

**Income Inequality and Health:
a review and explanation of the evidence**

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Income Inequality and Health: a review and explanation of the evidence

Abstract

Whether the scale of a society's income inequality is a determinant of population health is still regarded as a controversial issue. We decided to review the evidence and see if we could find a consistent interpretation of both the positive and negative findings.

We identified 169 analyses in 155 papers reporting research findings on the association between income distribution and population health. We classified them according to how far their findings supported the hypothesis that greater income differences are associated with lower standards of population health. Analyses in which *all* adjusted associations between greater income equality and higher standards of population health were statistically significant and positive were classified as “wholly supportive”; if none were significant and positive they were classified as “unsupportive”; and if some but not all were significant and supportive they were classified as “partially supportive”. Of those classified as either wholly supportive or unsupportive, a large majority (70 percent) suggest that health is less good in societies where income differences are bigger.

There were substantial differences in the proportion of supportive findings according to whether inequality was measured in large or small areas. We suggest that the studies of income inequality are more supportive in large areas because in that context income inequality serves as a measure of the scale of social stratification, or how hierarchical a society is.

We suggest three explanations for the unsupportive findings reported by a minority of studies. First, many studies measured inequality in areas too small to reflect the scale of social class differences in a society; second, a number of studies controlled for factors which, rather than being genuine confounders, are likely either to mediate between class and health or to be other reflections of the scale of social stratification; and fourth, the international relationship was temporarily lost (in all but the youngest age groups) during the decade from the mid 1980s when income differences were widening particularly

rapidly in a number of countries. We finish by discussing possible objections to our interpretation of the findings.

Introduction

Whether or not the extent of income inequality in a society is a determinant of population health remains a controversial issue despite a large body of research. Although the findings of a substantial majority of studies suggest that more egalitarian societies do have better health and longevity (Subramanian & Kawachi 2004; Lynch et al 2004a), a minority conclude otherwise and several authorities remain skeptical as to whether inequality has any implications for population health (Lynch et al 2004a; Deaton 2003). To gain a clearer understanding of the evidence and the nature of the disagreement, we decided to review all the research reports published in peer reviewed journals, and then to see if we could arrive at an interpretation of them which made sense of both the supportive and unsupportive findings.

The Review

We compiled a list of 155 published reports of research on the relation between income distribution and measures of population health. This is much the most comprehensive list of peer reviewed studies yet compiled: as well as containing all the studies listed in three previous reviews of parts of the literature (Hsieh & Pugh 1993; Subramanian & Kawachi 2004; Lynch et al 2004a), we also found 21 additional papers either by using electronic searches or through informal contacts. Several papers contained analyses at more than one level of aggregation (for example analyses of international data and data from states or regions within one country). Counting these separately, the 155 papers contained 169 separate analyses. To facilitate comparison, we decided to classify findings using the same criteria as Lynch et al (2004a). Thus we classified analyses into three categories according to their adjusted findings after the use of whatever control variables authors thought appropriate. We classified them as wholly supportive if they reported *only* statistically significant associations between greater income inequality and poorer population health; as unsupportive if they found *no* statistically significant positive associations; and as partially supportive or mixed if some, but not all, of the associations

they reported showed significant positive associations. [These categories correspond to those labeled “positive”, “negative” and “mixed” in Lynch et al (2004a)]

Findings

Table 1 provides a summary of the 169 analyses according to classification and the type of area over which inequality was measured. Table 2 lists all the analyses included according to their classification. A tally of numbers showed 88 wholly supportive analyses, 44 partially supportive, and 37 as unsupportive. Almost three-quarters of all analyses were classified as either wholly or partially supportive. Of all analyses classified as wholly supportive or unsupportive, 70 percent were wholly supportive. Given that almost every paper reported many different measures of association, for different health variables in different age, sex or ethnic subgroups, it is notable that only nine (classified as partially or unsupportive) contained any measures of an association suggesting a health variable was significantly better where inequality was greater. In no analysis were such associations the predominant finding.

However, our aim in this paper is to go beyond these crude totals which, take no account of methodological quality or statistical power, and to try to gain a theoretically coherent overview of the literature as a whole. We shall proceed by drawing attention to various patterns in the whole body of findings and the likely implications of each. In doing so we will outline a consistent interpretation of most of the evidence, both supportive and unsupportive. We shall end by discussing possible criticisms and alternative interpretations.

