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Political and welfare state determinants of infant and child health indicators: An analysis of wealthy countries

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Abstract

Economic indicators such as income inequality are gaining attention as putative determinants of population health. On the other hand, we are just beginning to explore the health impact on population health of political and welfare state variables such as political orientation of government or type of medical care coverage. To determine the socially structured impact of political and welfare state variables on low birth weight rate, infant mortality rate, and under-five mortality rate, we conducted an ecological study with unbalanced time-series data from 19 wealthy OECD countries for the years from 1960 to 1994. Among the political/welfare state variables, total public medical coverage was the most significant predictor of the mortality outcomes. The low birth weight rate was more sensitive to political predictors such as percentage of vote obtained by social democratic or labor parties. Overall, political and welfare state variables (including indicators of health policies) are associated with infant and child health indicators. While a strong medical care system seems crucial to some population health outcomes (e.g., the infant mortality rate), other population health outcomes might be impacted by social policies enacted by parties supporting strong welfare states (the low birth weight rate). Our investigation suggests that strong political will that advocates for more egalitarian welfare policies, including public medical services, is important in maintaining and improving the nation's health.

Keywords: Welfare state; Politics of health care; Public medical care; Infant mortality; Under-five mortality; Low birth weight; Comparative

Introduction

The goal of this investigation is to examine the relationship between political and welfare state variables and average levels of population health among wealthy countries. Researchers in comparative social epidemiology and adjacent disciplines characteristically study countries belonging to the Organization for Economic Cooperation and Development (OECD) because of a greater availability and quality of data on economic factors (e.g., income inequality and national income: Preston, 1975; Rodgers, 1979; Wilkinson, 1996). In fact, studying the relationship between income inequality and population health is one of the most heuristic research programs in contemporary social

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epidemiology (Wilkinson, 1996; Wilkinson, 2005). However, critics have argued that this model suffers from the omission of political factors that are necessary to explain health inequalities (Coburn, 2000; Muntaner & Lynch, 1999). Thus, new approaches to international health comparisons pay attention to political and health policy variables (Coburn, 2000; Conley & Springer, 2001, for American states; Lynch et al., 2004; Macinko, Starfield, & Shi, 2003; Macinko, Shi, & Starfield, 2004; Muntaner et al., 2002; Navarro & Shi, 2001).

For example, the relationship between income inequality and population health has been examined in several cross-national studies during the last three decades (Lynch et al., 1994; Wagstaff & van Doorslaer, 2000). In spite of recent challenges to the notion that, in wealthy countries, the link between income inequality and health has the generality of a natural law (Wilkinson, 1996, 2005), there is still some evidence of a positive association between income inequality and mortality rates in a wide variety of contexts (e.g., American states: Lynch et al., 2004). In one of the first studies, Rodgers examined the cross-sectional relationship between income distribution, mean income per capita, and all-cause mortality in 56 countries (Rodgers, 1979). He estimated that life expectancy in relatively egalitarian and relatively inegalitarian countries differed by 5–10 years. Rodgers suggested that the relationship was significant even in countries with per capita incomes below US$1000. Analysis restricted to countries with low per capita income found a similar relationship in the areas of life expectancy at birth and life expectancy at fifth birthday. The relationship was weaker in the area of infant mortality. Thus, Rodgers' and later studies on income inequality have contributed to establish that ecological designs in comparative international health are justified because they provide unique macro-level insights into the global distribution of health inequalities and its determinants.

