Welfare state matters: A typological multilevel analysis of wealthy countries

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Abstract

Building on the social science literature, we hypothesized that population health indicators in wealthy industrialized countries are 'clustered' around welfare state regime types. We tested this hypothesis during a period of welfare state expansion from 1960 to 1994. We categorized data from 19 wealthy countries into 4 different types of welfare state regimes (Social Democratic, Christian Democratic, Liberal and Wage Earner Welfare States). Outcome variables were the infant mortality rate (IMR) and the low birth weight rate (LBW), obtained from the Organization of Economic Co-operation and Development (OECD) Health Data 2000 and from the United Nations Common Statistical Database (UNCSD). A two-level multilevel model was constructed, and fixed effects of welfare state were tested. Through the 39 years analyzed, Social Democratic countries exhibited a significantly better population health status, i.e., lower infant mortality rate and low birth weight rate, compared to other countries. Twenty percent of the difference in infant mortality rate among countries could be explained by the type of welfare state, and about 10% for low birth weight rate. The gap between Social Democracies and other countries widened over the 1990s. Our results confirm that countries exhibit distinctive levels of population health by welfare regime types even when adjusted by the level of economic development (GDP per capita) and intra-country correlations. It implies that countries, as groups, adopt similar policies or through any other ways, achieve similar level of health status. Proposed mechanisms of such process and suggestions for future research directions are presented in the discussion.
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1. Introduction

This investigation starts with two different aims: one methodological–theoretical and the other empirical. The former is related to the increasing realization of the interdependence among countries, which would require a contextual or multilevel modeling for comparative health policy analyses. The latter is associated with examining the relationship between the type of welfare state and the average levels of population health among wealthy (OECD) countries in the last 39 years (1960–1998). OECD countries have been chosen in comparative public health studies because of the qual-

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ity of data available for the studies [1–3]. Also, because OECD countries are the most powerful nations in the world, we can control for external influences on domestic policy decisions, as these are vastly reduced. These two objectives will be explained in detail in the following section.

Since Esping-Andersen's "The Three Worlds of Welfare Capitalism" [5], a number of macro-comparative studies have been conducted using three or four different welfare regime types, and his typology has been proved to be a useful explanatory device for the emergence of welfare states, including national health policies [4]. Esping-Andersen claims that there are qualitatively different arrangements between state, market and family, resulting in three regime type clusters of nations [5]. One of these types is the 'Liberal' Welfare State, "in which means-tested assistance, modest universal transfers or modest social-insurance plans predominate", and this welfare state type is also closely related to traditional work-ethic norms. In the second type, we find 'Conservative–Corporatist' welfare states, where states stand up to provide welfare services to their citizens, but at the same time uphold social status differences so that the resulting redistributive impact is minimal. Also, the role of churches and families as providers of social services is emphasized in this type. Lastly, there is 'Social Democracy', "in which the universalism and de-commodification of social rights are extended to the new middle classes". In contrast to the Conservative–Corporatist model, the state in Social Democracy takes over much of the social welfare role of the family. In addition, the Social Democratic regime espouses full employment as an integral part of its welfare state commitment, which is characteristically distinct from the other two regime types.

Huber and Stephens [4] have modified Esping-Andersen's typology by using four categories instead of three. Their approach basically renames Esping-Anderson's "Conservative–Corporatist" group as "Christian Democratic" and distinguishes what Castles and Mitchell [6] call "Wage Earner Welfare States" from Anglo-Saxon countries because before circa 1980, the welfare system in Australia and New Zealand was quite different from the US and the UK [4,6,7]. The crux of Castles and Mitchell's observation is that the welfare state regime type or the provision of welfare state services is not only determined by the strength of 'left' parties, but also by the strength of 'right' parties [6,7]. These authors classified countries into four categories based on household transfers as a percentage of GDP ("welfare expenditure": high and low) and average benefit equality ("use of equalizing instrument": high and low). They argue that countries with high equalizing instruments and low expenditures (what they labeled "Wage Earner" countries) are "nations in which a strong labor movement has found it difficult to translate popular support into cabinet incumbency during the post-war era" (p. 17). The welfare state expenditure of "Wage Earner" countries is low because a long-term incumbency is needed for increases in welfare expenditure. On the other hand, through either trade unions functioning as an 'extra-parliamentary veto group' or through 'strong popular sentiment within the population, which governments of whatever complexion must take into account in their decision-making', these countries have managed to introduce this "equalizing instrument" into the state policy system [7]. The US and the UK, on the other hand, are countries in which "the role of the labor movement has been vestigial and in which rightist liberal parties have been dominant" (p. 16).[1]