Explanations of findings

The size of area

Figure 1 shows the percentage of analyses classified as either wholly supportive or unsupportive according to whether they were international analyses using data for whole countries, whether their data were for large subnational areas such as states, regions and

metropolitan areas, or whether they were for smaller units such as counties, census tracts or parishes. The proportion of analyses classified as wholly supportive falls from 83 percent (of all wholly supportive or unsupportive) in the international studies, to 73 percent in the large subnational areas, to 45 percent among the smallest units.

The tendency towards more positive findings in the largest areas compared to the smallest is important and has already received some attention in the literature (Subramanian & Kawachi 2004). The same pattern was observed in a review of studies of the relation between homicide and inequality (Hsieh & Pugh 1993). It was also shown in a study by Franzini et al (2001) comparing the strength of association among the counties of Texas according to population size. Wilkinson (1997) has argued that income inequality in small areas is affected by the degree of residential segregation of rich and poor and that the health of people in deprived neighbourhoods is poorer not because of the inequality *within* their neighbourhoods, but because they are deprived in relation to the wider society. If that is what matters, then it is to be expected that inequality will only be sensitive to this broader pattern of deprivation if inequality is measured across the wider framework in which the relevant social comparisons are made. The fact that measures of inequality made across larger areas are more closely related to health bears out this point.

This takes us to a familiar and difficult question: if inequality is important, what are the relevant social comparisons? Rather than suggesting any new causal processes or framework of comparisons which affect health, it is more parsimonious to suggest that inequality is related to health insofar as it serves as a measure of the extent of the same processes of class differentiation and social distances in a society which are responsible for class differences in health. The processes which lead to class differences in health are likely to be closely related to those which explain why greater inequality is related to worse health. If that is right, then the question then becomes one of the scale of the social units in relation to which one's class position is defined. The broad impression is that social class stratification establishes itself primarily as a national social structure, though there are perhaps also some more local civic hierarchies – for instance within cities and

US states. But it should go without saying that classes are defined in relation to each other: one is higher because the other is lower, and vice versa. The lower class identity of people in a poor neighbourhood is inevitably defined in relation to a hierarchy which includes a knowledge of the existence of superior classes who may live in other areas some distance away.

Control variables

If, in the association between income inequality and health, we are seeing the effects of the scale of social class stratification, of bigger or smaller class differences, then it is hard to decide what are legitimate variables to use as controls when analysing that association. What is part of class and what is not? If we had classified analyses by their findings *before* the use of control variables, 21 of the 37 studies we have listed as unsupportive of an association between income distribution and health actually started off with supportive findings but then lost them as a result of the various control variables they used.

A wide variety of control variables have been used, including the percent without a high school education (Muller 2002), individual income (reviewed in Subramanian & Kawachi 2004), perceived control (Bobak et al 2000), ethnicity (Deaton & Lobotsky 2003; Blakely et al 2003), social capital (Veenstra 2002a), and unemployment (Shi & Starfield 2000). Subramanian and Kawachi (2004) have a useful discussion of possible confounding by education, individual income, race, and regional effects. To know which are genuine confounders and which are pathway, or mediating, variables means – for us – knowing what is part of social class and what is not. If ethnicity is related to health because it is a proxy for a classification by class, then perhaps we should not control for ethnicity.

Similarly, if Sahlins (1974) was right to say “Poverty is not a certain small amount of goods (but)...a relation between people...a social status...an invidious distinction between classes...” (p. 37), then it may be misconceived even to control for individual income. Marmot (2004) and others (Charlesworth et al. 2004; Wilkinson 2005; Singh-Manoux et al 2003) have argued that the relation between health and social status may be

primarily a reflection of social position. If this view is right, then to control analyses of inequality for individual income may be like controlling the effects of class stratification for individual social status.

However, even if this objection to controlling for individual income is ignored, it appears that despite often using small areas, analyses of inequality which use multilevel methods have usually been able to identify inequality effects even after controlling out the effects of individual income (Subramanian & Kawachi 2004).

That there are so many correlates of income distribution is consistent with our view that income inequality is an indicator of the extent of social stratification and points to the need to think carefully about which factors are confounders and which are mediators in this relation.

Discussion

Taking account of the size of the area and the use of control variables reveals a high degree of consistency in the research findings. Thus if we confine our attention to the 129 analyses which use data for areas the size of metropolitan areas or larger, only 23 fail to find some support for the hypothesis. If we were to reclassify analyses on the basis of results before the use of potentially problematic control variables (including individual income in multilevel models), then only eight (6 percent) of the 129 analyses would remain classified as unresponsive.