However, few studies have explored the relationship between political variables and population health in groups of countries. Navarro et al.'s (2003) study might be the only study that has included a comprehensive number of political variables while adjusting for economic determinants. A key assumption of our theoretical approach is that understanding the association between social factors and health requires analyzing political as well as economic determinants (Coburn, 2000). Thus, although countries' income distribution and GDP have been associated with several population health outcomes such as infant mortality and low birth weight (Lynch et al., 2001), recent studies suggest that political and welfare state variables (e.g., access to health care) could also be important determinants of population health outcomes (David & Collins, 1997; Macinko, Starfield et al., 2003; Macinko et al., 2004; Muntaner et al., 2002; Navarro & Shi, 2001; Raphael & Bryant, 2003). For example Conley and Springer used a country-level fixed-effects model to determine whether public health spending had a significant impact in lowering infant mortality rates, and whether that effect was cumulative over a 5-year period (Conley & Springer, 2001). They found that state spending, which varied according to the institutional structure of the welfare state, affected infant mortality through both health and social policies. Raphael and Bryant reviewed literatures on welfare state and women's health in Canada, to find out that "characteristics associated with the advanced welfare state in industrialized nations are primary contributors of women's quality of life." (Raphael & Bryant, 2003) Muntaner and colleagues used political and welfare state variables, as well as social capital and economic indicators to examine GDP adjusted partial correlations with cause- and age-specific mortality rates. Among the outcome measures, the five variables related to birth and infant survival and non-intentional injuries were most consistently associated with economic inequality and political/welfare state variables (Muntaner et al., 2002). They found Gini coefficient, household income inequality, 90/10 percentile, 50/10 percentile, household poverty rate, voter turnout, social pact (a measure of pact between labor and employers), percentage of "left" (i.e., social democratic or labor) vote and "left" seats, women in government, and total public medical care to be significantly correlated with infant mortality rates ($p<0.05$) in both males and females. In addition, the low birth weight rate was significantly associated with the Gini coefficient, household income inequality, 90/10 percentile, 50/10 percentile, household poverty rate, voter turnout, social pact, "left" votes, women in government, and total public medical care.

The aim of our study is to build upon the preliminary studies reviewed above on the role of political and welfare state variables in population health. We develop a theoretical model that integrates previous findings and provides a blueprint for the macro-social causation of child health outcomes. We use a time series multivariate regression model that incorporates both GDP and income inequality, as well as political and welfare state variables to enhance the inferential power of the analyses.

The field of (macro) social epidemiology suffers from lack of comprehensive models (Macinko, Shi, Starfield, & Wulu, 2003). This is why we draw from the field of comparative welfare state politics for our model. In the study conducted by Huber & Stephens (2001), the authors emphasized partisan politics as the single most important factor that shaped the development of welfare states through time and that accounted for the variation in welfare state outcomes across countries. And partisan politics, in turn, was strongly related to social structural features, most importantly the strength of organized labor. Navarro, Borrell, and Muntaner's conceptual framework builds upon Huber and Stephen's empirical findings, but adds the dimension of 'income inequality', to examine political and economic determinants of population health (Navarro, 2003). According to this conceptual framework, politics (e.g., political orientation of the party in government) determines welfare state policies that affect population health, net of the influence of economic inequality, which is partially determined by welfare state policies (Huber & Stephens, 2001). We modified Navarro et al.'s model based on our review of the empirical literature summarized in the introduction section. (See Fig. 1) Variables in squares are those used in the present analyses, while those in circles are not used or could not be measured. Ones in grey are the ones that are not considered in this analysis.

Our conceptual model thus involves a country's political environment, welfare state policies, health care system, and income inequality. We measure political environment in two dimensions: the level of political participation and the ideological orientation. We hypothesize that the level of political participation is positively correlated with good population health status, based on a couple of partial and multivariate correlation analyses (Muntaner et al., 2002; Navarro et al., 2003). Literatures investigating the relationship between health and social network/cohesion, which is related to civic participation such as voting, support the hypothesis. (e.g., Blakely, Kennedy, & Kawachi, 2001)

The dominance of pro-egalitarian political ideology, which is measured by the votes gained by left-wing parties is positively correlated with better population health (Muntaner et al., 2002; Navarro et al., 2003) possibly through welfare state policies, such as commitment to full-employment, providing universal health coverage, and increase in redistribution of income. We used two indicators of welfare-state policy: social security transfer and percentage of population under public medical coverage. These two indicators are expected to be negatively associated with population ill health (i.e., high infant mortality rate, under-5 mortality rate, and low birthweight rate). While the former directly affects the level of income inequality, the latter primarily is associated with the level of access to

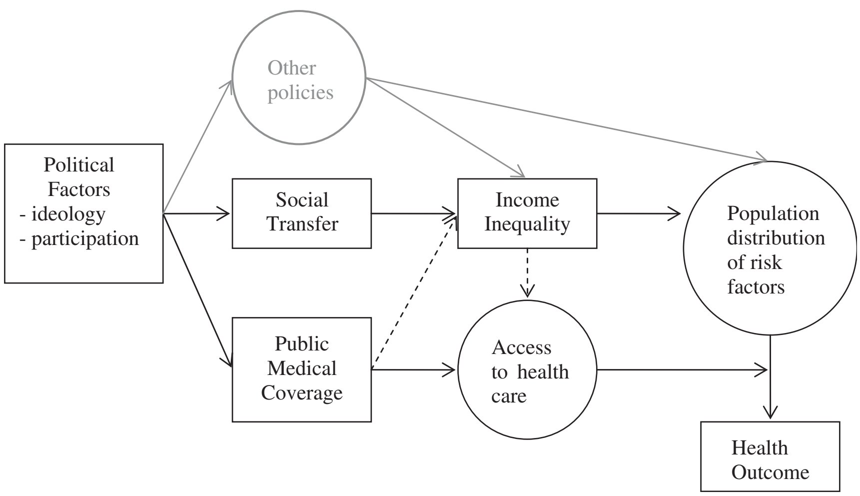

Fig. 1. Conceptual Model.

