and Kawachi 2004), where income inequality is at a much higher level than in Europe (Atkinson 2007). Owing to the structural differences, the US findings are not necessarily relevant in the European context.[2] All in all, the evidence on the relationship between economic inequality and health is far from conclusive.

This paper examines the previously unexplored relationship between income inequality and health in Finland, using individual microdata over the period 1993–2005.[3] Finland is an interesting case for a study of this relationship, because despite the fact that aggregate income inequality is at a low level from the perspective of international comparison (*e.g.* Jäntti and Danzinger 2000), there is still non-negligible regional variation in income inequality. For example, the Gini coefficients of 18 Finnish provinces, computed from disposable household income, ranged from 0.21 to 0.27 in 1993. Furthermore, the health outcomes vary largely by region (*e.g.* Helakorpi *et al.* 2007). We use the official division of

Finland into 18 provinces. More than half of these have populations of less than 200,000. Consequently, this paper examines the effect of income inequality on health within small populations.

Our paper contributes to the literature, because we exploit the most important advantage of our data, the availability of several different health indicators. Because we examine various health measures, we are in a better position to evaluate whether the relationship between income inequality and health is a more consistent pattern than the studies that focus on one single indicator. This is important, because there are several different domains of health. Furthermore, the published studies do not provide very precise information about what the exact health indicators are that are adversely affected by economic inequality. In particular, the inclusion of mental health information is able to tell us about the prevalence of specific psycho-social effects of inequality such as stress and depression, to which the literature has not paid much attention. This is useful, because mental health is more sensitive to the year-to-year changes in inequality than the general measures of objective health. The second contribution of this paper is that we analyse the gender differences in the relationship. This issue has been neglected. It is interesting to evaluate the potential gender differences, especially regarding the effects of inequality on mental health, because there is some experimental evidence (*e.g.* Eckel and Grossman 2008) according to which there might be substantial gender differences in the perception of fairness.

Data

The data on individuals' health that we are using originate from *Health Behaviour and Health among the Finnish Population* conducted by the National Public Health Institute. The Finnish surveys on health and health behaviour started in 1978. They have been repeated annually, using samples of 5,000 randomly selected 15–64-year-old permanently resident citizens. Hence, the survey constitutes a representative sample of Finns. The sample frame excludes non-citizens, about four per cent of the population. The survey was carried out as a postal questionnaire. On average, 73% of those targeted responded (Helakorpi *et al.* 2008). The core questions have remained the same over the years. The survey contains questions on health and health behaviour relevant to chronic diseases. In particular, in addition to respondents' general self-rated health level, it incorporates a detailed description of self-rated physical and mental health problems.

Because many of the earlier studies use general self-rated health as their only health indicator, our results for this particular variable constitute a benchmark to which other findings can be compared. We focus on six health indicators, because these capture the most important domains of health. The wording of questions for these health indicators has remained the same over the period of investigation. Self-rated health and physical health are quality-of-life measures. Mental health (the variable entitled 'No stress' in the tables) also captures external influences and information on sick leaves and disability retirement both reflect labour market conditions.[4] Furthermore, the use of medicines is a behavioural-related measure of health and it is an objective measure of health, unlike self-rated health. Relevant socioeconomic background variables, such as the years of education, are reported in the survey. The most important limitation of the survey is that it does not contain information on household income.

There has been a fall in general self-rated health, which mostly happened in the mid-1990s (Table 1, Column 1).[5] For objective health, and the occurrence of disability retirement, there has been virtually no trend over time (Table 1, Columns 2 and 6). Regarding the use

Table 1 *Average health in the 15–64-year-old population by year*

Year	*Good self-rated health*	*Good physical health*	*No stress*	*No medicines*	*No sick leave*	*No disability retirement*
1993	0.71	..	0.84	0.88	0.45	0.92
1994	0.74	0.89	0.82	0.88	0.41	0.91
1995	0.73	0.90	0.82	0.88	0.45	0.91
1996	0.66	0.89	0.82	0.87	0.41	0.91
1997	0.66	0.89	0.80	0.86	0.41	0.91
1998	0.66	0.89	0.81	0.87	0.41	0.91
1999	0.68	0.89	0.82	0.86	0.40	0.92
2000	0.67	0.89	0.81	0.85	0.40	0.93
2001	0.67	0.89	0.82	0.86	0.37	0.92
2002	0.68	0.89	0.82	0.84	0.39	0.92
2003	0.66	0.89	0.81	0.84	0.39	0.93
2004	0.67	0.89	0.83	0.83	0.38	0.92
2005	0.66	..	0.82	0.82	0.38	0.92