The extent of social class divisions may vary substantially from country to country: we know that human beings have lived in every kind of society from the most egalitarian (Erdal & Whiten 1996) to the most tyrannical. Given the importance of the social class gradient in health, the extent of social class inequality is not a variable we can ignore. Several variables may provide rough measures of the extent of social class differentiation; however, we think income inequality is likely to be one of the most widely applicable. Other indicators might include educational differences, inequalities in the distribution of power or wealth, and perhaps the Social Dominance Orientation Scale

(Sidanius & Pratto 1999). Although income inequality may not be the best measure of social hierarchy in *all* cultures, the fact that dominance hierarchies (in human societies as among animals) are fundamentally about privileged access to scarce resources, may mean that differences in income and/or wealth are particularly apposite and so may be among the most widely applicable indicators of rank difference across cultures. But even if there are better measures – perhaps ones which include measures of ownership of assets, income inequality has the substantial advantage that it is collected for numerous other purposes and so can be used in secondary data analyses. We hope that this interpretation may bring us closer to the thinking of others working in this field and narrow the area of controversy (Lynch et al 2004; Deaton 2003).

The interpretation of the evidence which we have put forward has the advantage of simplicity. Instead of suggesting that inequality is a new risk factor for health, it may be telling us more about the already widely recognised health effects of socioeconomic status and class. This may be simply that larger class differences lead to a steeper social gradient in health, but it could also be that a society more dominated by status competition and class differentiation suffers a more widespread health disadvantage. It is already clear from studies designed to illuminate this issue, that the health disadvantage of inequality is not confined to the poorest (Kennedy et al 1998; Lochner et al 2001).

Counter arguments

What are the objections and counter arguments to these interpretations? The most important is undoubtedly that income is related to health because it is a determinant, not of class differences or social position, but of material living standards which it is claimed continue to exert a major direct influence on health. However, although raising absolute material living standards continues to be important in developing countries, among the 25 or 30 richest countries there is no relation between Gross National Income per capita and health (Marmot & Wilkinson 2001; Wilkinson 1997) – even though curves are sometimes still fitted to the data to suggest otherwise (Lynch et al 2004a). If absolute living standards were overwhelmingly important, it would be difficult to understand why, despite having a median income four times as high, life expectancy among black men in

the USA was nine years shorter than for men in Costa Rica (Marmot & Wilkinson 2001). Similarly Greece, with half the average real income of the US has, like many other developed countries, better life expectancy. Indeed, in a regression of life expectancy against income distribution and Gross National Product per capita among 21 rich countries, we found only income distribution had significant independent effects on life expectancy. Gross National Product per capita showed no sign at all – regardless of statistical significance – of an independent association.

Alongside reasons such as these for discounting the continued primacy of material influences on health in the rich countries, the relation between income inequality and homicide (Hsieh & Pugh 1993) shows beyond doubt that inequality does have powerful psychosocial and behavioural effects (Wilkinson 2004). Indeed, the relation with homicide appears to be part of a more general effect which inequality has on social capital and the quality of social relations, both of which might be expected to influence health. As well as having higher levels of violence, people in more unequal societies also seem less likely to trust others and less likely to be involved in community life (Wilkinson 2005). Other examples of behavioural effects of inequality include higher teenage pregnancy rates (Pickett et al 2005a; Gold et al 2004) and more obesity (Pickett et al 2005b). While it is easy to understand why inequality and increased status differentiation should affect both health and behaviour through psychosocial stress (Wilkinson 2005), it would be hard to argue that material factors could affect behaviour unless it was through psychosocial pathways.

A second potential criticism of our interpretation of the studies of income inequality and health is the view, derived from relative deprivation theory, that people compare themselves with near equals. No doubt this explains why some have chosen to measure inequality in small areas, intending to capture the effects of these social comparisons rather than focusing on the wider structure of inequality. However, people's judgment of who their near equals are is dependent on a prior recognition of our class identity and where we fit into the wider class structure. The logic of what is happening in a dominance hierarchy when comparisons appear to be between near equals was spelt out

by Sapolsky when describing conflict over rank among baboons in the Serengeti. They too seem to compare themselves with near equals:-

“A pattern emerged that has grown familiar to me over the years. When you look at the frequencies of dominance interactions, the typical pattern you see is that, for example, number 4 is having his most interactions with 3 and 5, losing to the former, defeating the latter. Number 17 mostly interacts with 16 and 18.” (Sapolsky 2001, p. 95)

But, as Sapolsky points out, there is no point in animals fighting those which are clearly much higher or lower in the dominance hierarchy: because the outcome is predictable the subordinate must recognise its inferiority and avoid making a challenge. The fact that it is only among near equals that rank is contestable, and only among them that it is necessary to make careful comparisons – and tests – of relative strength, does not mean that the rest of the social hierarchy is irrelevant. If an individual failed to recognise its superiors and caused them offence, it would get beaten up. Similarly, if it did not assert its status over inferiors, it would rapidly lose rank. Who counts as a near equal is of course only the converse of recognising who, by virtue of their social superiority or inferiority, is not a near equal. Much the most important thing for a middle ranking baboon to keep in mind is that he is inferior to half the troop and superior to the other. The logic of social status is the same among humans. Rather than being defined by the outcome of interactions with near equals, our class status is constituted primarily by our acknowledgment – on the one hand – of the social superiority of those to whom we show deference and respect, and on the other, our superiority to those of lower status whom we so often ignore and exclude.