In addition, there is a welfare state type called "Confucian Welfare State" [8] or "East Asian Welfare State" [9]. The concept is a product of debates about Esping-Andersen's welfare state typology, claiming that the typology is too simple to capture the characteristics of former dictatorships (e.g., Southern European countries) or non-western (e.g., Japan) countries. In this type of countries, welfare services are provided by families rather than by the state or the market, which is confirmed by Hong through a qualitative comparative analysis method (Boolean algebra) [10]. However, other authors allege that East Asian countries, including Japan, can be also categorized using Esping-Andersen's typology. Esping-Andersen claimed that Japan showed a mixed type of "Conservative–Corporatist" and "Liberal" Welfare State, and as a whole, could be categorized as "Conservative–Corporatist", based on the characteristics of the social security system and the popular perception of welfare [5,11]. He also argued that

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[1] Canada is a partial exception, "with respect to its average benefit equality, depending on one's ideological classification of the Canadian Liberal Party" (p. 16).

patriarchy and Confucianism in Japan operated as functional substitutes for conservatism and Christianity in European countries in the process of building a welfare state. While acknowledging that Japan showed characteristics of Conservative–Corporatist, Cho pointed out that Esping-Andersen's "de-commodification" score was similar to Canada or the UK and therefore Japan should be categorized as a Liberal Welfare State [12]. Scholars in this tradition generally agree on the fact that Japan shows a mixed type of "Liberal" and "Conservative-Coporatist" even if they might vary in the final decision to assign Japan to either one of these two categories.

One of the main functions of the welfare state is 'income redistribution'; therefore, the welfare state framework has been applied to the fields of social epidemiology and health policy as an amendment to the 'relative income hypothesis'. Welfare state variables have been added to measures of income inequality to determine the structural mechanism through which economic inequality affects population health status [13–18]. However, while the relationship between income inequality and population health has been examined in several cross-national studies during the last three decades [19,20], few studies have explored the relationship between political variables and population health at the national level (e.g. [14–16,18,21]) and none, to our knowledge, has included a comprehensive number of political variables to understand their effect on population health, while simultaneously adjusting for economic determinants. Muntaner et al. [17] included a wide range of variables although their analysis was based on GDP adjusted cross-sectional correlations [17]. Overall, these studies suggest that welfare state variables (e.g., access to health care) could be important predictors of population health outcomes. However, all of these studies consider countries to be independent from one another, a fact that follows implicitly from their methodology: country-level fixed effects models or general cross-sectional linear regression, which amount to methodological individualism in international comparative studies. This methodological approach might be insufficient for two reasons. First, based on contemporary history [22], countries with similar types of welfare state regimes should display similar population health outcomes as a result of the similarity between their health and welfare policies. Second, it is unrealis-

tic to merely assume that the countries are independent from one another, especially in an era of increased economic, political and cultural interdependence.

Some of these theoretical concerns were addressed empirically in a couple of articles in the field of historical political sociology. For example, using a method of sequence comparison, or optical matching, Abbott and DeViney analyzed the sequence in which welfare programs were adopted and which of the three levels, individual country, diffusion from one country to another, or world-wide random phenomenon, were responsible for the events in 18 advanced countries [23]. In their conclusion, they strongly suggested that students of welfare states should take the second level (diffusion) and the third level (world-wide) more seriously and that when multilevel modeling is adopted, local effects would become considerably weaker. This means that rather than countries making their own policies, they learn from adjacent countries (diffusion) or from world-wide trends.

A more generous welfare state should result in better population health outcomes. This could be through the direct impact of welfare services which provide physical well-being, for example, change in workers' compensation and resulting change in occupational health status. Or this could be because more generous welfare states tend to have better health care systems. Either way, population-level indicators should be clustered among countries that fall into the same type of welfare state. Thus, the main goal of this study is to examine whether indicators of welfare state regime types have statistical significance even when models are adjusted by country-specific variances and the country's level of economic well-being (measured by GDP per capita). The implication of confirming the effect of welfare state regime type is that (1) welfare state typologies can be used as a informative analytical tools in public health and (2) historically, a certain type of welfare state establishment has provided a better health care environment to its population than others. Confirming this typology may also limit the amount of 'exceptionalism' that can be claimed for any particular country: countries influence each other's policies. The implication will be that health policy analysts need to pay attention to these 'external' aspects of policy planning and implementations.