medical care. Rather than including these two variables in a single welfare state construct, we separated them conceptually so that we will be able to understand their unique contribution to population health. Because social transfers and health services fall short from measuring the whole effect of different welfare-state arrangements, we included an additional pathway through ''other policies'' (e.g., labor market and environmental health policies), which might affect population health independently from the welfare-state indicators used in this study.

We also included income inequality because it has been associated with population health averages in a number of studies (e.g., Wilkinson, 1996). In epidemiology, the mechanism backing this prediction is based largely on two explanations: psychosocial (e.g., Wilkinson, 1996) and neo-material (e.g., Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996). In the welfare-state literature, income inequality is more a result of government policies, that is, an endogenous variable. For example, Bradley, Huber, Moller, Nielsen, and Stephens (2003). concluded that high pre-tax/pre-transfer inequality is determined by a high unemployment rate, a high proportion of female-headed households and by low union density, while reduction in inequality through taxes and transfers is strongly determined by political variables such as leftist cabinet, Christian democratic cabinet, constitutional veto points, and welfare generosity.

Based on the theoretical model described above, we hypothesize that egalitarian political and welfare state variables (e.g., proportion of votes to social democratic parties, universal access to health care) will predict child mortality outcomes at the national level.

Methods

Data sources and variables: The study focuses on 19 wealthy countries from Europe (14), North America (2), and Asia and the Pacific region (3) during the 35-year period from 1960 to 1994. Outcome variables are the infant mortality rate (IMR), the low birth weight rate (LBW) and the under-five mortality rate (U5MR). Data sources are the OECD Health Data (Organization for Economic Co-operation and Development (OECD), 2000) and the annual report ''The State of Children.'' (United Nations Children's Fund (UNICEF), 2003)

The most widely used population health outcomes are the infant mortality rate and life expectancy. One reason we chose to use infant and child health indicators was that, according to several studies, birth and infant related variables are particularly sensitive to political and welfare state variables (Conley & Springer, 2001; Macinko, Starfield et al., 2003; Macinko et al., 2004; Muntaner et al., 2002; Navarro et al., 2003). Child health indicators are sensitive to economic and political indicators and exhibit short lag time which is necessary for finding an effect with these indicators (Conley & Springer, 2001; Macinko et al., 2004). We also analyzed the under-five mortality rate because this indicator was less prone to under-reporting than the infant mortality rate (Conley & Springer, 2001).

We included Gross National Product per capita (GDPpc) and Gini coefficients as explanatory variables. For the Gini coefficient, we used data from Luxembourg Income Study that can be downloaded from the LIS website (Luxembourg Income Study, 2000). Since the LIS data set do not include data from Japan and New Zealand, analyses using the Gini coefficients lack these countries. For GDPpc, we used real GDPpc values, adjusted by the chain index obtained from the Penn World Table version 6.1 (Heston, Summers, & Aten, 2002). Other explanatory variables were obtained from Huber et al.'s (2004) ''Comparative Welfare States Data set.'' which contains a large number of political and welfares state indicators. In choosing indicators corresponding to our theoretical model we faced two problems: one was data availability. For example, variables such as the ''redistributive effect of the state'' (Muntaner et al., 2002) were not available for a time-series analysis. The second problem was multi-colinearity: The Pearson correlation coefficient between the ''percentage of left vote'' and the ''left seats'' was 0.96. The ''percentage left votes'' was retained for the current analyses because it showed stronger associations with outcome variables than ''left seats''. As a result, our set of independent variables was composed of GDPpc and Gini coefficient, two political variables (voter turnout and left vote), and two welfare state variables (social security transfers and total percentage of population under public medical coverage). Variables and data sources are presented in Table 1.

