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Original Research

Ecological analysis of the health effects of income inequality in Argentina

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KEYWORDS
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Summary *Objectives:* Despite a large body of empirical literature, a consensus has not been reached concerning the health effects of income inequality. This study contributes to ongoing debates by examining the robustness of the income inequality–population health relationship in Argentina, using five different income inequality indexes (each sensitive to inequalities in differing parts of the income spectrum) and five measures of population health.
Study design: Cross-sectional, ecological study.
Methods: Income and self-reported morbidity data from Argentina's 2001 Encuesta de Condiciones de Vida (Survey of living conditions) were analysed at the provincial level. Provincial rates of male/female life expectancy and infant mortality were drawn from the Instituto Nacional de Estadistica y Censos database.
Results: Life expectancy was correlated in the expected direction with provincial-level income inequality (operationalized as the Gini coefficient) for both males ($r = -0.55$, $P < 0.01$) and females ($r = -0.61$, $P < 0.01$), but this association was not robust for all five income inequality indexes. In contrast, infant mortality, self-reported poor health and self-reported activity limitation were not correlated with any of the income inequality indexes.
Conclusions: This study adds further complexity to the literature on the health effects of income inequality by highlighting the important effects of operational definitions. Mortality and morbidity data cannot be used as reasonably interchangeable variables (a common practice in this literature), and the choice of income inequality indicator may influence the results.

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Introduction

The income inequality hypothesis has generated an intense amount of controversy, particularly in the 10 years since the publication of Wilkinson's landmark book *Unhealthy societies*.[1] More than 115 empirical studies have been published in this area, yet a consensus has not been reached. The notion that health is affected not only by our own income, but by the equality of income distribution in our society was once praised as a 'big idea' by the editors of the British Medical Journal (*BMJ*),[2] but subsequently dismissed by other researchers, leading to a headline in the *BMJ* proclaiming that the evidence underlying the hypothesis had 'disappeared'.[3] However, more recently, a number of empirical studies have been published[4–11] that have brought the income inequality hypothesis back to the forefront of the research agenda in medical sociology and related fields.

Initially, the income inequality hypothesis was widely supported from ecological (aggregate-level) studies.[12] However, subsequent studies failed to replicate international correlations between income inequality and life expectancy,[13,14] and newer studies using multilevel designs have yielded mixed results.[15] For some researchers, this amounts to evidence that the income inequality–population health relationship observed in earlier work was spurious.[14,16] Although these claims have been dismissed by Wilkinson,[17] the income inequality hypothesis continues to generate debate.[18–20] Recently published reviews suggest that whilst the 'strong' version of the hypothesis may not be supported by the best data, 'weak' versions of the hypothesis may still hold true; that is, income inequality may affect certain health outcomes under particular conditions.[15,18] Interestingly, empirical studies published after the influential review by Lynch et al.[15] suggest a sort of revival for the income inequality hypothesis. Pickett et al.[8] observed significant ecological correlations between obesity and diabetes mortality with income inequality in a sample of 21 developed countries. Ram[21] found a significant relationship between state-level income inequality and mortality in the USA, and suggested that the scepticism raised about the income inequality hypothesis needs to be reconsidered; findings echoed by Zimmerman and Bell's[6] US analysis. De Vogli et al.[7] presented evidence from Italy and 21 wealthy countries in favour of the income inequality hypothesis, and Cantarero et al.[10] found an income inequality effect on life expectancy and child mortality using data from the European Community Household Panel Survey. However, this latest wave of studies has not quelled the debate on the income inequality hypothesis, and a number of compelling questions remain, such as: (a) how robust is the income inequality–population health relationship to differing operational definitions of income inequality and population health? and (b) is the income inequality hypothesis relevant in countries outside of the Organization for Economic Cooperation and Development (OECD)? This study examines these two issues using new survey data from Argentina.