Notes: The variation in socio-economic background characteristics has not been taken into account in the calculation of averages. 'Good self-rated health' takes the value of 1 if the individual denoted that his or her self-rated health was 'good' or 'reasonably good'. Otherwise, the variable takes the value of 0. The other three alternatives were 'average', 'rather poor', and 'poor'. 'Good physical health' takes the value of 1 if the individual has not answered that he or she suffers from any of the following illnesses or diseases verified by a doctor: diabetes, myocardial infarction, angina pectoris, heart failure, back illness, rheumatic arthritis, emphysema, chronic bronchitis, or asthma. If the individual suffers from one or several of those, the variable 'Good physical health' takes the value of 0. 'No stress' is our measure of mental health. 'No stress' takes the value of 1 if an individual has answered that he or she does 'not at all' or 'somewhat' suffers from nervous tension. The variable takes the value of 0 if the individual has answered that he or she suffers 'more than in general' or that 'life is almost unbearable'. The variable 'No medicines' takes the value of 1 if the individual has answered that he or she has not consumed during the past week the following: medicines for high blood pressure, sedatives, or sleeping pills. Otherwise it takes the value of 0. The variable 'No sick leave' takes the value of 1 if the individual has had no days of sickness absence from work during the year. If there has been sickness absence, it takes the value of 0. The variable 'No disability retirement' takes the value of 1 if the individual has not received disability pension during the past 12 months, and 0 otherwise. Source: Authors' calculations from *Health Behaviour and Health among the Finnish Population*.

of medicines and the propensity to take sick leave, the trend has been upwards, instead (Table 1, Columns 4–5). Moreover, there is a slight tendency to report more mental health disorders over time (Table 1, Column 3).

Non-negligible regional differences in health prevail, according to *Health Behaviour and Health among the Finnish Population*. In the region of Uusimaa and the western coastal area (Ostrobothnia), the probability of having good self-rated health is 0.71, whereas it is only 0.65 in North Karelia, which is located in the eastern part of Finland (Table 2, Column 1). However, differences are not by far as large regarding the prevalence of good physical health (Table 2, Column 2). Also, if anything, the probability of having no stress is actually lower in the region of Uusimaa compared with the rest of the country (Table 2, Column 3). Furthermore, a striking fact is that the probability of being on sick leave from work is the highest in the country's richest region, Uusimaa (Table 2, Column 5).

To examine the effect of income inequality on health, we link *Health Behaviour and Health among the Finnish Population*, using information on individuals' residence, to the

Table 2 *Average health in the 15–64-year-old population by region*

Region	*Good self-rated health*	*Good physical health*	*No stress*	*No medicines*	*No sick leave*	*No disability retirement*
Uusimaa	0.71	0.76	0.80	0.86	0.36	0.93
Varsinais-Suomi	0.68	0.77	0.82	0.87	0.39	0.92
Satakunta	0.66	0.77	0.82	0.86	0.44	0.92
Häme	0.67	0.76	0.83	0.85	0.40	0.92
Pirkanmaa	0.67	0.76	0.82	0.85	0.40	0.92
Päijät-Häme	0.67	0.76	0.83	0.85	0.42	0.93
Kymenlaakso	0.67	0.77	0.83	0.86	0.41	0.91
South Karelia	0.66	0.73	0.84	0.83	0.41	0.92
Etelä-Savo	0.65	0.76	0.82	0.85	0.43	0.90
Pohjois-Savo	0.66	0.75	0.82	0.83	0.43	0.89
North Karelia	0.65	0.73	0.83	0.85	0.45	0.89
Central Finland	0.68	0.74	0.82	0.85	0.43	0.92
South Ostrobothnia	0.68	0.77	0.83	0.86	0.42	0.91
Ostrobothnia	0.71	0.76	0.85	0.89	0.43	0.91
Central Ostrobothnia	0.68	0.74	0.81	0.85	0.42	0.90
North Ostrobothnia	0.67	0.75	0.83	0.87	0.41	0.91
Kainuu	0.69	0.76	0.82	0.86	0.46	0.88
Lapland	0.69	0.74	0.84	0.87	0.46	0.90

Note: See notes to Table 1.