2. Methods

2.1. Data sources and variables

The study was conducted among 18 wealthy countries of Europe (13), North America (2) and Asia and the pacific region (3) from the period of 1960–1998 (39 years). Based on Huber and Stephens' typology [4], we categorized these countries into four different types of welfare state regimes: Social Democratic, Christian Democratic, Liberal and Wage Earner Welfare States. Huber and Stephens did not include Japan in their work, so we categorized it as a Wage Earner Welfare State. Japan is usually considered as a mixed type

of Liberal and Conservative–Corporatist (i.e., Christian Democratic) (see Section 1), therefore assigning a Wage Earner type is justified. In all analyses, Social Democratic countries were considered as the comparison group.

Outcome variables were the infant mortality rate (IMR) and the low birth weight rate (LBW), which were obtained from the OECD Health Data 2000 [24]. Different types of population-level outcomes are used to measure a country's health status. We chose infant and child health indicators because previous studies [14–18] found that birth- and infant-related variables seem to be the most sensitive to political and welfare state conditions. Overall, the IMR and the LBW have

Table 1
List of countries and outcome variables

Country	Infant mortality rate (per 1000 live births)			Low birth weight rate (% of total live births)		
	Rank	Mean	S.D.	Rank	Mean	S.D.
Social Democratic Welfare States						
Sweden	1	9.3	3.6	4	4.5	0.3
Norway	4	10.8	4.0	2	4.3	0.3
Denmark	6	11.6	4.9	14	6.0	0.5
Finland	2	10.4	5.1	3	4.4	0.6
Mean	–	10.5	4.5	–	4.8	0.82
Christian Democratic Welfare State						
Austria	8	13.3	4.8	12	5.9	0.2
Belgium	16	16.0	7.1	16	6.1	0.4
Luxembourg	13	15.8	7.8	5	4.7	0.8
Netherlands	3	10.6	3.5	6	5.1	1.3
Germany	17	16.7	8.3	10	5.7	0.1
France	9	14.0	6.7	8	5.5	0.5
Italy	19	21.4	11.9	11	5.8	0.4
Switzerland	7	11.6	5.2	7	5.2	0.1
Mean	–	15.6	8.4	–	5.6	0.6
Liberal Welfare States						
Canada	12	14.4	7.2	17	6.5	0.9
Ireland	14	15.8	7.6	1	4.3	0.4
United Kingdom	10	14.2	5.3	18	6.6	0.2
United States	15	15.9	6.1	19	7.0	0.3
Mean	–	15.1	6.6	–	6.4	1.0
Wage Earner Welfare States						
Australia	18	18.7	9.2	13	5.9	0.3
Japan	5	11.3	7.4	9	5.7	0.7
New Zealand	11	14.3	4.3	15	6.0	0.2
Mean	–	13.0	5.7	–	5.8	0.5
ANOVA test comparing by welfare state regime type						
F (p-value)		14.33 (0.0000)			99.98 (0.0000)	

been shown to be sensitive to short-term changes in social conditions, and they constitute adequate variables with which we examined our hypothesis. List of countries and values for IMR and LBW are given in Table 1.

We incorporated a set of variables that indicate decades (i.e., period effects), to compare values from 1970s (1970–1979), 1980s (1980–1989) and 1990s (1990–1998) with those from 1960s (the comparison group).

2.2. Statistical analysis

We build conditional hierarchical models to explain variability in the lower level units (years). Also, we introduce welfare state type as a fixed effects indicator at the country-level. As a result, models are comprised of two levels, which are years (random effects), nested within countries.

For each health outcome, we fit seven GDP adjusted models. Social Democratic countries are considered as the comparison group to other welfare state regimes. Period indicators are constructed so that each decade such as 1970, 1980 and 1990s can be compared to the 1960s.

- *Model 1*: GDP per capita (logarithmic) only.
- *Model 2*: GDP per capita (log) and welfare state regime dummy variables, four categories.
- *Model 3*: GDP per capita (log) and welfare state regime dummy variables (four categories) and dummy variables for each decade.
- *Model 4*: GDP per capita (log) and welfare state regime dummy variables, three categories. In this model, we did not distinguish between Wage Earner countries and Liberal countries.
- *Model 5*: GDP per capita (log) and welfare state regime dummy variables (three categories) and dummy variables for each decade.
- *Model 6*: GDP per capita (log) and welfare state regime dummy variables, two categories. In this model, all other countries were compared to Social Democracies.
- *Model 7*: GDP per capita (log) and welfare state regime dummy variables (two categories) and dummy variables for each decade.

We expect the difference between the social democratic regime type and others to be statistically sig-

nificant, whereas we only expect marginal differences among the other three welfare state regimes [5,15,17,25]. See Appendix A for further statistical detail. STATA Version 8 was used to obtain the estimates through the random effect (mixed) method.

