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Income inequality and schizophrenia: Increased schizophrenia incidence in countries with high levels of income inequality

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Abstract

Background—Income inequality is associated with numerous negative health outcomes. There is evidence that ecological level socio-environmental factors may increase risk for schizophrenia.

Aims—The aim was to investigate whether measures of income inequality are associated with incidence of schizophrenia at the country level.

Method—We conducted a systematic review of incidence rates for schizophrenia, reported between 1975 and 2011. For each country, national measures of income inequality (Gini coefficient) along with covariate risk factors for schizophrenia were obtained. Multilevel mixed-effects Poisson regression was performed to investigate the relationship between Gini coefficients and incidence rates of schizophrenia controlling for covariates.

Results—One hundred and seven incidence rates (from 26 countries) were included. Mean incidence of schizophrenia was 18.50 per 100,000 (SD 11.9; range=1.7-67). There was a significant positive relationship between incidence rate of schizophrenia and Gini coefficient (β = 1.02; Z = 2.28; p = 0.02; 95% CI 1.00, 1.03).

Conclusions—Countries characterized by a large rich-poor gap may be at increased risk of schizophrenia. We suggest that income inequality impacts negatively on social cohesion, eroding social capital; and that chronic stress associated with living in highly disparate societies places individuals at risk of schizophrenia.

Keywords

Schizophrenia; Gini coefficient; Income inequality; systematic review

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Introduction

Socio-environmental risk factors for schizophrenia can be classified in terms of individual factors and neighbourhood-level or ecological factors. Individual factors include unemployment, low socio-economic status and migration (Byrne et al, 2004; Cooper, 2005; Marwaha & Johnson, 2004; Subramanian & Kawachi, 2004), while neighbourhood-level factors include urbanicity, ethnic density and deprivation (Kirkbride et al, 2007; Krabbendam & van Os, 2005; van Os et al, 2005). A criticism of this research field, which is in fact a criticism relevant to much social science research, is that the investigation of socio-environmental factors in the environment invariably focuses on poverty and deprivation to the exclusion of other important variables. One such variable is *income inequality*. Income inequality is a measure of the ‘rich-poor gap’ in any given society and therefore it exists at the ecological level. It reflects the extent to which a society is unequal in terms of income distribution. This is a concept of great relevance to South Africa, a country that ranks among the most inequitable in the world (Leibbrandt et al, 2010).

Social determinants of health (SDH) – the conditions in which individuals live and work - is a concept that has garnered increasing attention in relation to its role in perpetuating health inequity within and across countries (Marmot & Wilkinson, 2006). At the macro-level, SDH include categories that stratify societies hierarchically, such as social class, education, gender, race and income. Income inequality can thus be defined as a social determinant of health that affects risk of illness, and actions taken to prevent and treat illness on an individual, community, societal, and global level (Marmot, 2007). With this understanding, it becomes vitally important to understand the relationship between the SDH of income inequality and health outcomes.

There are many associations between income inequality and health status. The absolute income hypothesis describes a ‘curvi-linear’ relationship between health and income in which health improves with average income but at a decreasing rate (Subramanian & Kawachi, 2004). This curvi-linear relationship supports the finding of Croudace et al (2000) of a non-linear relationship between deprivation and incidence of schizophrenia. Wilkinson (1992; 1996) demonstrated in the 1980s and 1990s that the relative distribution of income in a society matters in its own right for population health. Specifically, the Wilkinsonian hypothesis asserts that health depends on the degree of income inequality in a given society, suggesting that for any given average level of income, the more equally distributed the income is, the higher the average standard of health (Wilkinson, 1996). This has been supported by subsequent research (Babones et al, 2008; Elstad, 2011; Kawachi et al, 2002; Kondo et al., 2009; Subramanian & Kawachi, 2004). Increasing income inequality has been associated with increased infant mortality rates (Wilkinson, 1996), increased risk for cardiovascular disease (Diez-Roux et al, 2000), reduced life expectancy (Kennedy et al, 1996) and common mental disorders such as anxiety, depression and suicide (Gunnell et al, 2003; Kahn et al, 2000; Weich et al, 2001).