IDS data (*Income Distribution Statistics*) that have been produced by Statistics Finland. IDS is an annual household survey. Its aim is to monitor income growth in various population groups and to observe the changes in income and wage dispersion. Each year, the survey collects information from around 10,000 households with approximately 25,000 individuals. Income measures for households are not self-reported, but obtained directly from the Finnish tax authorities. Therefore, IDS data are able to provide a very reliable picture of the evolution of income inequality.[6]

IDS data allow us to compute the regional income inequality measures (*i.e.* the Gini coefficients based on disposable household income) over the period 1993–2005. The Gini coefficient is defined as half of the arithmetic average of the absolute differences between all pairs of incomes in a population, the total then being normalised on mean income. The Gini coefficient ranges from 0.0 (perfect equality) to 1.0 (perfect inequality) (Cowell 1977). We use the standard OECD-equivalent scale when we calculate the Gini coefficients for the Finnish regions.[7] According to the OECD-equivalent scale, the first adult in the household counts as one unit, the next adults 0.7, and each child under the age of 17 counts as 0.5 units. The aim is to take into account the scale effects in consumption at the household level. The consumption-units-adjusted Gini coefficients are computed for 18 Finnish provinces, which constitute the so-called NUTS3 regions stipulated by the European Union. At this particular level of aggregation, IDS data are able to produce reliable patterns of the level and the changes in regional income inequality.[8] Finnish provinces each have their own identity. In this sense, they correspond to the States that have been used as the reference group in most of the US studies. All in all, our matched data contain 13 years and 18 regions.

Table 3 *Gini coefficient and real household disposable income by year*

Year	*Gini coefficient*	*Disposable income (2005 €)*
1993	0.21	34 659
1994	0.21	34 799
1995	0.22	34 734
1996	0.23	35 648
1997	0.24	37 751
1998	0.25	39 598
1999	0.27	41 837
2000	0.28	43 883
2001	0.27	43 317
2002	0.27	43 909
2003	0.27	44 467
2004	0.28	45 904
2005	0.28	46 966

Source: Statistics Finland and Authors' calculations from IDS data.

Income inequality has increased over the period (Table 3, Column 1). This trend is in line with the developments in several other western countries (Riihelä *et al.* 2007). Simultaneously, real household disposable income has gone up by over 30 per cent (Table 3, Column 2). Thus, living standards have risen on average, but the upper tail of the income distribution has had the most favourable development.[9]

There are permanent differences between regions in terms of income inequality and real disposable household income (Table 4). Income inequality tends to be higher in southern Finland compared with eastern and northern Finland. The province of Uusimaa, which contains the capital region with its surrounding areas, has the highest household real disposable income. It also has the highest income inequality. The evolution of income inequality has been notably different in different regions of Finland (*e.g.* Loikkanen *et al.* 1998). Living in the north and the east (*e.g.* North Karelia and Kainuu) means low incomes, whereas the south and the west are generally associated with higher incomes.[10]

Methods

We study the models where individuals' self-reported health indicators are related to relevant background variables (gender, age, the years of education and marital status) and a regional income inequality measure covering the period 1993–2005 with year dummies. We include the level of income in models. Because the objective is to assess the effect of income inequality (second and third moments of the income distribution) on health, one needs to fix the mean (first moment) as if regions equally contributed to GDP and there were no regional differences in income. Furthermore, income obviously matters for health (*e.g.* Fuchs 2004). The level of income that is incorporated into the models is the logarithm of real average disposable household income at the regional level. Nominal values are deflated by the consumer price index that refers to the Finnish economy.[11] Mellor and Milyo (2002) argue that it is important to control for individual characteristics. They use family income as one measure of income in their regressions, but this might be somewhat problematic,

Table 4 *Average income inequality and real household disposable income by region (1993–2005)*

Region	*Gini coefficient*	*Disposable income (2005 €)*
Uusimaa	0.31	46 133
Varsinais-Suomi	0.30	40 314
Satakunta	0.27	38 025
Häme	0.27	38 229
Pirkanmaa	0.28	39 268
Päijät-Häme	0.29	38 513
Kymenlaakso	0.26	38 245
South Karelia	0.27	37 339
Etelä-Savo	0.28	38 733
Pohjois-Savo	0.27	37 072
North Karelia	0.28	34 882
Central Finland	0.28	37 589
South Ostrobothnia	0.26	38 900
Ostrobothnia	0.25	39 142
Central Ostrobothnia	0.23	40 260
North Ostrobothnia	0.27	40 325
Kainuu	0.25	34 927
Lapland	0.26	36 070

Source: Authors' calculations from IDS data.

because family income is more endogenous with respect to individual-level health outcomes than income measured at the regional level.

The models that we estimate have the following structure:

$$Y_{ijt} = \alpha_j + \beta X_{ijt} + \delta G_{jt} + \lambda_t + \varepsilon_{ijt}$$

where Y is the outcome (the health measures from *Health Behaviour and Health among the Finnish Population*) for individual i living in province j in year t. X is a vector of individual characteristics (gender, age, the years of education and marital status), G represents regional income inequality measured by the Gini coefficient that is computed from IDS data for provinces, α and λ represent unobserved determinants of lifestyle behaviours associated with the region and survey year, and ε is an error term. In this fixed-effects model, the effect of income inequality on health is identified by intra-region variations, relative to the corresponding changes in other regions. The approach is similar to the one adopted by Ruhm (2000) to examine the effect of overall economic conditions on health. Descriptive statistics of the variables are shown in the Appendix (Table A1).