The importance of operational definitions

Income inequality

There is conflicting evidence in the literature regarding the extent to which the significance of the health effects of income inequality is dependent on the operational definition of income inequality.[22,23] Traditionally, the Gini coefficient has been the most widely used summary measure of income distribution.[24] However, the Gini coefficient is not 'neutral' or value-free.[25] Other summary measures of income inequality can be used and offer important insight into different patterns of inequality; after all, situations of large income differences within the bottom, middle or top of the income distribution are different types of inequality and would logically have varying effects on population health.[26,27] This is particularly important under the neomaterialist interpretation of the health effects of income inequality, which asserts that income inequality is associated with systematic underinvestment in social infrastructure, and therefore acts indirectly as a social determinant of health.[28,29] In contrast, the psychosocial interpretation posits a more universal health effect for income inequality,[30,31] perhaps suggesting that sensitivity to inequalities in different parts of the income spectrum is not important. However, inequalities in different parts of the income spectrum may influence patterns of social comparisons that are central to the psychosocial interpretation.[32] It is therefore important to examine income inequality with a range of indicators. It is exceedingly difficult, if not impossible, to adequately describe complex social conditions such as income inequality through a single summary statistic. To examine the income inequality–population health relationship more adequately, this study uses five different income inequality indexes (each sensitive to inequalities in differing parts of the income spectrum): the Gini coefficient and four categories of the Generalized Entropy (GE) Index.

Population health

Researchers examining the health effects of income inequality have used a wide range of operational definitions of population health, including life expectancy at birth, infant mortality, disease-specific mortality rates and self-reported health status.[15,18] Notably, the use of self-reported health status as the operational definition of health raises important implications, many of which are poorly understood. Indeed, whilst this operational definition is commonly used in medical sociology[33] and has been found to be highly predictive of actual health status, including subsequent mortality[34,35] and disability,[36] there is some evidence to suggest that self-reported measures suffer from poor reliability.[33] Most importantly for the present study, there is also some evidence to suggest that self-reported measures function poorly in developing countries[37] where expectations and standards of health are probably not shared as equally throughout the income spectrum.

According to Sen,[38] respondents in the prosperous Indian state of Kerala report poorer levels of self-reported health status than respondents in the more deprived state of Bihar, despite higher life expectancy in Kerala. This raises questions about the under-reporting of poor health among the poor,[37] and suggests that morbidity and mortality indicators are not necessarily congruent; a paradox discussed by Busfield[39] and tested using European data by Jurges.[40] Important gender effects may also be present in this phenomenon, given that in many countries, women experience more chronic diseases then men but have higher life expectancies. This dissonance between morbidity and mortality indicators has not been fully acknowledged in the literature on the health effects of income inequality.[41] Instead, self-reported morbidity and mortality data have been treated as reasonably interchangeable, leading to much confusion in the literature.[15] Indeed, if the two types of health data are not reasonably interchangeable, it is not right to expect income inequality to have the same effect on self-reported morbidity and mortality. This may contribute to the different conclusions reached by the aggregate- and multilevel studies; the former have predominantly used mortality data whilst the latter have tended to use morbidity indicators.

Extending the income inequality hypothesis to Argentina

An issue that the published empirical studies have not been able to address is the extent to which inequality affects health status in countries outside of North America and Europe. This is admittedly outside the remit of the original hypothesis,[42] as Wilkinson argued that the hypothesis was only applicable to the advanced countries of the OECD.[1]

However, the rationale for examining this hypothesis in more unequal parts of the world is strong. A number of the more recent studies to reject the income inequality hypothesis have been conducted in the relatively egalitarian countries of Japan,[43] Denmark[44,45] and New Zealand,[46] suggesting that at low levels, income inequality may not have a noticeable effect on health status. However, recent research from Chile suggested that a 'threshold effect' may be present, wherein inequality has a pathogenic effect on population health only once a sufficient level of inequality has been reached.[47] There is thus sound reason for examining the income inequality hypothesis in Latin America; a region acknowledged to be one of the most unequal in the world.[48,49]