3. Results

The multilevel approach enables us to decompose the variance into each level. In a usual regression model variances are assumed to be, and should be, random and independent. In multilevel analyses, we assume that errors are correlated. For example, our dataset includes 39 observations from each of the 18 countries. We can logically assume that the observations from one country are more highly correlated with themselves than with those from other countries. By analyzing the within (and between) country correlations, we understand the source of variation (measured through variance or standard deviation). On the other hand, if our model perfectly explains the data there will be no variance: everything is explained. Therefore, variance is an indicator of unexplained uncertainty. By incorporating explanatory indicators, we hypothesize that they will reduce the uncertainly and explain part of the variance (Tables 2 and 3).

In our model, σ_u represents the standard deviation originating from the country-level and σ_e represents the random error. These are the random parts of the model. The intra-class correlation (ICC) coefficient ρ provides the ratio of total variability that is explained by the country-level correlation (σ_u). The percentage of total variance explained by the within-country variability is 68–79% for IMR and 62–75% for LBW. In both modeling processes, the lowest ρ were observed in Model 7, meaning that the two category welfare state model with decade indicator explains the most country-level variation, compared to other models.

In the next section, we will focus on the significance of welfare state indicators and change in country-level variance (σ_u^2) following the addition of welfare state and decade indicators.

3.1. Infant mortality rate

The infant mortality rate is highly correlated with GDP per capita. In all models, the *p*-value for

Table 2

Infant mortality rate models

Model no.	1			2			3			4			5			6			7		
	Coefficient	S.E.	$p>|z|$	Coefficient	S.E.	$p>|z|$	Coefficient	S.E.	$p>|z|$	Coefficient	S.E.	$p>|z|$	Coefficient	S.E.	$p>|z|$	Coefficient	S.E.	$p>|z|$	Coefficient	S.E.	$p>|z|$
Fixed effects																					
GDP per capita, logarithmic	−1.31	0.01	0.000	−1.31	0.01	0.000	−1.36	0.04	0.000	−1.31	0.01	0.000	−1.36	0.04	0.000	−1.31	0.01	0.000	−1.36	0.04	0.000
Welfare state, four categories[a]																					
Christian Democratic				0.19	0.12	0.109	0.19	0.10	0.073												
Wage Earner (WE)				0.01	0.14	0.966	0.00	0.13	0.969												
Liberal (L)				0.24	0.134	0.095	0.24	0.13	0.063												
Welfare state, three categories[b]																					
Christian Democratic										0.15	0.11	0.187	0.15	0.10	0.156						
WE + L										0.12	0.11	0.295	0.12	0.11	0.263						
Welfare state, two categories[c]																					
Others																0.31	0.10	0.002	0.31	0.09	0.000
Decades[d]																					
1970s							0.06	0.02	0.001				0.06	0.02	0.001				0.06	0.02	0.001
1980s							0.11	0.03	0.001				0.11	0.03	0.001				0.10	0.03	0.002
1990s							0.02	0.04	0.553				0.02	0.04	0.550				0.02	0.04	0.592
Intercept	7.48	0.07	0.000	7.34	0.10	0.000	7.48	0.17	0.000	7.36	0.10	0.000	7.51	0.17	0.000	7.23	0.10	0.000	7.37	0.16	0.000
Random effects																					
σ_u				0.216			0.208			0.185			0.215			0.190			0.173			0.153
σ_e				0.111			0.111			0.105			0.111			0.105			0.111			0.105
ρ^e				0.790			0.778			0.756			0.789			0.766			0.707			0.680
R^2																					
Within				0.9518			0.9518			0.9571			0.9518			0.9571			0.9518			0.9571
Between				0.0132			0.1766			0.1734			0.0860			0.0844			0.3198			0.3153
Overall				0.7978			0.8299			0.8327			0.8133			0.8162			0.8535			0.8565
Number of observations				693			693			693			693			693			693			693
Number of groups				18			18			18			18			18			18			18

[a] Social Democratic (control group), Christian Democratic, Wage Earner and Liberal Welfare States.

[b] Social Democratic (control group), Christian Democratic and Wage Earner + Liberal Welfare States.

[c] Social Democratic (control group) and other welfare states.

[d] Compared to 1960s.

[e] Fraction of variance due to σ_u.