We take into account the fact that observations of our matched data are clustered by provinces when we calculate the standard errors of estimates. Moulton (1990) has stressed that otherwise standard errors would be seriously biased downwards in a matched data set that combines aggregate variables such as regional income inequality measures on micro-units, because there is a correlation of error terms within regions. The calculation of standard errors for estimates without taking into account the clustering of observations by provinces would easily lead to the wrong conclusion about the existence of a statistically significant negative relationship between income inequality and health. This is illustrated in the next section.[12]

Results

Baseline estimates

We estimate Probit models, because our dependent variables are dichotomous health indicators. The results from linear probability models would be almost similar, though. To make it easier to interpret the results, marginal effects are given. We take into account the permanent differences in health outcomes by controlling for the year and regional fixed effects.

The most important finding from the pooled sample that combines both genders is that an increase in income inequality leads to few if no effects on our measures of health (Table 5, Panel A). Only in the case of the consumption of medicines is there some evidence in favour of the hypothesis, although the effect is not significant at conventional levels (Table 5, Panel A, Column 4). Interestingly, there is no overall evidence of specific mental health effects of inequality.

The regional income level is generally not statistically significant (Table 5, Panel A). One potential reason for the lack of statistically significant results for regional income is that it is possible that the variability of income across regions is not enough, especially once the regional fixed effects are controlled for. To check this, we have estimated the models without regional indicators. This decreases the estimated standard errors for regional income, and it is statistically significant at the 10 per cent level in most of the models. Furthermore, it is interesting to see that an increase in household disposable income has a negative association with the 'no sick leave' variable that is almost significant at conventional levels (Table 5, Panel A, Column 5). This result is most likely due to the procyclicality of sickness absence (*e.g.* Holmlund 2004). Thus, in good times the probability of sick leave is higher.

The individual-level control variables point out the well-known pattern that better educated persons have a much higher level of health (Table 5, Panel A). This is not true, however, for mental health, where the more highly educated actually have worse health (Table 5, Panel A, Column 3). This may explain why mental health is unrelated to income inequality (Wilkinson and Pickett 2008). In particular, it is possible that lower educated persons with mental health problems are less likely to be included in the health survey than better educated persons with mental health problems. This could explain the pattern that highly educated persons have worse mental health. Hence, the result may not be robust to possible reporting differences between different socioeconomic groups. Women have better self-rated health, but they are substantially more prone to be absent from work. Holmlund (2004) notes that it has become a stylised fact of the literature that women have significantly higher sickness absence rates than men. The effect of age on the probability of no sick leave is positive, which may seem surprising. However, this most likely reflects selection effects within the older workforce. Thus, older individuals who work and are not retired are those who are the healthiest and probably also the most motivated to work.

It is important to take into account the permanent regional differences and the year effects, because they are substantial and highly statistically significant. For example, the unreported indicators for the regions reveal that the difference between general self-rated health between southern Finland and some parts of eastern and northern Finland is so large that the average education level should be around four to five years longer in some parts of eastern and northern Finland in order to compensate for their lower level of self-rated health compared with southern Finland.

Our findings for women differ to quite a large extent from those of men and the pooled sample (Table 5, Panel B). Here, although the coefficient is significant only at the 10 per cent level, it is fair to say that an increase in the Gini coefficient is negatively related to the probability of good physical health and lack of disability retirement (Table 5, Panel B, Columns 2 and 6). What makes the result interesting is that the magnitude is fairly large.