Just as baboons conflict with near neighbours, we exclaim “Who do they think they are?” not so much at the behaviour of people we had long recognised as higher status, but when those we regard as our equals pretend to superiority over us. To maintain rank we have to pay attention to the fine grain of social status: that means keeping up with the Joneses. But that does not mean our position is defined regardless of the rest of the class hierarchy.

It is quite clear that our sense of class identity comes from a recognition of our position in the wider society. Because classes are mutually defining, it would be impossible for researchers to identify the effects of the social status differentiation, and of our class identity within it, in a statistical context (such as a small, residentially segregated, neighbourhood) which excluded much richer or poorer neighbourhoods.

Sometimes discussion of these issues is further confused by arbitrarily labeling an income variable as absolute rather than relative income. This is important because it is often assumed that a relation between health and absolute income reflects the direct effects of material living standard on health – regardless of the rest of society, whereas any affect of relative income is assumed to reflect psychosocial processes contingent on social status or social comparisons. But in different analyses income differences which are called absolute in one context are called relative in another, apparently without anyone noticing. Income differences which make up income inequality within large areas can of course be broken down into inequalities within and between smaller constituent areas. The smaller and more numerous the constituent areas used, the more of the income inequality in the larger areas gets converted into income differences *between* the small areas and the less that remains as inequality within them. That conversion can be done almost *ad infinitum* until, at the limit, all inequality is reduced to differences in income between the smallest (single household) areas. Nevertheless, income differences between small areas are almost always naïvely labeled as differences in “absolute” income, even though it may be obvious that an area has bad health because it is poor or lower class *in relation to the rest of society*. Only the residual income differences remaining within the small areas are labeled “relative” income as if poor health in deprived areas is explained by the inequality within those areas. How much of the income differences in a society are analysed as income differences within, and how much between, small areas is nothing more than a by-product of the choice of units of analysis.

In this situation what tends to happen is that people look for an effect of income inequality in small areas, find it weak or non-existent, and report an association between health and the average income of the small areas. Instead of interpreting that as an effect

of low income *relative* to the wider society, it is interpreted as evidence of a direct effect of material living standards.

If health among the developed countries is unrelated to the big differences in material living standards between countries, then why should the same differences in living standards have an effect on health when they occur within the same society? The truth is surely that income is related to health where – as within countries – it serves as a marker for position in the national structure of class inequality.

For those who still prefer to believe in the primacy of the direct effects of material living standards on health, and interpret the association between income inequality and health as a reflection of a curvilinear relation between individual income and health, there is one more major obstacle. Although it once seemed plausible that the curvilinear relation between individual income and health reflected a tendency towards diminishing health returns to increased income, so that any given sum of money made more difference to the health of the poor than the rich, such a pattern cannot explain the findings of this review. If the relation between individual income and health resulted simply from the healthfulness of whatever material standard of living a given income can buy, then these effects would be just as apparent if inequality was measured in small areas as in large areas. According to that interpretation it is the incomes themselves which count – regardless of their social meaning. We would then be left with no explanation of why the overwhelming majority of studies which measure inequality in large areas do report associations whereas only a minority of those using data for small areas do. This confirms our view (expressed above) that it is mistaken to control for individual income in multilevel models because it amounts to controlling the effects of income (and class) inequality for the effects of individual social status. It also seems likely that if we were dealing with the material effects of individual income they would be harder to control away than the effects of class inequality and social differentiation for which we believe income inequality is merely a proxy.

International analyses

Perhaps the most important set of results which our interpretation does not explain, is a small group of international studies using data from between the later 1980s and the mid 1990s. Although 30 of the 45 international studies are classified as wholly supportive and a further nine as partially supportive, there are nevertheless four classified as unsupportive which cannot be attributed to the use of inappropriate control variables, and so run counter to the interpretation we have advanced in this paper.