Table 3

Low birth weight rate models

Model no.	1			2			3			4			5			6			7		
	Coefficient	S.E.	$p > |z|$	Coefficient	S.E.	$p > |z|$	Coefficient	S.E.	$p > |z|$	Coefficient	S.E.	$p > |z|$	Coefficient	S.E.	$p > |z|$	Coefficient	S.E.	$p > |z|$	Coefficient	S.E.	$p > |z|$
Fixed effects																					
GDP per capita, logarithmic	−0.42	0.08	0.000	−0.42	0.08	0.000	−0.02	0.24	0.931	−0.42	0.08	0.000	−0.01	0.24	0.958	−0.42	0.08	0.000	−0.02	0.24	0.938
Welfare state, four categories																					
Christian Democratic				0.71	0.43	0.093	0.74	0.35	0.036												
Wage Earner (WE)				0.90	0.51	0.081	0.92	0.42	0.030												
Liberal (L)				1.24	0.52	0.017	1.27	0.43	0.003												
Welfare state, three categories																					
Christian Democratic										0.66	0.41	0.107	0.68	0.33	0.039						
WE + L										1.07	0.41	0.010	1.09	0.33	0.001						
Welfare state, two categories																					
Others																1.14	0.42	0.006	1.17	0.33	0.000
Decades																					
1970s							−0.40	0.11	0.000				−0.41	0.11	0.000				−0.41	0.11	0.000
1980s							−0.70	0.19	0.000				−0.71	0.19	0.000				−0.70	0.19	0.000
1990s							−0.41	0.24	0.084				−0.42	0.24	0.078				−0.42	0.24	0.079
Intercept	7.30	0.36	0.000	6.56	0.46	0.000	5.42	0.87	0.000	6.60	0.45	0.000	5.43	0.87	0.000	6.43	0.47	0.000	5.27	0.87	0.000
Random effects																					
σ_u				0.828			0.756			0.619			0.745			0.593			0.732			0.576
σ_e				0.481			0.481			0.451			0.481			0.451			0.481			0.451
ρ				0.747			0.712			0.653			0.705			0.634			0.698			0.620
R^2																					
Within				0.0678			0.0678			0.1880			0.0678			0.1879			0.0678			0.1880
Between				0.0509			0.2989			0.3492			0.3492			0.3339			0.3007			0.3553
Overall				0.0025			0.3648			0.4222			0.3259			0.3849			0.3568			0.4191
Number of observations	451			451			451			451			451			451			451		
Number of groups	18			18			18			18			18			18			18		

log(GDPpc) is highly significant. log(GDPpc) alone explains more than 95% of within-country variation (R^2-within), which means that the change of infant mortality rate in a country over the last 39 years can be explained mostly by the change in economic well-being of that country. On the other hand, economic development explained a little over 1% of the variation between countries (R^2-between). Between country R^2 values increase by the addition of welfare state indicators and it is largest when two categories are used. Model 6 (two category welfare state, no decade indicators) explains about 32% of between-country variation in low birth weight rate.

Welfare state regime type is not significant at $\alpha = 0.05$ when either four or three categories are used. Christian Democratic and Liberal countries each as a group are marginally different ($p < 0.1$) from Social Democracies in four welfare state category models. In the last model, Social Democracies are significantly different from other welfare state regime types ($p = 0.002$). We also observe a period effect. Infant mortality in the 1970s and 1980s is significantly different from the 1960s ($p = 0.001$), but the values from the 1990s are similar to those of the 1960s. When adjusted by logarithmic GDP per capita, the infant mortality actually increased in the 1970s and 1980s, and then decreased in the 1990s to the level of infant mortality rate in the 1960s.

In Fig. 1, we present the values of σ_u and σ_e to compare their change when adding indicators. If the variable newly introduced to the model has explanatory

power at the country-level variation of infant mortality rate, the random effect standard error σ_u will decrease. When we compare Models 2, 4 and 6 with Model 1 we observe that σ_u is the smallest when using two categories of welfare state regime, whereas it is large with three categories. Using two categories explained the most of country-level variation in infant mortality rate, but 80% of total variability at the country-level is left unexplained.

3.2. Low birth weight rate

GDP per capita (logarithmic) is significantly associated with the low birth weight rate as well, but only in those models where we did not adjust for period effects ($p = 0.000$ for Models 1, 2, 4 and 6; $p = 0.931$ for Model 3, 0.958 for Model 5 and 0.938 for Model 7). Model 1 explained about 6, 5 and 0.25% of within, between and overall R^2 values, respectively. This is different from Model 1 in the infant mortality rate analysis, where log(GDPpc) alone predicted most of within-country variation.