Table 5 *Probit estimates for the probability of good health*

	Good self-rated health	*Good physical health*	*No stress*	*No medicines*	*No sick leave*	*No disability retirement*
Panel A: Pooled sample						
Gini coefficient	0.174	–0.084	–0.006	–0.133	–0.029	–0.032
	(0.89)	(0.71)	(0.05)	(1.34)	(0.17)	(0.56)
Regional income	–0.121	0.012	0.030	0.074	–0.128	0.001
	(1.33)	(0.23)	(0.61)	(1.44)	(1.62)	(0.02)
Age	–0.008**	–0.004**	–0.001**	–0.008**	0.003**	–0.004**
	(35.49)	(13.21)	(4.83)	(69.00)	(17.67)	(37.62)
Female	0.017**	–0.002	0.001	0.005	–0.059**	0.007*
	(3.49)	(0.65)	(0.47)	(1.69)	(8.52)	(2.46)
Years of education	0.013**	0.006**	–0.008**	0.002**	0.008**	0.008**
	(20.01)	(14.03)	(13.03)	(4.28)	(10.93)	(14.21)
Married	0.043**	0.017**	0.029**	0.040**	0.033**	0.044**
	(8.50)	(5.52)	(6.35)	(10.56)	(6.72)	(18.36)
N	43 883	37 256	43 883	43 883	43 883	43 883
Panel B: Women						
Gini coefficient	0.755	–1.523	–0.646	–0.638	–0.687	–1.265
	(1.05)	(1.61)	(1.07)	(0.77)	(1.32)	(1.70)
Regional income	–0.211	0.463	0.486	0.453	–0.121	0.502
	(0.70)	(1.11)	(1.43)	(1.44)	(0.51)	(0.97)
Age	–0.019**	–0.019**	0.001	–0.045**	0.009**	–0.036**
	(23.84)	(7.75)	(1.26)	(40.73)	(13.35)	(23.41)
Years of education	0.042**	0.034**	–0.030**	0.019**	0.017**	0.085**
	(12.74)	(11.84)	(11.62)	(6.45)	(10.08)	(11.80)
Married	0.100**	0.084**	0.123**	0.185**	0.197**	0.370**
	(8.46)	(2.95)	(5.46)	(6.89)	(12.24)	(12.90)
N	23 648	21 915	23 648	23 648	23 648	23 648
Panel C: Men						
Gini coefficient	0.193	0.698	0.737	–0.784	0.637	0.705
	(0.26)	(0.81)	(0.86)	(1.06)	(0.93)	(0.74)
Regional income	–0.478	–0.360	–0.310	0.376	–0.612*	–0.495
	(1.59)	(1.07)	(0.81)	(0.96)	(2.29)	(1.27)
Age	–0.028**	–0.025**	–0.008**	–0.050**	0.009**	–0.042**
	(33.41)	(21.71)	(10.46)	(61.74)	(13.52)	(30.50)
Years of education	0.035**	0.037**	–0.030**	0.001	0.026**	0.078**
	(11.92)	(10.49)	(9.18)	(0.45)	(8.11)	(15.85)
Married	0.170**	0.128**	0.113**	0.276**	–0.049**	0.482**
	(6.89)	(4.71)	(5.25)	(9.47)	(2.98)	(19.52)
N	20 235	18 743	20 235	20 235	20 235	20 235

Notes: Robust z statistics in parentheses. * significant at 5%; ** significant at 1%. Observations are assumed to be clustered by provinces. Reported coefficients are marginal effects. For dummy variables, this entails the effect of changing the variable in question from 0 to 1, while holding the other explanatory variables constant at their means. All models contain the unreported controls for regions and years.

The coefficient of −1.52 for the probability of good physical health means that one unit increase in the Gini coefficient would decrease the probability of good physical health by 152 percentage points (Table 5, Panel B, Column 2). On average over the period the Gini coefficient has increased by 0.07, which would translate into a decrease of roughly 11 percentage points in the probability of good physical health. The equivalent increase in the probability of lack of disability retirement would be around nine percentage points.

For men, income inequality is clearly not important for health (Table 5, Panel C). On the other hand, higher regional real household disposable income has a negative effect on the probability of no sick leave during the year. Again, this most likely reflects the cyclicality of sickness absence. Interestingly, we do not find any gender differences in the effects of inequality on mental health.

Robustness of the results

The number of observations in the health survey ranges from 828 in Uusimaa to 39 in Central Ostrobothnia in 2005. (The average number of observations for each region is 180.) In particular, there are three provinces (North Karelia, Central Ostrobothnia and Kainuu) among the total of 18 that have fewer than 100 observations for each year over the period 1993–2005. The total number of observations for these three provinces over the period of 1993–2005 is 1158, 568 and 813, respectively. The fact that three regions have fewer than 100 observations on health for each year to base estimates suggests that correlating health with the estimates of annual changes in income distribution in these regions might be correlating changes in income distribution with artefactual changes in health resulting from sampling error. We have examined the robustness of the results for the exclusion of these particular provinces from the estimations. It turns out that the exclusion of these three provinces from the models does not have much effect on the results, *i.e.* the effects remain almost the same. The only difference is that income inequality is associated at the ten per cent significance level with the probability of good physical health, and income inequality is associated at the five per cent significance level with the probability of no sick leave for females when these three provinces are excluded from the models.