During the 1980s and early 1990s, when income differences were widening particularly rapidly in many countries, much of the relation between inequality and mortality among rich countries temporarily disappeared (Judge 1995; Gravelle et al 2002; Mellor & Milyo 2001; Wildman et al 2003). What happened varied by age group (Judge et al 1998; Lobmayer & Wilkinson 2000; Lynch et al 2001). While infant mortality rates remained consistently related to inequality, the relation was entirely lost with death rates among the middle aged and elderly. The relation was clear earlier on (Wilkinson 1992) and has now reappeared (De Vogli et al 2005). It is noticeable that the publication dates of the positive international studies tends to be earlier than the mixed and negative ones.

The three most likely explanations of why the international relationship temporarily disappeared – except with health in the youngest age groups – are: first, that it was affected by the downward shift in the age distribution of relative poverty which took place in many countries. Although relative poverty had been more common among the elderly, it became more common among young families with children (Kangas & Palme 1998). Second; in one country after another, death rates among older people began an unprecedentedly rapid decline. A contributing factor may have been the widespread use of drugs to lower blood pressure and cholesterol levels. It appears that the timing of the onset of the decline was earlier in some countries than others. It may therefore have affected international comparisons of mortality before the decline (and perhaps the use of these drugs) became general. Interestingly, three of the very few statistically significant *negative* associations (greater inequality related to better health) reported in any of the studies were international studies among rich countries of inequality in relation to death

rates among the elderly. The third possible explanation is that the changes in income distribution may have had lagged effects on mortality, particularly on mortality at later ages (Subramanian & Kawachi 2004). Although income differences widened particularly rapidly in many countries during the 1980s and 1990s, the relationship between income distribution and infant mortality may have remained throughout because lag times are probably shortest at youngest ages. Mayer and Sarin (2005) found that neonatal mortality rates are significantly more closely related to current inequality than to inequality five years earlier, whereas Subramanian and Kawachi (2004) found the strongest associations with adult health after a lag of ten or fifteen years. Health among adults may then reflect the inequalities of the past

Mechanism

Low social status and the quality of the social environment are both known to affect health (Marmot & Wilkinson 1999; Berkman & Kawachi 2000). Not only are more unequal societies likely to have a bigger problem of low social status, but there is now substantial evidence to suggest that inequality is socially corrosive, leading to more violence, lower levels of trust, and lower social capital (Wilkinson 2005). Psychosocial factors, many of which are associated with low social status, are known to affect health partly through direct physiological effects of chronic stress (Brunner & Marmot 1999), and partly through their influence on health related behaviour. Marmot (2005) has argued that low social status is stressful because it reduces people's control over their lives and work. Others have argued that low social status is stressful because people are made to feel looked down on, devalued and inferior (Charlesworth et al 2004; Wilkinson 2005). Both suggestions are borne out by a recent review of the most salient stressors affecting cortisol responses (Dickerson & Kemeny 2004). What matters most are uncontrollable threat to one's social esteem, value and status. As well as explaining the relationship between health and inequality, this approach is concordant with the suggestion that inequality is related to violence because the increased burden of low social status makes more people feel disrespected. Feeling disrespected, put down and humiliated is much the most frequent trigger to violence (Gilligan 1996; Wilkinson 2004).

Conclusions

Our interpretation of 169 analyses of the relationship between income inequality and health is that income distribution is related to health where it serves as a measure of the scale of social class differences in a society. In small areas, where income inequality is unlikely to reflect the degree of social stratification in the wider society, it is – as figure 1 shows – less likely to be related to health. The overwhelmingly positive evidence from studies of larger areas suggests that this interpretation is correct. The fact that social stratification is such a fundamental feature of social organization explains why there are so many socioeconomic factors correlated with inequality. Many will function, like income inequality itself, as other proxy indicators of the extent of social stratification or socioeconomic inequality. Others still may be mediating or pathway variables.

The methods researchers have used to test the hypothesis that greater inequality is associated with poorer population health have reflected many different assumptions about the mechanisms involved. In effect, a whole family of quite different hypotheses about income distribution and health have been tested. The two most important kinds of differences between the tests are those we have discussed: first, the different sizes of areas in which people have thought inequality most likely to be salient, and second, in what are regarded as legitimate control variables. Studies which have analysed data for areas as small as parishes, and controlled for things as closely related to class as education differentials, have helped clarify how income inequality does not work. Hypotheses about mechanisms take them into account. Similarly, the suggestion that the percent of the population who are black explains away the income inequality relation at state (if not county) level in the USA, has been regarded by some as a falsification of the inequality hypothesis; but we think it comes closer to being a confirmation of the underlying view that what matters is the extent of social class differentiation. No one suggests that it is blackness itself which matters. Rather it is the social meaning attached to it – the fact that it serves as a marker for class and attracts class prejudice – which leads both to worse health and to wider income differences. Future tests of the theory that

the extent of class inequality is a determinant of population health must test its most plausible form.