Statistical analysis: We conducted an unbalanced panel data analysis of the 19 countries, using the

Table 1
Description of variables and data sources

Variable	Description	Data source
Dependent variables		
Infant mortality rates	Per 1000 live births	OECD Health Data, 2000
Under 5 mortality rates	Per 1000 live births	The State of the World's Children (UNICEF)
Low birth weight rates	% total live births	OECD Health Data, 2000
Independent variables		
Economic variables		
GDP per capita	Real GDP per capita in constant dollars using the Chain index based on purchasing power parities (PPPs) in 1985 international prices	The Penn World Table version 6.1
Gini coefficient		Luxembourg Income Study
Political variables		
Voter turnout	Voter turnout in each national election, in percentages of electorate that voted	Huber et al., (2004)
Left vote	Percentage of total votes for left parties	Huber et al. (2004)
Welfare state variables		
Social transfers	Social security transfers as a percentage of GDP. Consists of benefits for sickness, old-age, family allowances, etc., social assistance grants and welfare. Substituted the variable "redistributive effect of state" in Muntaner et al. (2002)	Huber et al. (2004)
Total public medical care	Share of population with total medical coverage	Huber et al. (2004)

robust-cluster variance estimator. (Diggle, Liang, & Zeger, 2002; Moller, Bradley, Huber, Nielsen, & Stephens, 2003) The standard (i.e., non-cluster) Huber–White or "sandwich" robust estimator of the variance matrix of parameter estimates provides correct standard errors in the presence of any pattern of heteroskedasticity (i.e., unequal variances of the error terms) but not in the presence of correlated errors (i.e., non-zero off-diagonal elements in the covariance matrix of the errors). The robust-cluster variance estimator is a variant of the Huber-White robust estimator that remains valid (i.e., provides correct coverage) in the presence of any pattern of correlations among errors within units, including serial correlation and correlation due to unit-specific components (Moller et al., 2003; StataCorp, 1999). Thus, the robust-cluster standard errors are unaffected by the presence of unmeasured stable country-specific factors causing correlation among errors of observations for the same country, or for that matter by any other form of within-unit error correlation.

By generating successive adjusted variable plots, we confirmed that all explanatory variables were in linear relationships with the outcome variables of interest except GDPpc. We used a logarithmic term for GDPpc, because it provided a better model fit than other transformations. Plots of the "social security transfer" versus outcome indicators also showed non-linear relationships, but we did not transform this variable since using a quadratic or a logarithmic term only decreased the predictability and significance of the model.

The following describes our model building process; all models were GDPpc adjusted:

- Model 0 included only one outcome variable and GDPpc.
- Model 1 was built to assess the impact of political variables (voter turnout and left vote).
- Welfare state variables (social security transfer and total public medical care) were included in Model 2 to determine their impact.
- Model 3 incorporated variables that were found significant in Models 1 or 2 ($p<0.05$).
- Model 4 is built to assess how much of the correlations in model 4 are accounted by income inequality.
- We fit the last model (5), replicating model 4 without Gini coefficients, using only the data

points that were in model 4 for comparison purposes.

We built our final models (4 and 5) to evaluate the effect of the Gini coefficient on other explanatory variables and vice versa. However, in doing so, many of the data points were dropped, mainly because of missing data points in the Gini coefficients and a few in other variables. We conducted *t*-tests to see if the groups used are different from the groups dropped in the final modeling process.

"An outlier is an observation far from the rest of the data. This may represent valid data or a mistake in experimentation, data collection, or data entry." (Fisher & van Belle, 1993) Many values for the US are actually different from other countries, and thus the US can be considered as a statistical outlier. However, we chose to include the US in the analysis. First, our sample is the whole universe of advanced capitalist countries, and therefore, the distant values of the US are not a result of any fault in sampling process, but a result of distinct historical process of that country. Also, we do not have a rationale to expect that our theoretical model regarding the impact of political and welfare state factors of population health does not apply to the US. In addition, the decision of including the US is supported by most quantitative comparative health policy research studies.

The US is included currently in most comparative analyses of industrialized welfare states from which we draw our theoretical framework (Navarro, 2003; see also Esping-Andersen, 1990; Huber & Stephens, 2001). With The UK, Canada, and Ireland, the US has been characterized as a "liberal" country, more likely to implement certain policies that affect population health (e.g., welfare state retrenchment; Huber & Stephens, 2001). Previous studies on the macro-social epidemiology of political and economic factors have included the US (Conley & Springer, 2001; Macinko et al., 2004; Muntaner et al., 2002; Navarro et al., 2003; Navarro & Shi, 2001). This is in part due to the theoretical reason (Peters, 1998) as the US is part of the system of industrialized welfare stare regimes. It also reflects the public health importance of the US as a large nation. On the other hand, we also present the Pearson's correlation matrix with and without the US in Appendix A to show the effect of excluding the US in the correlation between the dependent variables and outcome variables.