We have estimated the baseline specifications of Table 5 without controlling for the regional income level and the years of education, because there is the possibility of overcontrolling for social status differentiation in the models by including variables that are synonymous with social class differences in health. The results are presented in Table 6. Overall, the results remain the same. The only difference is that there is a statistically significant association between income inequality and the probability of no sick leave for the pooled sample (Table 6, Panel A) and for women (Table 6, Panel B). The results are therefore largely robust with respect to the exclusion of the regional income level and the years of education among the explanatory variables. We have also estimated the models presented in Table 5 without any other controls than the fixed effects for years and regions. The results (not reported in tables) remain the same as those documented in Table 6.

To further evaluate the robustness of the baseline results, we have included RHS variables progressively, as Mellor and Milyo (2002) do. Table 7 reports a number of different specifications for the probability of consuming no medicines, because it was the only health indicator that provided some weak evidence in favour of the income inequality hypothesis in our pooled sample (Table 5, Panel A, Column 4). Interestingly, there is a statistically significant negative relationship at the one per cent level when we do not include any controls in the model (Table 7, Column 1). The correlation between inequality and health decreases as regional income, individual characteristics, regional effects, and year effects are included. This is consistent with the pattern documented by Mellor and Milyo

Table 6 *Probit estimates for the probability of good health; additional specifications (without controlling for regional income and the years of education)*

	Good self-rated health	*Good physical health*	*No stress*	*No medicines*	*No sick leave*	*No disability retirement*
Panel A: Pooled sample						
Gini coefficient	0.015	–0.110	0.069	–0.028	–0.241*	–0.042
	(0.17)	(0.96)	(0.75)	(0.46)	(2.57)	(0.92)
N	44 593	41 318	44 593	44 593	44 593	44 593
Panel B: Women						
Gini coefficient	0.165	–0.242	0.055	–0.003	–0.330*	–0.046
	(1.17)	(1.63)	(0.39)	(0.03)	(3.03)	(0.61)
N	24 019	22 259	24 019	24 019	24 019	24 019
Panel C: Men						
Gini coefficient	–0.149	0.059	0.099	–0.040	–0.151	–0.019
	(0.94)	(0.36)	(0.86)	(0.44)	(1.00)	(0.27)
N	20 574	19 059	20 574	20 574	20 574	20 574

Notes: Robust z statistics in parentheses. * significant at 5%; ** significant at 1%. The models in Panel A include unreported controls for age, gender and marital status. The models in Panels B-C include unreported controls for age and marital status. Observations are assumed to be clustered by provinces. Reported coefficients are marginal effects. For dummy variables, this entails the effect of changing the variable in question from 0 to 1, while holding the other explanatory variables constant at their means. All models contain the unreported controls for regions and years.

(2002). In particular, the results reveal that it is important to take into account the fact that observations are clustered by provinces in the calculation of standard errors of estimates (Table 7, Columns 2–3).

The baseline specifications included individuals aged 15–64 and one of the control variables is education. We have therefore estimated models by focusing on individuals aged 25–64 in order to exclude those who are still possibly completing their education. This does not change the results. Moreover, in the baseline models 'No disability retirement' was coded as 0 when an individual was not in the labour force and we included all age groups in the analysis. Because this health indicator was statistically significant for women at the 10 per cent level, we have checked the robustness of the finding by coding those who are out of the labour force as missing observations and have restricted the age to those who are over 30. The result remains almost the same when those who are out of the labour force are coded as missing observations. However, the restriction of analysis to those who are over 30 wipes out the statistically weakly significant effect. In addition, the conclusions remain the same when those who are out of the labour force and the unemployed are treated as missing observations when one is analysing the effect of inequality on the probability of no sick leaves.

Furthermore, we have aggregated the data set to the provincial level and explained the shares of individuals who report various health problems with average regional characteristics as controls; because of data limitations we were unable to control for household income (and its square) in the baseline models. Hence, these estimations are based on 234 observations (13 years × 18 regions), which is still substantially more than in some recent cross-country studies (*e.g.* Babones 2008). Overall, these results do not provide support for the statistically significant negative relationship between inequality and health (Table 8).

Table 7 *Probit estimates for the probability of good health; additional specifications*

Variable	*No medicines*	*No Medicines*	*No medicines*	*No medicines*	*No medicines*	*No medicines*	*No medicines*	*No medicines*	*No medicines*	*No medicines*
Gini coefficient	–0.291**	–0.178*	–0.178	–0.194**	–0.109	–0.253**	0.036	–0.037	–0.132	–0.133
	(4.68)	(1.99)	(1.36)	(6.39)	(0.98)	(8.04)	(0.33)	(0.62)	(1.29)	(1.34)
Controls:										
Regional income	No	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes
Individual characteristics	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional effects	No	No	No	No	No	Yes	Yes	No	No	Yes
Year effects	No	No	No	No	No	No	No	Yes	Yes	Yes
Clustering by provinces	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	44 597	44 597	44 597	43 883	43 883	43 883	43 883	43 883	43 883	43 883

Notes: See notes to Table 5. The models contain the unreported controls as indicated. Observations are assumed to be clustered by provinces except in Column 2.