While GDP per capita is not significantly associated with the low birth weight rate, welfare state indicators, regardless of number of categories used in the analysis, predicted about 30% of between-country variability in all models. Almost all fixed effect slopes of welfare state regime type are statistically significant at the 95% confidence interval, regardless of the number of welfares state regime categories used. The only exception was Christian Democratic ($p = 0.0983$) and Wage Earner countries ($p = 0.081$) in Model 2 and Christian Democratic countries in Model 4 ($p = 0.107$).

The effect of decades was similar to that in infant mortality rate models, but was more highly associated. Low birth weight in the 1990s was marginally different from that in 1960s ($p = 0.078$–0.084), whereas p-values for 1970s and 1980s in all models were highly significant ($p = 0.000$). The mean low birth weight rate was the lowest in the 1980s, when adjusted for GDP per capita (logarithmic).

The pattern from low birth weight rate analyses in Fig. 1 is different from infant mortality rate results. The predictability of the model was enhanced with a smaller number of categories for welfare state type, but the change is small. The remaining σ_u after the inclusion welfare state regime indicators was 88–91%.
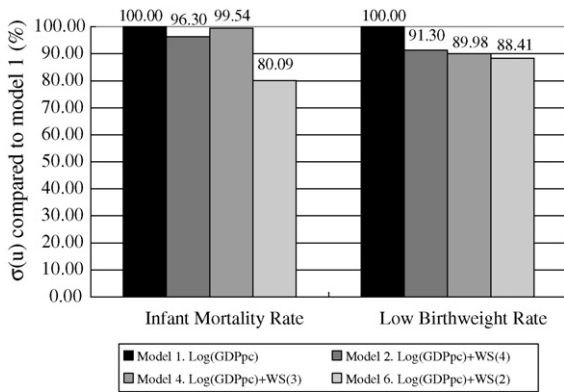

Fig. 1. A comparison of σ_u (country-level variation) by outcome and number of welfare state (WS) categories used.
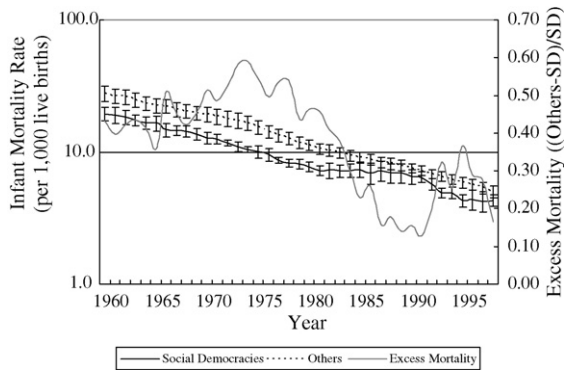
Fig. 2. Infant mortality rate in Social Democracies and other countries, 1960–1998.

3.3. Changes in IMR and LBW over time by welfare state type

We present Figs. 2 and 3 to depict changes in infant mortality and low birth weight over time according to welfare state regime type. In both infant mortality rate and low birth weight rate models, Social Democracies show a better health status over the 39-year period. We should note that all values for 'difference' are positive. The error bars in both graphs indicate 95% confidence intervals. When the error bar from Social Democracies and other countries at a certain time-point do not overlap, the difference is statistically significant at $\alpha = 0.05$. In that perspective, differences are statistically significant most of the time for infant mortality, and half of the time (since circa 1980s) for low birth weight. We do not have many data points for low birth weight in the earlier decades, so this limitation should be taken into
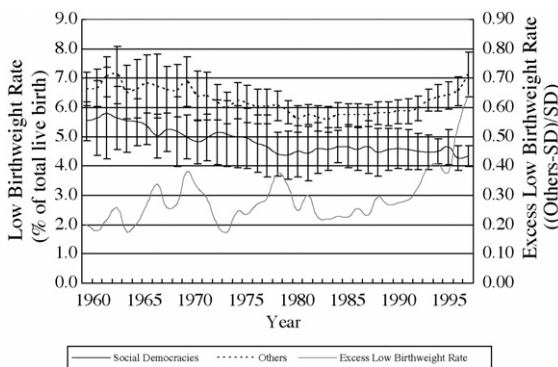
Fig. 3. Low birth weight rate in Social Democracies and other countries, 1960–1998.

account. For the infant mortality rate, there seems to be a 'convergence' in the 1980s between Social Democracies and other countries. However, for the low birth weight rate, differences seem to increase over time, with an exponential growth in the 1990s.