It is important to note that income inequality appears to have a negative effect on a wide array of health and mental issues and this is thought to relate to the erosive effect of income inequality on social capital. It is also important to note that critics of the 'income inequality hypothesis' maintain that the apparent association between income inequality and poor health outcomes is a 'statistical artifact' related to inadequately estimating this association using an inappropriate geographical scale (Gravelle, 1998; Gravelle, et al, 2002; Jen, Jones & Johnstone, 2009a; 2009b; Lorgelly & Lindley, 2008). These authors refute the Wilkonsonian hypothesis as simplistic and subject to the ecological fallacy.

Despite opposing views about the role of income equality and health outcomes, two mental health studies explored and found a significant association between income inequality and the incidence of schizophrenia. Both studies measured income inequality at municipal or ward level (Boydell et al., 2004; Burns & Esterhuizen, 2008). A study led by Boydell and colleagues (2004) demonstrated that in the most deprived electoral wards in South London, the incidence of schizophrenia increased with increasing inequality. This finding should be treated with some caution since it emerged from a post hoc analysis of the primary results. In a separate study, Burns and Esterhuizen (2008) found a significant association between increasing income inequality and treated incidence of first-episode psychosis across seven mixed urban and rural municipalities in KwaZulu-Natal Province in South Africa, irrespective of levels of deprivation of municipalities.

The objective of the current study was to investigate the association between income inequality and incidence of schizophrenia at the level of countries. In the current study, a systematic review of the literature was conducted, and multiple incidence rates of schizophrenia were clustered according to countries and compared based on income inequality measures reported for those countries.

Methods

Measures

A systematic review of the literature was conducted. Inclusion and exclusion rules were as follows. Studies reporting original data on incidence of schizophrenia and published between January 1975 and March 2011 were identified through MEDLINE and PsychInfo database searches (using the search terms 'schizophrenia' and incidence'), as well as from the citations of major review papers (especially McGrath et al, 2004). Studies were included if they reported primary data on incidence rates of schizophrenia (using a range of diagnostic criteria) and were drawn from general population samples. Migrant studies were included if they reported incidence rates for general population samples, and birth cohort studies were included if they reported incidence per 10,000 or 100,000 population. Studies reporting incidence rates for special populations only (e.g. twins, specific ethnic groups, students) were excluded. Where studies only reported incidence rates for males and females and not for the combined population, a mean incidence rate was computed and included. Where papers reported data that overlapped (e.g. overlapping time periods in the same population), the paper covering the longest period was included and the others excluded. In cases where data from the same study was reported at different times on overlapping population samples (e.g. the AESOP Study (Kirkbride et al, 2006)), incidence rates from the latest report only were included. Studies were clustered by country. Incidence rates were all recorded as a rate per 100,000 population.

Income equality was measured using the Gini coefficient. The Gini coefficient is a commonly used measure of income inequality where higher coefficients indicate higher degrees of inequality (Subramanian & Kawachi, 2004). Data on Gini coefficients for different nations was obtained from the World Bank (2012b). Our study utilized the available Gini coefficient for the year closest to (and prior to) the year in which the selected study began. If the study period was not available from the cited works, our study utilized the available Gini coefficient for the year closest to when the study was published. This study also controlled for other risk factors known to be associated with incidence of schizophrenia. Urbanization, migration, national unemployment rate, population density and GDP per capita were also obtained from the World Bank (2012a). Therefore, the final sample for the study was also limited to countries for which the following were available: one or more incidence rate for schizophrenia; Gini coefficient; percentage of urbanization; GDP per capita; percentage of migration; and national unemployment rate.

Data Analysis

Analysis involved the use of multi-level mixed-effects Poisson regression with a three-level hierarchical structure to investigate the relationship between country Gini coefficients and the country-level incidence rates of schizophrenia. This method was adopted to take into account the clustered structure of data with repeated measures within a country (level 1), different countries (level 2) and world regions (level 3). Poisson regression was used to model for count responses (i.e. incident rate). We included additional covariates that, theoretically, have been hypothesized to influence the incidence of schizophrenia. A p value of <0.05 was considered statistically significant. Data were analyzed using STATA 11 (StataCorp, 2009).

Results

From an initial 1,666 papers identified when combining the search terms ‘incidence’ and ‘schizophrenia’ and published between January 1975 and March 2011, 110 studies from a total of 28 countries were identified that included incidence data for schizophrenia and met all other inclusion criteria (detailed above). Three papers reporting data from two countries (Taiwan and Surinam) were excluded, as data was not available for Gini coefficients or the other variables of interest.