The possible correlation among clusters through time (i.e., period effects) was not assessed in our analyses, based on the fact that Moller et al. (2003) examined the possibility of period effect during 1960–1994 using the same data set and they concluded there was no such effect for the years included in the study. To assess the reliability of our analysis, we conducted a couple of sensitivity tests, namely extreme bound analyses and a kind of jackknife method, and the results can be provided at request. We used STATA version 8.0 for this analysis.

Results

A clear declining trend in infant and under-five mortality rates was observed during the year analyzed. The low birth weight rate decreases until the mid-1970s and starts to increase from the mid-1980s. The GDPpc continues to increase, but the Gini coefficient shows a rather random picture. But we must keep in mind that there are many missing values in the earlier period so that mean values for the Gini coefficient are quite unstable. Results are presented in Tables 2–4. Coefficients can be interpreted in the same way as in OLS regressions.

Infant mortality rate and under-five mortality rate: Models with log GDPpc predict 70 and 64 percent of the variability in IMR and U5MR, respectively. When political variables are added, models predict 76 and 71 percent of the variability. Both political variables are significantly correlated with health outcomes. Left vote shows stronger associations with health outcomes than voter turnout. Voter turnout is associated with IMR and U5MR but not in the expected direction: higher voter turnout is associated with higher mortality rates.

Among the welfare variables, only percentage of people under public medical care is significantly correlated with both mortality outcomes at the 95% confidence interval. The two welfare state variables accounted for more of variability in mortality rates than the two political variables.

When we include all significant variables together in a single model, the explanatory power increases in both IMR and U5MR models. All variables in these models are significant at 95% confidence interval except for voter turnout in the U5MR model.

For IMR, the inclusion of the Gini coefficient slightly enhanced the explanatory power ($R^2 = 0.4231-0.4283$), and decreased the model fit

Table 2
Infant mortality rate models

Variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value
Wealth												
Log GDP	−18.5 (1.55)	0.000	−18.9 (1.50)	0.000	−18.0 (1.62)	0.000	−18.1 (1.39)	0.000	−11.2 (4.13)	0.013	−11.4 (3.99)	0.015
Political variables												
Voter turnout			0.097 (0.04)	0.018			0.093 (0.04)	0.021	0.019 (0.04)	0.655	0.026 (0.05)	0.466
Percentage of vote obtained by left parties			−0.167 (0.05)	0.005			−0.062 (0.04)	0.173	−0.057 (0.05)	0.227	−0.049 (0.03)	0.316
Welfare state variables												
Social security transfer					−0.147 (0.10)	0.141						
Total public medical care					−0.130 (0.02)	0.000	−0.127 (0.03)	0.000	−0.090 (0.03)	0.015	−0.090 (18.31)	0.016
Income inequality												
Gini Coefficient									−7.713 (18.48)	0.682		
Intercept	192 (14.75)	0.000	194 (15.78)	0.000	200 (15.84)	0.000	194 (14.45)	0.000	136 (43.62)	0.007	129 (41.96)	0.007
Number of obs (clusters)	655 (19)		653 (19)		624 (19)		648 (19)		61 (17)		61 (17)	
Prob > F	0.0000		0.0000		0.0000		0.0000		0.0002		0.0001	
R^2	0.6993		0.7585		0.7971		0.8023		0.4283		0.4231	

Table 3
Under-five mortality rate models

Variables	Model 0		Model 1		Model 2		Model 3	
	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value
Wealth								
Log GDP	−22.0 (2.91)	0.000	−22.4 (3.02)	0.000	−21.1 (2.96)	0.000	−21.1 (2.96)	0.000
Political variables								
Voter turnout			0.132 (0.06)	0.044			0.134 (0.07)	0.064
Percentage of vote obtained by left parties			−0.241 (0.06)	0.001			−0.116 (0.05)	0.020
Welfare state variables								
Social security transfer					−0.126 (0.13)	0.361		
Total public medical care					−0.171 (0.04)	0.001	−0.150 (0.04)	0.002
Income inequality								
Gini coefficient								
Intercept	227 (28.09)	0.000	229 (30.20)	0.000	236 (29.12)	0.000	225 (30.32)	0.000
Number of obs (clusters)	131 (19)		131 (19)		128 (19)		131 (19)	
Prob > F	0.000		0.000		0.000		0.000	
R^2	0.6372		0.7122		0.7333		0.7504	