One of the most important points to come out of this debate is that there are likely to be fundamentally important and measurable differences in the extent of socioeconomic stratification in different societies. While income distribution is a convenient and widely applicable measure, we hope that better ones may be found.

We recognise that when discussing physical health, it has been possible for some to deny the involvement of psychosocial pathways and argue that differences in health – such as those we see in the social gradient in health or in the relation between population health and inequality – are the direct and unmediated effects of exposure to different material circumstances. However, if the argument were to move on to try to explain a range of *behavioural* outcomes which also show social gradients and relations with inequality, it becomes impossible to deny psychosocial mediation. So for instance in the very well established relation between violence and inequality, we are necessarily concerned with a causal chain which runs all the way from the material facts of inequality to the psychosocial effects which lead to violence. The same is presumably true of other behavioural outcomes – such as teenage pregnancy, obesity and trust – which seem to be related to inequality as well as showing social gradients. If psychosocial processes consequent on low social status are recognised as having health effects, then it seems unlikely that they will not also have behavioural consequences. Perhaps there are some common pathways involved in the wide range of problems known to be more common in poorer areas. The possibility of a general theory of social gradients capable of explaining, and of policy prescriptions capable of reducing, a wide range of social ills at once, is obviously a worthwhile objective.

Table 1. Summary of results of 169 analyses of the relation between income distribution and population health contained in 155 papers.

(In parentheses: homicide studies.)

	Wholly Supportive <i>Only sig. positive findings</i>	Partially Supportive Some sig. positive & some null.	<u>Unsupportive</u> No sig. positive findings	Total All studies	Wholly supportive as % of all analyses excluding partially supportive
Nations	30 (11)	9	6	45 (11)	83%
States, Regions, Cities	46 (13)	21	17	84 (13)	73%
Counties, tracts, parishes	12 (2)	14	14 (1)	40 (3)	45%
Total	88 (26)	44	37 (1)	169 (27)	70%

Table 2: Studies of income inequality and health

Table footnote:

This table contains the 98 studies reviewed by Lynch et al (2004) (including all peer-reviewed studies in Subramanian & Kawachi (2004)) and the 20 studies of income inequality and homicide reviewed by Hseih and Pugh (1993), as well as 37 additional studies which were omitted from earlier reviews or have been published more recently. These 155 papers contain the 169 separate analyses listed here. To aid comparisons with other reviews the following notation is used in the table.

^N denotes new and previously omitted studies (n=37)

^H denotes studies where homicide was the only outcome (n=25)

^{RC} denotes studies that we re-classified from the Lynch et al (2004) review, as results did not match the classification given previously (n=6)

^M denotes multi-level, rather than ecological studies, although not all of these use appropriate multi-level statistical techniques

^U denotes “unsupportive” studies that reported an unadjusted association between income inequality and health that was removed when inappropriate control variables were added to models.

	Supportive studies	Mixed studies	Unsupportive studies
INTERNATIONAL STUDIES	<p>Avison & Loring, 1986^H Davey Smith & Egger, 1996 De Vogli, Mistry, Gnesotto, & Cornia, 2005^N Drain, Smith, Hughes, Halperin & Holmes, 2004^N Duleep, 1995 Fajnzylber, Lederman, & Loayza, 2002^{N, H} Flegg, 1979, 1982 Groves, McCleary, & Newman, 1985^H Hales, Howden-Chapman, Salmond, Woodward, & Mackenbach, 1999 Hansmann & Quigley, 1982^H Kick & LaFree, 1985^H Krahn, Hartnagel, & Gartrell, 1986^H Krohn, 1976^H Lee & Bankston, 1999^H Legrand, 1987 Macinko, Shi, & Starfield, 2004 Marmot & Bobak, 2000 McIsaac & Wilkinson, 1997 Messner, 1980^H, 1982^H, 1989^H Pampel & Zimmer, 1989 Pickett, Kelly, Lobstein, Brunner, & Wilkinson, 2005^N Pickett, Mookherjee, & Wilkinson,</p>	<p>Ellison, 2002 Judge, Mulligan, & Benzeval, 1998 Lester, 1987^N Lobmayer & Wilkinson, 2000 Lynch, Smith, Hillemeier, Shaw, Raghunathan, & Kaplan, 2001^{RC} Pampel, 2002^M Pampel & Pillai, 1986 Ross, Dorling, Dunn, Hendricksson, Glover, & Lynch, 2005^N Weatherby, Nam, & Isaac, 1983</p> <p>9 studies</p>	<p>Beckfield, 2004^{N, U} Bobak, Pikhart, Rose, Hertzman, & Marmot, 2000^{M, U} Gravelle, Wildman, & Sutton, 2002 Judge, 1995 Mellor & Milyo, 2001 Wildman, Gravelle, & Sutton, 2003</p> <p>6 studies</p>