A total of 26 countries (including 107 incidence rates across the 26 countries) had data available for incidence of schizophrenia, Gini coefficient and the other confounding variables (see **Table 1**). Countries ranged from having only one incidence rate (Australia, Costa Rica, Croatia, Israel, Jamaica, New Zealand, Singapore and Spain) to 32 rates per country (the UK); while mean incidence rates for countries ranged from 5.4 (Norway) to 53.0 (Israel) per 100,000 population. The overall mean and median incidence of schizophrenia for all 107 rates was 18.5 per 100,000 (SD = 11.9; range: 1.7–67.0) and 16 per 100,000 respectively. The mean Gini coefficient for the 26 countries was 33.1 (SD = 6.4; range: 22.8–59.4). (See **Table S1** in supplementary material for a list of all 107 rates included in this analysis).

The result of the first model suggests that there was a significant positive relationship between income inequality as measured by the Gini coefficient (β = 1.02; Z = 2.28; $p = 0.02$; 95% CI 1.00, 1.03) and the incidence rate of schizophrenia. When the model controlled for the covariates (rates of urbanization, GDP per capita, migrant population, and national unemployment rate), the relationship between income inequality and the incidence rate of schizophrenia still remained significant [as indicated in **Table 2**]. In conclusion, for every one-point increase in income equality, there was a two-point increase in incidence rate of schizophrenia. This suggests a positive relationship between increasing income inequality and incidence of schizophrenia (**Figure 1**).

Discussion

Income inequality and incidence of schizophrenia

This study demonstrated important results when considering the social determinant of health, and income equality. Findings conclude that at the country level, there is an association between increasing measures of income inequality and increasing incidence rates of schizophrenia. Of utmost significance, populations of countries characterized by a large rich-poor gap may be at increased risk of schizophrenia.

This finding is an important addition to the growing literature focused on elucidating the specific role played by a number of neighbourhood-level or population-level environmental factors (social determinants) in increasing risk for schizophrenia. It may also shed light on the findings that while individual-level low socio-economic status (SES) is associated with increased risk for schizophrenia (Byrne et al., 2004), country-level low SES (e.g. low GDP per capita) does not correlate with median incidence rates of schizophrenia per country (Saha et al, 2006). Indeed, Saha and colleagues (2006) found no association between median incidence rates and countries grouped according to economic status (least developed countries, emerging economies, developed countries). Thus, at the ecological level, simple poverty or low economic status may not directly increase risk for schizophrenia. Rather, other factors associated with a deprived environment may play a role (e.g. overcrowding, poor nutrition, etc). On the other hand, as the present analysis concludes, living in a society that is characterized by significant differentials in income does appear to be associated with increased risk for schizophrenia.

The only study to examine a similar question reported an overall association between income inequality at the municipal level and treated incidence of first-episode psychosis in KwaZulu-Natal, South Africa (Burns & Esterhuizen, 2008). In a post hoc analysis of a similar study in South London, Boydell and colleagues (2004) demonstrated that only in the most deprived wards was increased incidence of schizophrenia associated with increasing inequality. This raises the important question in relation to income inequality as to whether the added burden of adverse health outcomes is partitioned to the most deprived segment of the community, or whether this burden is evenly distributed. In the current study, we added country GDP per capita as a covariate – the absence of an effect suggests that the added burden of increased schizophrenia incidence is distributed evenly. This question nevertheless remains unresolved and further research is certainly required to clarify the nature of the potential negative impact of income inequality on risk for schizophrenia among different types of communities and levels of social clustering. Emerging newer methods of geographical measurement may assist future ecological research in this field to focus more accurately on the appropriate definitions of real-life neighbourhoods (Diez-Roux, 2007; Diez-Roux & Mair, 2010).