Argentina presents a unique opportunity for studying the health effects of income inequality. Its disease profile displays a post-epidemiological transition pattern, with circulatory diseases, cancers and respiratory diseases being the leading causes of death, and infectious and parasitic diseases accounting for only a small percentage of deaths (less than 5%).[50] National population health indicators from 2002, such as male life expectancy (70.8 years), female life expectancy (78.1 years) and infant mortality (17 deaths per 1000 live births),[51] are not dissimilar to those of the advanced countries of the OECD (the traditional focus of research on the health effects of income inequality). However, income inequality is far higher in Argentina than it is in countries of the OECD.[48,52] Indeed, Gini coefficients are typically 20 points higher in Latin American countries than they are in the OECD countries.[53]

Methods

This study examines the robustness of the income inequality–population health relationship in Argentina using five different income inequality indexes and five measures of population health. The primary data source is the 2001 Encuesta de Condiciones de Vida (ECV; Survey of living conditions); a nationally representative social survey from Argentina. The ECV was conducted by the Argentine Government's Sistema de Informacion Monitoero y Evaluacion de Programas Sociales (SIEMPRO; Information and monitoring system of

social programmes). The survey was conducted under a multinational programme concerned with improving the quality, geographical coverage and thematic concerns of population surveys in Latin America and the Caribbean.[54] This programme began in 1996 and is jointly funded by the World Bank, the Inter-American Development Bank and the United Nations Economic Commission for Latin America and the Caribbean.[54,55] Its goals include improving the quality and coverage of population surveys concerned with poverty and living conditions in Latin America, and ensuring wider access to data files for researchers.

The 2001 ECV utilized a sampling frame developed by the Instituto Nacional de Estadistica y Censos (INDEC) based on the 1991 Census. The population universe was defined as areas with at least 5000 inhabitants. According to SIEMPRO,[56] this amounts to 96% of the total urban population in Argentina and 84% of the total population. The ECV dataset contains information on 71,574 individuals (including 46,590 adults and 24,984 children aged less than 18 years of age). The present analyses are restricted to respondents aged 18 years or over with self-reported morbidity data, leaving a sample of 29,970 individuals (amounting to a 64.3% item response rate). The survey was administered via a face-to-face interview. The overall response rate was 74.4%, with some geographical variation in response. The lowest response rate was 61.4% in Metropolitan Buenos Aires and the highest response rate was 88.1% in Córdoba.[57]

Data collection occurred in May 2001, just months before the country's economic and political collapse. The Argentine crisis of December 2001 was particularly devastating. Gross domestic product per capita declined sharply from US$8210 in 1998 to US$2850 in 2002 (this decline was partly attributable to the devaluation of the peso), employment in the construction industry (including unskilled labour) fell by 42% from 2001 to 2002, and poverty levels rose from 38% in October 2001 to 53% in May 2002.[58] The banking system was paralysed,[59] and inflation, which had been low and stable throughout the 1990s, reached 70% per year.[58] This was accompanied by significant increases in displays of social tension, as exemplified by large-scale social protests in Buenos Aires and the 'piquetero' movement throughout the country.[60] The 2001 ECV is thus uniquely timed to provide cross-sectional data on a society on the verge of a dramatic social change. It is a vivid snapshot of a country gripped by economic inequality and social conflict prior to economic and political collapse. The effects of the 2001 crisis are expected to have a significant effect on Argentina's population health,[61] both at the level of the social determinants of health and due to crisis effects in the healthcare system itself.[62]

Health variables

Two measures of self-reported morbidity from the 2001 ECV are used in this study: poor health in the past 4 weeks (yes/no); and the interruption of usual activities because of that health problem in the past 4 weeks (yes/no). Additionally, provincial rates of male/female life expectancy and infant mortality in 2001 were drawn from the Instituto Nacional de Estadistica y Censos database.