Table 8 *OLS estimates for the prevalence of good health at the provincial level*

Variable	*Good self-rated health*	*Good physical health*	*No stress*	*No medicines*	*No sick leave*	*No disability retirement*
Gini coefficient	0.047	–0.014	–0.044	–0.229	–0.176	0.075
	(0.26)	(0.12)	(0.28)	(1.74)	(0.85)	(0.70)
Controls:						
Income and income squared	Yes	Yes	Yes	Yes	Yes	Yes
Average individual characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Regional effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
N	234	234	234	234	234	234

Notes: See notes to Table 5. The models contain the unreported controls as indicated.

The only health indicator that is statistically significant at the 10 per cent level is the one for the consumption of medicines (Table 8, Column 4). This is exactly the same finding as earlier (Table 5, Panel A, Column 4) and it suggests that the non-linear relationship between income and health that was discussed in the introduction is not particularly important in our case. The control variables reveal that health is better in regions with higher shares of young and highly educated persons, which is consistent with the individual-level models.

We have also estimated models that include the mean of squared incomes calculated from the individual-level IDS data as an additional explanatory variable, following the proposition by Miller (2001). The idea is that the mean of squared incomes is able to capture the non-linear relationship between income and health. The only change to the earlier conclusions from the pooled sample is that the indicator for the consumption of medicines is not even weakly statistically significant. For women, we discover that the negative effect of inequality on the probability of good physical health and lack of disability retirement is statistically somewhat weaker when we include the mean of squared incomes as an additional explanatory variable.

As a final check of robustness, we have estimated our baseline specifications reported in Table 5 separately for the low-educated persons, because it is possible that income inequality has a significantly larger effect on their health outcomes compared with the average population. This differential effect based on socioeconomic status would be consistent with the so-called weak income inequality hypothesis (Mellor and Milyo 2002). There is earlier evidence from other Nordic countries that is in accordance with this hypothesis. Dahl *et al.* (2006) have reported that the effects of economic inequality on mortality are particularly marked among socio-economically disadvantaged groups in Norway,[13] and the findings by Henriksson *et al.* (2007), through the use of the Swedish census, point out that there could be a differential impact from income inequality on mortality, dependent on individuals' social position. Overall, our results do not change much when we estimate the models separately for those individuals who have at most 10 years of education. (The results are not reported in the tables.) There is some weak indication at the 10 per cent significance level that income inequality has a negative effect on the probability of lack of disability retirement among the low educated in the pooled sample, however. Otherwise, the conclusions remain the same.[14]

Conclusions

This paper examines the sensitivity of a variety of individual health indicators to income inequality as measured by regional Gini coefficients, using individual micro-data from Finland over the period 1993–2005. There is no overall association between income and health at the regional level. We discover that, among men, there are no significant associations between income inequality and several measures of health status. Among women or among both sexes combined, there are some indications of associations in the predicted direction between income inequality and physical health, disability retirement, sick leave, and consumption of medicines, but none are robust to different model specifications.

The Finnish evidence demonstrates that income inequality is not always harmful for health. The effects are dependent on the context. Our findings are in accordance with the previous results confirming that income inequality in small populations (not large enough to measure the overall class pyramid of the society) is often immaterial for health outcomes (*e.g.* Wilkinson 1997, Franzini *et al.* 2001, De Vogli *et al.* 2005, Wilkinson and Pickett 2006). Furthermore,

our estimation results are consistent with the earlier Finnish findings that have shown that income inequality is not related to alcohol-related mortality (Blomgren *et al.* 2006).

However, the finding according to which the health effect of income inequality may be gender-specific is particularly interesting, because the literature has not addressed this issue. Our results show that the gender-differences of the effect seem to prevail in the domain of objective health rather than in the domain of mental health. One possible reason for the finding that inequality has more bearing on the objective health of women in Finland is that their overall income stream is more dependent on income transfers by the public sector, as they are more often out of the labour force than men. There has been quite a substantial reduction in income transfers by the public sector in Finland since the great depression of the early 1990s (*e.g.* Riihelä *et al.* 2007), which may have hurt women more. Hence, further research on the difference is clearly needed. Another important finding of this paper is that only among the population aged less than 30 is there some indication that mental health is associated with inequality. The non-existence of gender differences in the effects of inequality on mental health speaks against the scanty evidence on differences in the perception of fairness between genders.