In terms of understanding the possible mechanisms by which income disparities in societies might increase risk for schizophrenia, it is instructive to consider the wider literature that supports an association between income inequality and poor health outcomes. As stated earlier, this association has been found for many general health and mental health conditions and thus, one must conclude that the negative effects of income inequality are not specific to schizophrenia but extend to a range of health conditions (Diez-Roux et al, 2000; Gunnell et al, 2003; Kahn et al, 2000; Kawachi et al., 2002; Kennedy et al, 1996; Subramanian & Kawachi, 2004; Wilkinson, 1992, 1996). An observation supported by this growing evidence base is that individual health depends not just on personal income, but also on the incomes of other members of one's community or society (Kawachi et al., 2002). Furthermore, the negative health effects of living in a disparate society are not restricted to those individuals occupying the lowest socio-economic ranks; they are experienced by all members of that society, regardless of rank (Wilkinson, 1996). If this is the case, then it follows that the negative health effects of living in a disparate society are likely to impact adversely on social dynamics and structures.

Indeed, Wilkinson, (1996, p. 157), who is arguably the originator of this research paradigm, states that ‘income distribution has important psychosocial effects on society’ and that ‘wider income differences are socially divisive’. Wilkinson (1996, p. 185) cites work by Kawachi, Kennedy, Lochner and Prothrow-Stith (1997), arguing that they have provided ‘quantitative evidence that social cohesion provides the link between income distribution and mortality in the USA’ and that this ‘confirms on US data what Putnam reports… that social cohesion is very strongly related to income distribution’. Wilkinson (1996) and other authors (Ichida et al, 2009; Mansyur et al, 2008) have suggested that income inequality erodes social capital in communities and societies, leaving individuals vulnerable to psychosocial stressors.

If inequality leads to loss of social cohesion and chronic stress related to continuous comparisons of rank in society members, then it is possible to speculate about the likely neurobiological mechanisms by which inequality might lead to mental health disorders including schizophrenia. Attainment of status and rank, and affiliation with other members of society, are evolved ‘drives’ in social species such as humans (Panksepp, 1998). Primate research shows that ascent in rank is associated with increased serotonin and dopamine, while loss of rank results in a reduction of both neurotransmitters (Morgan et al, 2002; Panksepp, 1998; Raleigh et al, 1984). Likewise, higher serotonin levels are related to greater sociability and more affiliative behavior in macaques, while low levels are related to social distance and isolation (Mehlman et al., 1995). There is good evidence that such variations in neurotransmitter levels occur downstream to chronic hypothalamo-pituitary-adrenal axis activation with resulting high basal levels of cortisol (Wilkinson, 2005). Hypothetically, the onerous task of continually having to compare one's SES with one's neighbour's in a highly disparate society has neurobiological effects that seem to operate through stress-related pathways, placing one at risk for psychiatric (and some medical) disorders.

Methodological issues

There are a number of limitations to this study that should caution against over-interpretation of the results. While efforts were made to be rigorous in both the search strategy and the selection of data, it is possible that some data meeting the inclusion criteria for the study was omitted during the search. Further, some of the methodological decisions adopted in this study may be open to criticism. For example, mean incidence rates were calculated where only rates for males and females (but not a composite rate) were reported. This may have introduced some unknown bias, but in this case was judged the best solution to insufficient information when cited studies did not disclose the necessary information needed to compute weighted mean incidence rates. While our method may lead to either over-representation or under-representation of incidence rates for specific countries, we chose to include all available 107 rates rather than simply calculating a mean or median incidence rate for each country, thereby strengthening the analysis. Furthermore, we attempted to introduce a multilevel aspect to the regression by adjusting the data for group 'clusters' at the country level, a statistical strategy adopted in another study (Antai, 2009).

It is possible that the quality of incidence data on schizophrenia might vary by country, and itself reflect local social and economic circumstances. Thus, there may be an unknown relationship between specific methodological approaches and research practices (e.g. diagnosis) and socio-economic circumstances between countries. If this were the case, this relationship could have biased our results, yielding an apparently significant association between inequality and incidence of schizophrenia where in fact, no such relationship exists. We would have liked to rate the quality of data in the various studies but insufficient information was available to compare studies reliably. One way to reduce possible bias due to diagnostic practices would be to include method of diagnosis as a covariate; although this would not completely resolve the issue. If a bias did indeed exist (say between diagnostic practices and SES of countries) then one might anticipate that in more deprived countries where resources are poorer, diagnostic practices might be less precise, leading to overdiagnosis of schizophrenia. In the USA, higher rates of schizophrenia have been shown consistently to be higher in African Americans and many authors believe this relates to a range of system-level factors such as lack of cultural competence (DeCoux Hampton, 2007). One might hypothesize that within low-income and poorly resourced countries, a similar range of system-level factors may lead to overdiagnosis in local populations. However, this is conjecture and without large prospective multisite studies enriched with solid ethnographic data, we are unlikely to resolve these questions. Of course, an honest appraisal forces us to admit that it seems implausible that a simple Gini coefficient will capture context-specific sociocultural factors related to different countries and that these factors will scale in an obedient linear fashion.