Income inequality indicators

Five different income inequality indexes were used in this study: the Gini coefficient and four categories of the GE Index: GE(−1), GE(0), GE(1) and GE(2). The Gini coefficient is derived from the Lorenz curve of the plot of cumulative percentage of the population by socio-economic status and cumulative percentage of total income; a Gini coefficient of 0 reflects a perfectly equal society in which all income is shared equally, and a Gini coefficient of 100 represents a perfectly unequal society wherein all income is earned by one individual.[24] The Gini coefficient's main weakness as a measure of income distribution is that it is incapable of differentiating different types of inequality; Lorenz curves may intersect (reflecting differing patterns of income distribution) but may nevertheless result in the same Gini coefficient value.[26] In contrast, the GE Index incorporates a sensitivity parameter to help differentiate different patterns of inequality; the more positive α (the sensitivity parameter; −1, 0, 1 or 2) is, the more sensitive GE(α) is to inequalities at the top of the income distribution.[63] The theoretical range of GE values is 0 to ∞, with 0 being a state of equal distribution and values greater than 0 representing increasing levels of inequality.

Provincial median income, poverty and indigence

Median provincial household income was calculated based on total household income per capita (in the month prior to the interview, Argentine pesos). Provincial rates of poverty and indigence were calculated using pre-existing variables in the ECV; these variables are based on INDEC calculations based on regional costs of living. Households below the poverty line do not have enough income for a

minimum food basket and a minimum of non-food consumption goods (e.g. clothing, basic entertainment), whilst households below the indigence line do not have enough income for a minimum food basket.[64]

Statistical analysis

Data from the 2001 ECV were aggregated to provincial level (23 provinces and the federal capital of Buenos Aires) and analysed using Pearson correlation coefficients. Correlations were weighted by provincial population.

Results

Summary univariate statistics for provincial-level health, income, poverty and inequality indicators are presented in Table 1.

Pearson correlation coefficients show the associations between these variables (see Table 2).

Life expectancy was correlated with provincial-level income inequality (operationalized as the Gini coefficient) for both males ($r = -0.55$, $P<0.01$; also see Fig. 1) and females ($r = -0.61$, $P<0.01$; also see Fig. 2) in the expected directions; at higher levels of income inequality, provinces tend to have lower levels of life expectancy. However, this association was not robust for all income inequality indexes. In total, male life expectancy was correlated in the expected direction with only two of the five income inequality indexes, and female life expectancy was correlated in the expected direction with three of the five income inequality indexes.

Infant mortality, self-reported poor health and self-reported activity limitation were not correlated with any of the income inequality indexes. Furthermore, provincial-level mortality indicators were not correlated with morbidity indicators.

Discussion

This study adds further complexity to the literature on the income inequality hypothesis. Whilst the results show that provincial-level Gini coefficients are negatively correlated with rates of male and female life expectancy in Argentina, this relationship is not robust for all measures of income inequality or population health. The correlations between income inequality and life expectancy were weakest for income inequality indicators that were sensitive to inequalities at the bottom [GE(−1)] and the top [GE(2)] of the income spectrum, but were strongest for indicators that were sensitive to inequalities in the middle of the spectrum [Gini, GE(0), GE(1); see Table 2]. The results from this study also suggest that mortality and morbidity indicators cannot be used as reasonably interchangeable variables; until now, this has been common practice in the literature. In this analysis, provincial rates of self-reported poor health and activity limitation because of poor health were not correlated with provincial rates of life expectancy, and whilst life expectancy

Table 1 Provincial-level descriptive statistics.

	Mean	Min.	Max.	SD
Health indicators				
Male life expectancy	67.5	65.2	69.8	1.1
Female life expectancy	74.1	71.7	76.6	1.4
Infant mortality rate	17.0	9.6	28.9	4.9
Self-reported poor health (%)	18.3	4.7	29.2	6.2
Self-reported activity limitation (%)	4.3	0.9	8.3	2.0
Income, poverty and inequality indicators				
Median household income	145.8	40.0	300.0	58.5
Households below the poverty line (%)	35.9	12.4	62.7	12.3
Households below the indigence line (%)	14.7	5.8	39.4	7.4
Gini	0.50	0.47	0.55	0.03
GE(−1)	1.07	0.64	3.28	0.54
GE(0)	0.48	0.40	0.58	0.06
GE(1)	0.47	0.39	0.62	0.07
GE(2)	0.81	0.44	1.30	0.24

SD, standard deviation; GE, generalized entropy.