4. Discussion

Our results confirm that countries exhibit distinctive levels of population health (in this study, the infant mortality rate and the low birth weight rate) by welfare regime type. Social Democratic countries as a group showed significantly better health status compared to other countries during the whole period of 39 years investigated. Therefore, our investigation provides additional empirical evidence to previous studies [14,16–18,25] suggesting that Social Democratic countries exhibit better population health status before the so-called 'neo-liberal' reforms, and that this achievement continued during the era of 'welfare state retrenchment' [4]. Huber and Stephens pointed out that, in the changed environment of the 1980s, "the active, service-oriented Social Democratic Welfare States were in a stronger position than the passive, transfer-oriented Christian Democratic Welfare States" (p. 321). This statement also applies to the Liberal and Wage Earner Welfare States that had started "ideologically driven cuts" (p. 320) in welfare state funding even earlier. This conclusion is also supported by the changes shown in Figs. 2 and 3. The excess infant mortality of other countries compared to Social Democracies maintained until the early 1980s, but differences in low birth weight kept growing until the end of the period analyzed. These results support the hypothesis that Social Democracies maintained a healthier social environment than other welfare state regimes after the 1980s.

Even after adjusting for GDP per capita and intra-country correlations, welfare state regime type indicators were highly significant predictors of health indicators. This suggests that certain factors at the supra-national level might determine the population health status of the countries examined. It might be due to shared policy characteristics of a given welfare state regime type, resulting from policy diffusion or proximate political alliances. Going back to Abbott and DeViney's observations [23], they suggest two models

for policy diffusion. The sequence of welfare policy adoption follows a "humped" adoption pattern: "a distinct early peak is followed by a larger peak and then one or more lesser ones" (p. 268). This pattern can be explained through a "wait and see" model. "On this model [. . .], countries have varying thresholds for adoption. A group of low threshold countries adopt a policy, and others wait to see if it works. After a sufficient time has passed, a group with higher thresholds decides to adopt" (p. 268). We cannot confirm this hypothesis using the results provided in this study, but we suspect that Social Democracies are countries with low thresholds, assuming that these policies have favorable effects on population health. Abbott and DeViney also point out the existence of "conspicuous nonadoption", which can be applied to countries like the US, which, in comparative research, is usually considered a statistical outlier.

An alternative approach to the explanation of these humps is that "they reflect actual international policy connections—at meetings of the ILO, for example" (p. 268). A policy connection does not necessarily have to be a meeting or a convention. As a matter of fact, before and after World Wars I and II we observe the major adoption peaks for welfare policies (p. 269).[2] In our analysis, the observed difference could be due to the fact that Social Democracies and Christian Democracies are all members of the European Union and the Liberal and Wage Earner Welfare States are all extra-EU countries (except the UK). Studies could be designed to examine this question by using multiple independent variables or a cross-classified third level model including local economic or political memberships of countries.

But what are the salutary policies that affect health outcomes? They could include universal access to health care, higher female employment in the labor market, higher unemployment compensation and subsidies to single mothers and divorced women in mostly Northern European Social Democratic countries, most of which were developed before the 1960s [5]. In particular, active labor-market interventions to ensure full employment, especially among women, has been a distinctive feature of Social Democratic countries during the last century [27]. All these social policies have

been associated with better outcomes in individual-level studies, thus giving plausibility to our interpretation [14–18,25,28].

In our analysis, using two categories of welfare state regime (Social Democracy versus other) best explained the variations in infant mortality rate and low birth weight rate. Using three categories better explained the health variation than using four welfare state regime categories in infant mortality rate analyses. This can lead to a conclusion that, in terms of assessing infant mortality, having a separate category of Wage Earner type of welfare state does not enhance the predictability our welfare state models. A problem with this conclusion is related to the categorization of countries by different authors. Huber and Stephens use a different set of countries for the "Wage Earner" type than Castles and Mitchell. For example, Castles and Mitchell categorize not only Australia and New Zealand but also the United Kingdom as a "Wage Earner" Welfare State (p. 21) [7]. Japan was excluded in their final categorization too. Therefore, understanding the relationship between welfare state regimes and population health outcomes will likely involve further analysis into each country's political history.

This, however, by no means should lead to the conclusion that a country's welfare state regime type is predetermined. For example, in the last couple of decades, Spain established its own welfare state after an oppressive fascist regime. Also, even if they fall into the same 'Liberal Welfare State' regime type, the difference in population health status between Canada and the US has been widening over the last decades [29]. "The life expectancy of all Americans has been lower than that of all Canadians since the beginning of the 20th century. Until the 1970s this disparity was the result of the low life expectancy of African Americans. Since then, the life expectancy of white Americans has not been improved as much as that of all Canadians" (p. 5). The divergence after the 1970s coincides very closely with the adoption of universal health care coverage in Canada (p. 31). This observation emphasizes the importance of providing quality health care services for all. The impact of health care services might be relatively smaller than that of welfare state policies as a whole. Nevertheless, this example illustrates one of the key ways to improve a country's population health status.