Several country-level factors were used as proxies for factors that were controlled for in this analysis and these choices may be open to criticism. For example, urban residential status is a recognized risk factor for schizophrenia at the individual level. Incidence rates have also been shown to correlate with urban density at the neighbourhood level (Krabbendam & van Os, 2005; van Os et al., 2005). Percentage urbanization was therefore used as a proxy for urbanicity and entered as a covariate in the current study. If percentage urbanization is accepted as a reasonable proxy for urban density at the national level (van Os et al., 2003; Weiser et al., 2007), then it is possible to argue that the positive association demonstrated between schizophrenia incidence and income inequality is a genuine relationship and not a function of urbanicity.

Finally, since this is an ecological study conducted at the level of country, one cannot generalize the apparent relationship between income inequality and risk for schizophrenia to the individual level – this would be a case of the ‘ecological fallacy.’ Adjusting the results for individual-level measures of poverty, deprivation and other socioenvironmental factors in a multi-level modelling design would have been preferable (Driessen et al, 1998), but there were no individual-level data available.

Conclusion

In conclusion, despite its limitations, which caution us not to overstate the significance of the results or to make causal claims, the current study shows an association at the ecological (national) level between income inequality and incidence of schizophrenia. It is hypothesized that economic disparity damages social capital and reduces social cohesion, setting up stressful rank comparisons that negatively impact hormonal and neurotransmitter systems especially during early development and creating vulnerability to mental disorders. In an era where gene-environment research is growing in importance, it is imperative that income inequality is included as a significant environmental factor in future studies designed to unravel the complex pathways to schizophrenia.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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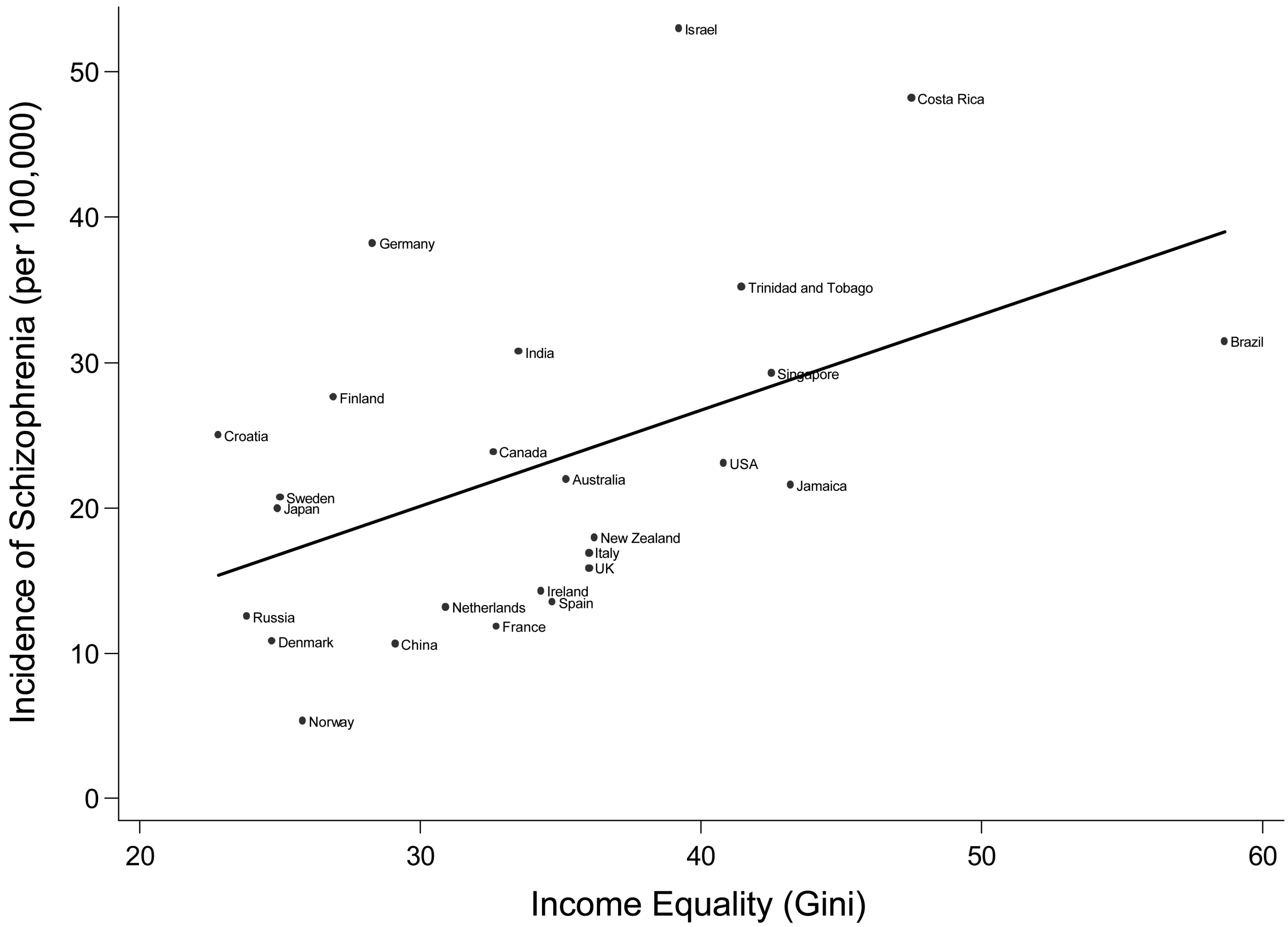