Table 2 Bivariate Pearson correlation coefficients for provincial-level variables.

	Male life expectancy	Female life expectancy	Infant mortality	Poor health (%)	Activity limitation (%)	Median income	Poverty (%)	Indigent (%)	Gini	GE(−1)	GE(0)	GE(1)	GE(2)
Male life expectancy	1.00												
Female life expectancy	0.93***	1.00											
Infant mortality	−0.65***	−0.66***	1.00										
Poor health (%)	−0.14	−0.28	−0.07	1.00									
Activity limitation (%)	−0.41	−0.40	0.28	0.71***	1.00								
Median income	0.53**	0.51**	−0.74***	0.09	−0.23	1.00							
Poverty (%)	−0.69***	−0.68***	0.78***	−0.07	0.31	−0.94***	1.00						
Indigent (%)	−0.59**	0.54**	0.65***	−0.25	0.18	−0.80***	0.90***	1.00					
Gini	−0.55**	−0.61**	0.21	−0.14	−0.05	−0.21	0.37	0.33	1.00				
GE(−1)	−0.22	−0.16	0.09	0.01	−0.02	−0.17	0.16	0.14	0.46*	1.00			
GE(0)	−0.60**	−0.62**	0.26	−0.14	0.00	−0.31	0.46*	0.46*	0.97***	0.54**	1.00		
GE(1)	−0.38	−0.44*	0.03	−0.15	−0.11	0.02	0.17	0.15	0.95***	0.38	0.90***	1.00	
GE(2)	0.01	−0.05	−0.37	−0.10	−0.23	0.33	−0.22	−0.15	0.67***	0.20	0.61**	0.84***	1.00

GE, generalized entropy.
*$P<0.05$, **$P<0.01$, ***$P<0.001$.