A potential limitation of the paper is that it is possible that there might not be enough regional variation in income inequality and health indications with which to identify statistically significant results. Furthermore, measures of health and income inequality are for some regions based on a small number of observations. We have however studied the robustness of the results in this respect, as discussed earlier. Another potential limitation is that in all the Nordic countries the level of relative public spending on health care and education is much higher than in the US, which may explain that few effects would be found when one is studying these countries. However, as Gerdtham and Johannesson (2004) argue in their study regarding Sweden, this particular feature should not invalidate the effect of income inequality on health as such, because public consumption is actually more heavily targeted towards low-income groups in the United States than in the Nordic welfare states, where almost all citizens are entitled to public consumption.

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Appendix

Table A1 *Descriptive statistics of the variables*

	Average	*Standard deviation*
Dependent variables:		
Good self-rated health	0.682	0.466
Good physical health	0.757	0.429
No stress	0.819	0.385
No medicines	0.857	0.350
No sick leave	0.403	0.491
No disability retirement	0.917	0.275
Explanatory variables:		
Gini coefficient	0.283	0.034
Regional income	10.598	0.142
Age	40.124	13.928
Female	0.539	0.499
Years of education	12.296	3.605
Married	0.637	0.481

Notes

1 There is also some cross-country evidence according to which inequality is negatively related to health (*e.g.* Babones 2008).

2 Some of the existing studies rely solely on cross-sectional variation in economic inequality (*e.g.* Diex-Roux *et al.* 2000, Kahn *et al.* 2000, Sturm and Gresenz 2002), which makes it hard to detect reliable patterns, because it is not possible to control for the permanent regional differences.

3 Blomgren *et al.* (2006) report that low social cohesion (family cohesion and voting turnout) produce adverse effects on alcohol-related mortality in Finland. However, they discover that neither mean income nor income inequality is related to alcohol-related mortality.

4 The variable 'No stress' does not capture all aspects of mental health. Stress and mental illness are not necessary the same thing. Although depression is often accompanied by high levels of anxiety, the chronic stress which can increase vulnerability to disease may fall a long way short of mental illness.

5 The wording of the question on self-rated health in the survey has remained exactly the same over the period 1993–2005. However, there has been a change in the order of the questions in the health survey. In particular, the question on self-rated health appeared before the questions on disease symptoms in 1994 and 1995. In and after 1996 the question on self-rated health was placed after the questions on disease symptoms. The reason for this change in the health survey was technical, because there was a need to keep certain questions on the same forms of the health survey. This change in the order of questions has most likely contributed to the decline in self-rated health, but we are unable to estimate its exact quantitative magnitude on the decline in self-rated health. That being said, all models that we estimate contain a full set of indicators for the years that control for unobserved determinants associated with the survey year.

6 Deaton (2001) notes that many of the earlier studies on economic inequality and health have been based on self-reported income measures that are known to contain a significant amount of measurement error and non-reporting that hinder efforts to identify robust effects.

7 The OECD-equivalent scale is incorporated into IDS data by Statistics Finland.

8 IDS data are based on a larger sample than the health survey. In particular, the number of households in IDS data ranges from 2414 in Uusimaa to 195 in Kainuu in 2005. (The average number of households for each region is roughly 550.) We have evaluated the standard errors of regional Gini coefficients. It turns out that the regional differences between the major regions of the country (for example, Southern Finland vs. Eastern Finland) are clearly statistically significant.

9 It is also interesting to note that incomes actually fell from 2000 to 2001. This is most likely due to extraordinarily high incomes from dividends and other capital income sources in 2000, which then fell sharply in 2001.

10 Differences in real household disposable income between regions are not as large as differences in the level of regional GDP per capita. The reason for this is that the public sector in Finland is fairly active in terms of regional policy, which effectively entails transfers from the high-income regions to the low-income regions (Loikkanen *et al.* 1998).

11 We are not able to take into account the regional differences in the price level, because Statistics Finland do not provide regional measures of costs-of-living at the provincial level.

12 Subramanian and Kawachi (2004) mention in their survey of the literature that this particular problem in the identification of the statistically significant relationships between economic inequality and health has not been taken into account in most of the existing studies.

13 It is noteworthy that regional Gini coefficients vary more in Norway than in Finland.

14 We have also estimated our baseline specifications reported in Table 5 separately for those who are below age 30. There is some evidence that mental health is negatively affected by income inequality. Other results remain the same.

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