	<p>2005^N Rodgers, 2002 Steckel, 1983 Waldmann, 1992 Wennemo, 1993 Wilkinson, 1992</p> <p>30 studies, including 11 of homicide only</p>		
<p>STATES, REGIONS, METROPOLITAN AREAS 1. US states</p>	<p>Baron & Straus, 1988^H Blakely, Kennedy, Glass, & Kawachi, 2000^M Blakely, Kennedy, & Kawachi, 2001^M Daly, Wilson, & Vasdev, 2001^H Gold, Kennedy, Connell, & Kawachi, 2002^N Holtgrave & Crosby, 2004^N Huff-Corzine, Corzine, & Moore, 1986^H Kahn, Wise, Kennedy, & Kawachi, 2000^M Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996 Kawachi & Kennedy, 1997 Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997</p>	<p>Blakely, Lochner, & Kawachi, 2002 Daly, Duncan, Kaplan, & Lynch, 1998^M Diez-Roux, Link, & Northridge, 2000^M Holtgrave & Crosby, 2003 Kahn, Tatham, Pamuk, & Heath, 1998 Laporte, 2002^{RC} Lochner, Pamuk, Makuc, Kennedy, & Kawachi, 2001^M Lynch, Smith, Harper & Hillemeier, 2004^N Mayer & Sarin, 2005^{N,M} Mellor & Milyo, 2001 Reagan & Salsberry, 2005^{N,M} Shi, Macinko, Starfield, Politzer, Wulu, & Xu, 2004^N</p>	<p>Deaton & Lubotsky, 2003^U Henderson, Liu, Diez Roux, Link, & Hasin, 2004^{M,U} McLeod, Nonnemaker & Call, 2004^{N,U} Mellor & Milyo, 2002^{M,U}, 2003^{M,U} Muller, 2002^U Shi, Macinko, Starfield, Xu, & Politzer, 2003^U</p> <p>7 studies</p>

<p>2. Canadian provinces</p>	<p>Kennedy, Kawachi, Glass, & Prothrow-Stith, 1998^H Kennedy, Kawachi, & Prothrow-Stith, 1996 Kennedy, Kawachi, Prothrow-Stith, Lochner, & Gupta, 1998^M Loftin & Hill, 1974^H Pickett, Kelly, Lobstein et al., 2005^N Pickett, Mookherjee, & Wilkinson, 2005^N Ross, Wolfson, Dunn, Berthelot, Kaplan, & Lynch, 2000^{RC} Shi, 1999 Smith & Parker, 1980^H Subramanian, Blakely, & Kawachi, 2003^M Subramanian & Kawachi, 2003^M, 2004^N Wilkinson, Kawachi, & Kennedy, 1998 Wolfson, Kaplan, Lynch, Ross & Backlund, 1999^N</p> <p>25 studies, including 6 of homicide only</p> <p>Daly, Wilson, & Vasdev, 2001^H</p>	<p>Subramanian, Kawachi, & Kennedy, 2001^M</p> <p>13 studies</p>	<p>Laporte & Ferguson, 2003 Ross, Wolfson, Dunn et al., 2000</p>
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3. UK regions		Weich, Lewis, & Jenkins, 2001 ^M , 2002 ^M	
4. Spanish regions			Regidor, Calle, Navarro, & Dominguez, 2003 Regidor, Navarro, Dominguez, & Rodriguez, 1997
5. Brazilian states			Messias, 2003 ^U
6. Italian regions	De Vogli, Mistry, Gnesotto et al., 2005 ^N		
7. Russian regions	Walberg, McKee, Shkolnikov, Chenet, & Leon, 1998		
8. Chilean regions	Subramanian, Delgado, Jadue, Vega, & Kawachi, 2003 ^M		
9. Israeli regions		Shmueli, 2004 ^N	
10. Finnish regions			Blomgren, Martikainen, Makela, & Valkonen, 2004 ^{N,M}
11. Ecuadorean regions	Larrea & Kawachi, 2005 ^{N,M}		