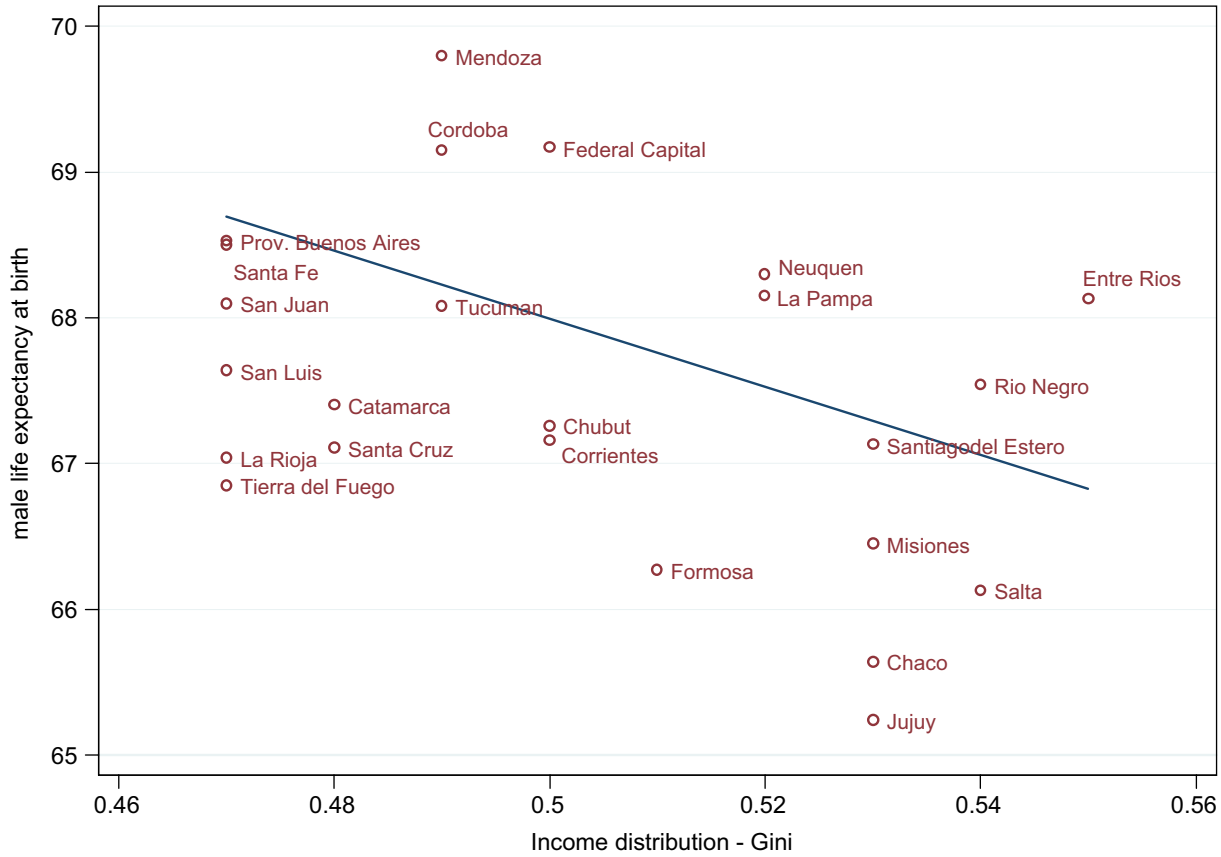

Figure 1 Provincial-level correlation between income distribution (Gini) and male life expectancy ($r = -0.55$, $P < 0.01$).

showed a tentative correlation with income inequality (i.e. only significant for some income inequality measures), morbidity levels showed no significant correlation with any of the income inequality measures (see Table 2). It would not be appropriate to conclude from this study that one particular measure of income inequality or population health is better than another; the point is that a range of indicators need to be used for both concepts since the income inequality–population health hypothesis does not seem to be robust to differences in operational definitions. Awareness of this notion may ultimately enable the development of a more nuanced theory of the health effects of income inequality.

Strengths and weaknesses of the study

The strength of this study lies in its attempts to broaden and problematize the operationalization of income inequality and population health. Both concepts are multidimensional and complex, and thus require a multifaceted operationalization strategy. As the results show that conclusions about the income inequality–population health relationship are dependent on the operationalization of these concepts, it is important to use and report a variety of measures in future tests of the income inequality hypothesis. A weakness of this study is its reliance on aggregate-level analysis. Limitations of this type of analysis, including problems of ecological fallacy and the inability to distinguish contextual from compositional effects, are well known.[65] However, ecological correlations remain an important building block in empirical research on the health effects of income inequality. As such, these results may be used to inform more sophisticated analyses using multilevel regression frameworks.

In relation to the large and growing literature on the health effects of income inequality,[15,18] this study makes several contributions: it emphasizes the important effects of operational definitions of income inequality and population health; and it supports the growing attention paid to the health effects of income inequality in countries outside of the OECD. In particular, this study argues that Argentina is an appropriate country in which to study the health effects of income inequality. Its