Table 4
Low birth weight rate models

Variables	Model 0		Model 1		Model 2		Model 3		Model 4		Model 5	
	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value	Coef. (Robust SE)	*p*-value
Wealth												
Log GDP	−0.334 (0.65)	0.611	−0.788 (0.58)	0.193	−0.280 (0.52)	0.598	−0.836 (0.58)	0.165	−1.430 (0.68)	0.049	−1.548 (0.73)	0.049
Political variables												
Voter turnout			0.014 (0.01)	0.283								
Percentage of vote obtained by left parties			−0.040 (0.02)	0.038			−0.019 (0.02)	0.341	−0.042 (0.013)	0.004	−0.043 (0.013)	0.005
Welfare state variables												
Social security transfer					−0.045 (0.03)	0.135						
Total public medical care					−0.028 (0.01)	0.000	−0.019 (0.01)	0.128	−0.008 (0.01)	0.209	−0.005 (0.01)	0.466
Income inequality												
Gini coefficient									−0.033 (0.05)	0.525		
Intercept	8.83 (6.29)	0.177	13.6 (6.08)	0.039	11.6 (5.04)	0.034	16.3 (5.55)	0.009	22.8 (6.95)	0.004	22.7 (7.16)	0.005
Number of obs (clusters)	415 (19)		413 (19)		386 (19)		411 (19)		172 (19)		172 (19)	
Prob > F	0.6109		0.1653		0.0000		0.0001		0.0001		0.0000	
R^2	0.0071		0.2080		0.2407		0.2314		0.4073		0.4451	

(p-value = 0.0001–0.0002). The Gini coefficient weakened the association of both voter turnout and left vote with infant mortality rate, while strengthened that of log GDPpc and total public medical care. We could not fit the model with the Gini coefficient for under-five mortality rate because of insufficient data points.

Low birth weight rate: Findings for the low birth weight rate clearly differ from results obtained with the infant and the under-five mortality rates. Log GDPpc alone predicts less than 1% ($R^2 = 0.0071$) of the low birth weight rate. The model is not significant (p-value = 0.6109). Political variables, together with log GDPpc, explain 21% of LBW variability. Left vote is significantly associated with LBW (p-value = 0.038), while voter turnout is not (p-value = 0.283).

Welfare-state variables together are stronger predictors of LBW ($R^2 = 0.2407$) compared to political variables. Percentage of population under public medical care is significantly associated with LBW (p-value = 0.000) but social security transfer is not (p-value = 0.135).

In the model incorporating log GDPpc, left vote and total public medical care, none of the explanatory variables is significantly associated with the outcome (LBW) at the 95% confidence interval, although the model is significant (p-value = 0.000) and explains 23% of the variability. The Gini coefficient does not explain much of the variation in LBW ($p = 0.209$). The model explains more of the variability in LBW without the Gini coefficient (p-value = 0.000; $R^2 = 0.4451$) than with the Gini coefficient (p-value = 0.0001; $R^2 = 0.4073$).

Sensitivity analyses: To test the stability of our analyses, we conducted two different types of sensitivity analyses by each outcome variable. First, an "extreme bound analysis" (Deravi, Hegji, & Moberly, 1990; Leamer, 1983) was performed using one explanatory variable and all possible combinations of other (less than four) explanatory variables. Because of insufficient data points, we excluded the Gini coefficient from this test. We also performed a kind of jackknife test generating 19 bivariate regressions by using subsets of our data set with one country omitted at a time.[1]

In most instances, the results from extreme bound analysis and jackknife method are congruent, and the direction of association between the variables being tested and the outcome is stable. Results from regressions when the US is omitted yielded minimum or maximum values about half of the times, but the direction of the associations does not change, and the values are not far off from the range. Therefore, the results from sensitivity tests did not substantially modify the conclusions of our analyses.

In conclusion, our results show that the strongest predictor of these three population health indicators was the percentage of population under public medical coverage. Political and welfare state variables had more explanatory power for the IMR and the U5MR than for the LBW rate. And welfare state variables had stronger explanatory power than political variables.