<p>Metropolitan areas and cities – studies are of USA unless otherwise noted</p>	<p>Bailey, 1984^H Balkwell, 1990^H Blau & Blau, 1982^H Chiang, 1999 - <i>Taiwan</i> Cooper, Kennelly, Durazo-Arvizu, Oh, Kaplan, & Lynch, 2001 Kahn, Patel, Jacobs, Calle, Kennedy & Kawachi, 1999^N Kennedy, Silverman, & Forde, 1991^H - <i>Canada</i> Loftin & Parker, 1985^H Lopez, 2004^N Lynch, Kaplan, Pamuk, Cohen, Heck, Balfour et al., 1998 Messner, 1983^H Ronzio, 2003^N Ronzio, Pamuk & Squires, 2004^N Sanmartin, Ross, Tremblay, Wolfson, Dunn, & Lynch, 2003^N Shi & Starfield, 2000^M, 2001^{RC}</p> <p>16 studies, including 6 of homicide only</p>	<p>Blakely, Lochner, & Kawachi, 2002^{M, RC} Larrea & Kawachi, 2005^{N, M} - <i>Ecuador</i> Lobmayer & Wilkinson, 2002 Sanmartin, Ross, Tremblay et al., 2003^N - <i>Canada</i> Shi, Starfield, Politzer, & Regan, 2002^M</p> <p>5 studies</p>	<p>Deaton & Lubotsky, 2003^U McLeod, Lavis, Mustard, & Stoddart, 2003^M - <i>Canada</i> Mellor & Milyo, 2002^{M, U} Sturm & Gresenz, 2002^{M, U}</p> <p>4 studies</p>
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<p>SMALL AREAS: COUNTIES, NEIGHBORHOODS, ZIP CODES, CENSUS TRACTS, PARISHES ETC – studies are of USA unless otherwise noted</p>	<p>Baldani, Vasconcelos & Antunes, 2004^N Galea, Ahern, Vlahov, Coffin, Fuller, Leon et al., 2003^M Gold, Kawachi, Kennedy, Lynch, & Connell, 2001^N Messner & Tardiff, 1986^H Massing, Rosamond, Wing, Suchindran, Kaplan, Tyroler, 2004^N Muramatsu, 2003^N Pattussi, Marcenes, Croucher & Sheiham, 2001^N - <i>Brazil</i> Shi, Macinko, Starfield, Xu, Regan, Politzer, & Wulu, 2005^N Soobader & LeClere, 1999^M Stanistreet, Scott-Samuel, & Bellis, 1999 - <i>UK</i> Subramanian, Delgado, Jadue et al., 2003 - <i>Chile</i> Szwarcwald, Bastos, Viacava, & de Andrade, 1999^H - <i>Brazil</i></p> <p>12 studies, including 2 of homicide only</p>	<p>Brodish, Massing, & Tyroler, 2000 Fiscella & Franks, 2000^M Franzini, Ribble, & Spears, 2001 Gold, Connell, Heagerty, Bezruchka, Davis, Cawthon, 2004^{N,M} Hou & Chen, 2003 LeClere & Soobader, 2000^M McLaughlin & Stokes, 2002 McLaughlin, Stokes, & Nonyama, 2001 Osler, Christensen, Due, Lund, Andersen, Diderichsen et al., 2003^M - <i>Denmark</i> Osler, Prescott, Gronbaek, Christensen, Due, & Engholm, 2002 - <i>Denmark</i> Robert & Reither, 2004^{N,M} Sohler, Arno, Chang, Fang, & Schechter, 2003 Szwarcwald, Andrade, & Bastos, 2002^{RC} - <i>Brazil</i> Veenstra, 2002a - <i>Canada</i></p> <p>14 studies</p>	<p>Blakely, Atkinson, & O'Dea, 2003^{M,U} - <i>New Zealand</i> Blakely, Lochner, & Kawachi, 2002^U Drukker, Feron, & van Os, 2004^N - <i>Netherlands</i> Fiscella & Franks, 1997^{M,U} Franzini & Spears, 2003^M Hou & Myles, 2005^{N,M,U} - <i>Canada</i> Larrea & Kawachi, 2005^{N,M,U} - <i>Ecuador</i> Lorant, Thomas, Deliege, & Tonglet, 2001 - <i>Belgium</i> Muntaner, Li, Xue, O'Campo, Chung, & Eaton, 2004^{N,M,U} Osler, Prescott, Gronbaek et al., 2002^{M,U} - <i>Denmark</i> Shibuya, Hashimoto, & Yano, 2002^M - <i>Japan</i> Szwarcwald, Bastos, Viacava et al., 1999 - <i>Brazil</i> Veenstra, 2002b^U - <i>Canada</i> Wen, Browning, & Cagney, 2003^M</p> <p>14 studies, including 1 of homicide only</p>
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