Figure 1.
Scatter plot showing the relationship between Gini coefficient per country and mean schizophrenia incidence.

Table 1

Countries with mean incidence and Gini coefficient

Country	Number of Studies	Mean incidence of Schizophrenia per 100 000 population	SD [Range] Variance	Mean Gini
Australia	1	22.0		35.2
Brazil	2	31.5	22.2 [15.8-47.2] 493	58.7
Canada	7	23.9	8.8 [11.1-33] 78	32.6
China	3	10.7	0.6 [10-11] 0.3	29.1
Costa Rica	1	48.2		47.5
Croatia	1	25.0		22.8
Denmark	10	10.8	8 [3.9-32] 63.4	24.7
Finland	4	27.6	14 [18.9-48.5] 195.4	26.9
France	2	11.9	1.6 [10.7-13] 2.6	32.7
Germany	2	38.3	40.7 [9.5-67] 1653.1	28.3
India	2	30.8	6 [26.5-35] 36.1	33.5
Ireland	4	14.3	5.7 [6-18.8] 32.6	34.3
Israel	1	53.0		39.2
Italy	5	16.9	7.8 [8.8-27] 60.7	36.0
Jamaica	1	21.6		43.2
Japan	3	20.0	4.6 [15-24] 21	24.9
Netherlands	8	13.2	9.1 [2.1-26] 83.2	30.9
New Zealand	1	18.0		36.2
Norway	2	5.4	3.6 [2.8-7.9] 13	25.8
Russia	3	12.6	9.6 [1.7-20] 92.6	23.8
Singapore	1	29.3		42.5
Spain	1	13.5		34.7
Sweden	4	20.7	8.1 [9.4-27.4] 65.5	25.0
Trinidad and Tobago	2	35.2	19.4 [21.5-48.9] 375.4	41.5
UK	32	15.9	7.7 [3-33] 58.6	36.0
USA	4	23.1	17.9 [12.5-49.9] 321.3	40.8
Total	107	18.5	11.9 [1.7-67] 142.1	33.06

Table 2

Mixed-effects Poisson regression models.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	IRR, SE	IRR, SE	IRR, SE	IRR, SE	IRR, SE
Income Equality	1.03 (0.01)***	1.03 (0.01)***	1.03 (0.01)***	1.02 (0.01)**	1.02 (0.01)**
Migration		1.02 (0.01)**	1.02 (0.01)**	1.02 (0.01)**	1.02 (0.01)***
Population Density			1.00 (0.01)	1.00 (0.01)	1.00 (0.01)
Unemployment				1.02 (0.01)	1.02 (0.01)
GDP per Capita					1.00 (0.01)

** $p < 0.05$

*** $p < 0.01$