Discussion

Our study contributes to the emerging body of research on the impact of political factors on population health. We used a data set from 19 different countries over a 35-year period. This pooled regression approach helps us to draw more general conclusions than we have been able to, based on previous cross-sectional analyses.

While our study dealt tangentially with the relative income hypothesis, we tried to go a step further by assessing three maternal and child health outcomes in relation to political and welfare state factors. Based on our conceptual model, we hypothesized that generous welfare state policies and egalitarian political will would produce better population health, partially through reduction in income inequality. If the Gini coefficient were negatively and significantly associated with outcomes, we would know that the enhancement in the population health status is achieved partially though a reduction in income inequality. If the coefficients and p-values of political and welfare state variables in a model were affected by the addition of the Gini coefficient, the Gini coefficient would be in the path of these variables affecting population health.

In our analysis, the Gini coefficient was not significantly associated with either IMR or LBW, even if the zero order correlation between the Gini and the low birth weight was 64% (see Appendix A). This result implies that income inequality itself is not a cause of ill-health in populations, but is a result of something else in society, for example the welfare or health policies which directly impact population health status. By

[1]Results are available from authors on request.

this we mean that income inequality is endogenous to economic and welfare policies and resulting political economic arrangements of a country. Our models with Gini coefficients were adjusted by both political and welfare state variables so that income inequality did not have additional explanatory power.

Results on the comparison between IMR and LBW models suggest that maternal and child health outcomes respond to different social mechanisms. Our model had less explanatory power for the LBW compared to IMR or U5MR, leaving untapped uncertainties to be explored in future studies.

Thus, our findings contribute to the body of literature that challenges the strong version of the 'relative income hypothesis' (Lynch et al., 2004; Muntaner & Lynch, 1999). Infant and child health indicators of the effects of income inequality are weaker than some welfare state policies such as public health expenditure. Therefore the reliance on the psychological consequences of perceptions of income distribution as determinants of population health seems inadequate, at least for these indicators.

On the other hand, our results confirm the presence of an association between welfare state policies and child health outcomes, which has already been reported in a handful of studies (Conley & Springer, 2001; Macinko, Starfield et al., 2003; Macinko et al., 2004; Muntaner et al., 2002). Regarding specific welfare state policies, our investigation reaffirms the importance to provide public medical services to its citizens (Conley & Springer, 2001; Macinko et al., 2004; Muntaner et al., 2002; Navarro & Shi, 2001). Not only was this variable not affected by the Gini coefficient, but also it remained in all three model including political and welfare state variables simultaneously. Our findings are consistent with those of Macinko et al. (2004) who incorporated health services measures into his models (e.g., public expenditure for health, number of doctors per 1000 population and healthcare finance). They found that healthcare financing was the only variable showing a consistent relationship with the infant mortality rate.

Regarding the remaining relationships involving political variables, voter turnout was a weaker predictor of MCH outcomes than the percentage of left vote. It might be due to the fact that the former measures only the degree of the country's political participation, whereas the latter captures the "direction" of that participation (e.g., towards egalitarian redistribution of household incomes via taxation). Contrary to the 'social capital' literature would predict, voter turnout variables are 'positively' associated with mortality rates in Pearson's correlation analyses, and with all three outcomes in the models adjusted with log GDPpc and left vote as well.

The percentage of left vote was significantly associated with all MCH outcomes (p-value = 0.005 for the IMR; 0.001 for the U5MR; 0.038 for the LBW). However, the statistical association was lost (for the infant and the under-five mortality rate) or weakened (for the low birth weight rate) when welfare state variables were introduced into models. Thus we can state that the mere existence of political power with a "pro-welfare" state ideology is not sufficient to improve population health: this potential has to be institutionalized via the implementation of welfare state policies. This finding is congruent with what Huber and Stephens have found repeatedly for a variety of welfare state indicators (Huber & Stephens, 2001).

Our study has several limitations. They include the difficult interpretation of the low birth weight rate indicator. There are debates about whether the low birth weight rate is a meaningful population health indicator due to its heterogeneity (e.g., David, 2001). However, despite its ambiguity, our investigation, among many others (Collins et al., 2003; Collins, Wu, & David, 2002), suggests that LBW it is a sensitive indicator of societal impact on child health.