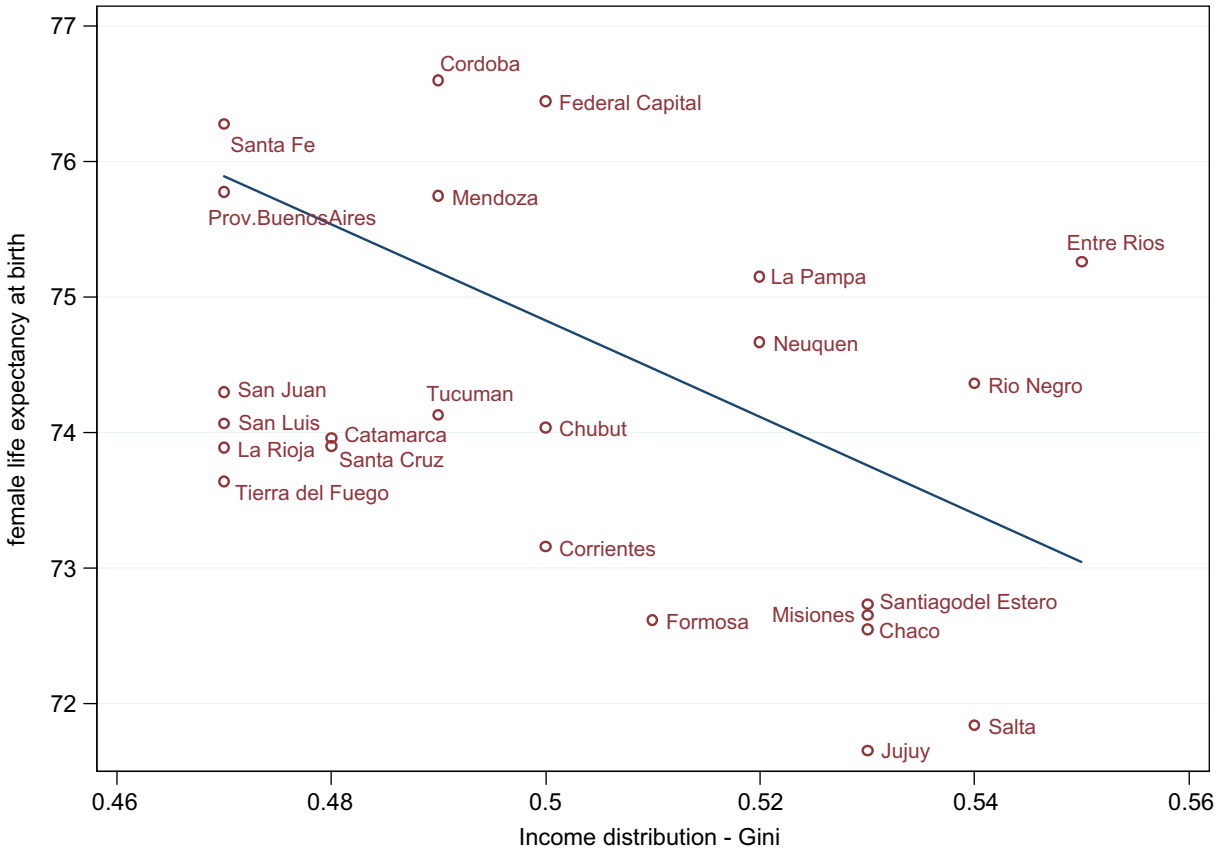

Figure 2 Provincial-level correlation between income distribution (Gini) and female life expectancy ($r = -0.61$, $P < 0.01$).

population health profile displays a post-epidemiological transition pattern of mortality, and it is currently experiencing significant socio-economic pressures that influence its level of income distribution. This study also builds upon the work of Subramanian et al.[47] by suggesting that Argentina, along with Chile, is a country where the health effects of income inequality may be present and detectable.

In future research, a comparative study utilizing data from the high-income countries of the OECD and middle-income countries such as Argentina may yield new insight into the health effects of income inequality. Such research ought to employ a wide range of indicators for income inequality and population health. Given recent developments in Latin America, such research could enable a closer integration with literature on economic development and political economy. This may help to generate a bridge between the positivist-based research that has dominated the literature on the health effects of income inequality with the tradition of critical realism.[66–68] This would ultimately lead to a more comprehensive theoretical and empirical body of literature on the causes of the causes; i.e. not just the health effects of income inequality, but the social mechanisms behind income distribution and its effect on health in a global context. However, as shown above, for such a project to succeed, careful attention will need to be paid to the operationalization of income inequality and population health.

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Competing interests

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