As a conclusion, observed differences in population health indicators among these countries do not

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[2] For the relationship between the two World Wars and labor movements in advanced countries, see Silver [26].

seem to be only quantitative (e.g. [30], i.e., the differences are in degree) but also qualitative: distinctively different 'clusters' of welfare state regime types have notable consequences for population health. In addition, by using this framework, we were able to show that more protective types of welfare state regimes, namely the group of Social Democratic countries, were able to provide a more population health-friendly environment to its citizens in the last 39 years than other types. Future studies should investigate the specific welfare regime features that account for welfare regime effects on maternal and child health and other related population health indicators.

Acknowledgements

Appendix A

Let y_{ij} denote the infant mortality rate (logarithmic) or the low birth weight rate at the jth country in ith year. Then, a model to describe the relationship is:

$$y_{ij} = \beta_{0j} + e_{ij}$$
$$\beta_{0j} = \gamma_{00} + \gamma_{01} \log(\text{GDPpc}) + \gamma_{02}(\text{CD})$$
$$\qquad + \gamma_{03}(\text{WE}) + \gamma_{04}(L) + u_j$$

By the integration of above two formulae, we acquire the following:

$$y_{ij} = \frac{\gamma_{00} + \gamma_{01} \log(\text{GDPpc}) + \gamma_{02}(\text{CD})}{+ \gamma_{03}(\text{WE}) + \gamma_{04}(L)}$$
Fixed effects part
$$+ \frac{u_j + e_{ij}}{\text{Random effects part}}$$

$i = 0, 1, 2, \ldots, 38, j = 1, 2, 3, \ldots, 19$, CD is the dummy variable for Christian Democratic countries, WE the dummy variable for Wage Earner countries and L is the dummy variable for Liberal countries, where

$$y_{ij} \sim iid(\beta_{0j}, \sigma^2)$$
$$a_j \sim iid(0, \sigma_{\text{u}}^2)$$
$$e_{ij} \sim iid(0, \sigma_{\text{e}}^2)$$

When dummy variables indicating decades are used, the formula can be written out as follows:

$$y_{ij} = \gamma_{00} + \gamma_{01} \log(GDPpc) + \gamma_{02}(CD) + \gamma_{03}(WE) + \gamma_{04}(L)$$
$$+ \gamma_{05}(70s) + \gamma_{06}(80s) + \gamma_{07}(90s)$$
$\longrightarrow$ Fixed effects part
$$+ u_j + e_{ij}$$
$\longrightarrow$ Random effects part

$i = 0, 1, 2, \ldots, 38, j = 1, 2, 3, \ldots, 19$, CD is the dummy variable for Christian Democratic countries, WE the dummy variable for Wage Earner countries, L the dummy variable for Liberal countries, 1970s the dummy variable for 1970s, 1980s the dummy variable for 1980s and 1990s is the dummy variable for 1990s.

When three categories of welfare state regime types are used:

$$y_{ij} = \gamma_{00} + \gamma_{01} \log(\text{GDPpc}) + \gamma_{02}(\text{CD}) + \gamma_{03}(L_2)$$
$$\quad + u_j + e_{ij} \text{ and } y_{ij} = \gamma_{00} + \gamma_{01} \log(\text{GDPpc})$$
$$\quad + \gamma_{02}(\text{CD}) + \gamma_{03}(L_2) + \gamma_{05}(1970s)$$
$$\quad + \gamma_{06}(1980s) + \gamma_{07}(1990s) + u_j + e_{ij}$$

where CD is the dummy variable for Christian Democratic countries, L_2 the dummy variable for Wage Earner and Liberal countries, 1970s the dummy variable for 1970s, 1980s the dummy variable for 1980s and 1990s is the dummy variable for 1990s.

When two categories of welfare state regime types are used:

$$y_{ij} = \gamma_{00} + \gamma_{01} \log(\text{GDPpc}) + \gamma_{02}(\text{OTH}) + u_j$$
$$\quad + e_{ij} \text{ and } y_{ij} = \gamma_{00} + \gamma_{01} \log(\text{GDPpc})$$
$$\quad + \gamma_{02}(\text{OTH}) + \gamma_{05}(1970s) + \gamma_{06}(1980s)$$
$$\quad + \gamma_{07}(1990s) + u_j + e_{ij}$$

where OTH is the dummy variable for other countries as opposed to Social Democracies, 1970s the dummy variable for 1970s, 1980s the dummy variable for 1980s and 1990s is the dummy variable for 1990s.

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