In addition, our models left a substantial amount of untapped variation because we did not design our study to explain causal mechanisms. Future studies should incorporate specific health services variables (e.g., access to NICUs) that might more fully explain the pathways between political and welfare state variables (e.g., universal access to health care) and various MCH outcomes (e.g., the infant mortality rate). Also, longer time series with complete data points would be necessary to examine causal models. Research using multiple levels of analysis (e.g., neighborhood proximity to a NICU) might also be necessary to capture the adequate level of explanation for a given outcome. In addition, instead of using 1 or 2 variables to measure theoretical constructs such as 'welfare-state generosity' or 'political egalitarianism', incorporation of latent variables that consists of multiple indicators available in comparative data sets, might provide stronger tests of these hypotheses. Thus, a limitation of our study is that our choice of indicators, heavily influenced by available data and by previous studies (Muntaner et al., 2002; Navarro et al., 2003) might have resulted in the exclusion of relevant variables (Peters, 1998, p. 70). To account for this limitation, we performed sensitivity analyses. Results suggest that the direction of association between the explanatory variables and health indicators is stable.

Another limitation of our analysis is that using completely exogenous political variables might fail to capture the endogenous nature of political factors. For example, the rising affluence of a society may facilitate the expansion of welfare state expenditures (Huber & Stephens, 2001). There are techniques that can be used to control for such endogeneity, such as through instrumental variables, but this can introduces risks of its own. For example, the efficiency of error terms can be potentially reduced, and therefore can make it difficult to detect statistical significance (Kennedy, 2001; Macinko et al., 2004). Since the endogeneity problem in political economic quantitative research is well known (e.g., Przeworski, 2004), development of instruments to account for the problem should be warranted. On the other hand, the stable nature of the political and welfares state systems of the countries included in our analyses, all of them with welfare state systems developed earlier in the 20th century, allowed us to use them as exogenous variables (Peters, 1998).

This investigation on the macro-social determinants of population health in wealthy countries found substantial variation attributable to political and welfare state factors. Thus it seems parsimonious to suggest that economic development alone does not create a healthy society. Political will that serves to implement and institutionalize welfare systems, including public medical services, appears to contribute as well to the health and well-being of its citizens.

Appendix A. The comparison of Pearson's correlation coefficients

Since some of the US values are distant from those of other countries, these data points can function as influential points, significantly altering regression results. Therefore we present the correlation matrix of all variables with and without the US. We put an asterisk the when direction of the relationship changes. The coefficients change slightly with the omission of the US. In terms of the correlation with the outcome variables, voter turnout is the only variable that changes sign when the US is dropped (negative to positive) (Table A1).

Table A1
Pearson's correlation coefficients

Pearson's correlation coefficients	IMR	UFMT	LBW	LOGGDP	VTURN	LEFTVOT	SSTRAN	TMEDCV	GINI
With US									
Infant mortality rate (IMR)	1								
Under-5 mortality rate (UFMR)	0.8955	1							
Low birth weight rate (LBW)	0.4406	0.4507	1						
Logarithmic GDP per capita (LOGGDP)	−0.8362	−0.7983	−0.0844	1					
Voter turnout (VTURN)	0.2137	0.1945	−0.1324*	−0.3098	1				
% vote for leftist parties (LEFTVOT)	−0.0536	−0.1131	−0.3842	−0.2255	0.6206	1			
Social transfer (SSTRAN)	−0.4704	−0.4079	−0.3070	0.3724	0.1949	0.2167	1		
% under public medical care (TMEDCV)	−0.3048	−0.3461	−0.4059	0.0028	0.3556*	0.6360	0.1738	1	
Gini coefficient (GINI)	0.1180	0.3218	0.6443	−0.0057	−0.4933	−0.4950	−0.3875	−0.2594*	1
Without US									
Infant mortality rate (IMR)	1								
Under-5 mortality rate (UFMR)	0.8924	1							
Low birth weight rate (LBW)	0.4621	0.4655	1						
Logarithmic GDP per capita (LOGGDP)	−0.8647	−0.8159	−0.2067	1					
Voter turnout (VTURN)	0.2611	0.2252	0.0697*	−0.2312	1				
% vote for leftist parties (LEFTVOT)	−0.0187	−0.1180	−0.2238	−0.1318	0.4666	1			
Social transfer (SSTRAN)	−0.4590	−0.3980	−0.2766	0.4206	0.1372	0.1270	1		
% under public medical care (TMEDCV)	−0.4164	−0.5105	−0.2399	0.2583	−0.0473*	0.2624	0.0182	1	
Gini coefficient (GINI)	0.0749	0.3218	0.5759	−0.1895	−0.3190	−0.3256	−0.3159	0.0963*	1

*The direction of association changes by exclusion of the US.

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