Creating and Using New Data Sources to Analyze the Relationship Between Social Policy and Global Health: The Case of Maternal Leave

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ABSTRACT

Objectives. Operating at a societal level, public policy is often one of our best approaches to addressing social determinants of health (SDH). Yet, limited data availability has constrained past research on how national social policy choices affect health outcomes. We developed a new data infrastructure to illustrate how globally comparative data on labor policy might be used to examine the impact of social policy on health.

Methods. We used multivariate ordinary least squares regression models to examine the relationship between the duration of paid maternal leave and neonatal, infant, and child mortality rates in 141 countries when controlling for overall resources available to meet basic needs measured by per capita gross domestic product, total and government health expenditures, female literacy, and basic health care and public health provision.

Results. An increase of 10 full-time-equivalent weeks of paid maternal leave was associated with a 10% lower neonatal and infant mortality rate ($p \leq 0.001$) and a 9% lower rate of mortality in children younger than 5 years of age ($p \leq 0.001$). Paid maternal leave is associated with significantly lower neonatal, infant, and child mortality in non-Organisation for Economic Co-operation and Development (OECD) countries and OECD countries.

Conclusions. This preliminary study, using newly available worldwide policy data, demonstrates the potential strength of using globally comparative data to examine SDH. Further data development to make multilevel modeling of the impact of labor conditions possible and to broaden which social policies can be examined is a critical next step.

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The data needed to study different approaches to improving social determinants of health (SDH) are different from the data required to examine, for example, pharmacologic approaches to health. While individual patients can change the medication they're taking for a particular condition, and physicians can change the treatment they're prescribing, programs that address many SDH—from poverty to labor conditions—require societal-level change. Differences exist not only in the level at which action needs to be taken for many SDH, but also in the likelihood of conducting randomized trials. While there are important occasions when governments, businesses, and others have been willing to engage in randomized trials, they are far less common than natural experiments. In many cases, our best evidence as to whether a program or policy will lead to positive health outcomes is to examine the natural experiments that occur when institutions and policy-making bodies select different approaches.

In the past, comparative research on the impact of national social policy has been hampered by the lack of policy data on a sufficiently large number of nations to allow researchers to control for differences across countries. In this study, we conducted preliminary analyses demonstrating the potential strength of data that compare social policy across 141 out of 192 United Nations (UN) member countries. We examined the association between paid maternal leave and neonatal, infant, and child mortality as an important example of the relationship between social policies and health.

Infant and early childhood deaths have received increasing attention since the adoption of the UN's Millennium Development Goals (MDGs). At the 2000 Millennium Summit, participants, including 189 heads of state, made a public commitment to achieve the goal of reducing mortality in children younger than 5 years of age (hereafter referred to as "under-5 mortality") from its 1990 rate by two-thirds by 2015 (MDG 4).

A fair amount is known about what works. For example, there is extensive evidence that breastfeeding lowers infant and child morbidity and mortality by reducing the risk of infection. Studies around the world, in affluent and poor nations alike, have shown a 1.5- to 5-fold decrease in mortality among breastfed infants.[1] Breastfeeding lowers the risk of diarrheal disease,[2] respiratory infections,[3] and malnutrition,[4] which can cause or contribute to infant death. Breastfeeding has been shown to reduce rates not only of common infections such as otitis media,[5] but also life-threatening ones, including meningitis.[4,6] Studies have also found lower risk of chronic diseases, including inflammatory bowel disease,[7] type 1 diabetes,[8] leukemia,[9] and lymphoma,[10] in breastfed children.

Most deaths of children younger than 5 years of age are from preventable causes. Thirty-seven percent are neonatal deaths (occurring in the first 28 days of life), 17% are due to acute respiratory diseases, 16% to diarrheal disease, 7% to malaria, 4% to measles, 9% to other infections and parasitic diseases, and 4% to injuries.[11] Neonatal deaths can be markedly reduced, and maternal health outcomes can be improved at the same time, through prenatal and perinatal care. If a child contracts a serious respiratory illness, parents need to be able to take the child to a clinic, office, or hospital where there is a trained health provider and obtain medication and other treatments. The ability of a parent to act quickly if a child gets dehydrated from diarrhea is equally critical to the child's survival. For other childhood diseases, such as measles, vaccines are available, and timely completion of immunization protects a child from these illnesses. Malnutrition contributes to 35% of all child deaths,[11] but can be reduced by ensuring that new mothers are able to breastfeed and that families have adequate incomes. In sum, prenatal care, quality care during and immediately after delivery, immunizations of newborns and their pregnant mothers, breastfeeding, access to postnatal health care and treatment, and adequate sanitation and nutrition are all known to markedly improve child health outcomes.

While increased participation of women and mothers in paid work has improved family income and gender equity, both of which are associated with improved health outcomes for women[12] and children,[13,14] poor working conditions can negatively affect both maternal and child health. Previous research has shown that paid work does not affect women's intention or biologic capacity to breastfeed.[15] Yet, poor working conditions can be associated with a decreased practical ability to breastfeed due to logistical barriers.[16] When women return to work and are unable to take breaks to breastfeed and see their infant, or face obstacles to pumping breast milk, they often have difficulty continuing to breastfeed. As a result, it is not surprising that interviewed mothers frequently cite return to work as a stimulus for needing to wean their infants from the breast or to substantially supplement breast milk.[17–19] Yet, when working conditions are supportive of breastfeeding and when women receive parental leave, studies suggest that they are far more likely to breastfeed.[20–22] While the magnitude of impact is likely to be less on neonatal than infant mortality, given the number of neonatal deaths associated with congenital defects and perinatal causes, parental leave may affect neonatal mortality, as women lacking leave in the poorest settings may return to work within one or two weeks of delivery, jeopardizing infant care as well as nutrition.

As another example, without access to flexibility or paid leave from work for children's health needs, parents may be unable to bring their children to clinics or physicians' offices for immunizations or to bring them home during the day when immunization campaigns occur. Research has confirmed that when parents experience barriers to taking time off during the work day, their children are significantly more likely to be underimmunized.[23] Studies have demonstrated the importance of working conditions to immunization in countries as diverse as Haiti,[24] Indonesia,[25] and the U.S.[26,27]

Paid maternal leave can increase the ability of employed women to breastfeed and improve the quality and extent of adult care available to neonates and infants. Paid parental leave can increase the availability of parents to meet infants' health needs. Yet, little is known about the impact of national parental leave policies on infant and child health beyond Organisation for Economic Co-operation and Development (OECD) countries. We created a global policy database to examine the relationship between guarantees of leave from work to meet essential family health needs and health outcomes.

METHODS

In this study, we used multivariate ordinary least squares regression models to examine whether national paid maternity leave policies influence neonatal, infant, and under-5 mortality rates. Models control for total national health expenditure as a percentage of gross domestic product (GDP), the percentage of health expenditures that were made by the government (in contrast to expenditures by individuals or households), overall resources available to meet basic needs (using GDP per capita), female literacy, and basic public health measures.

Data sources

Since 2005, the McGill University Institute for Health and Social Policy's World Legal Rights Data Centre (WoRLD) has compared policies and outcomes relating to issues such as working conditions, education, and poverty in all 192 UN countries, filling critical gaps faced by researchers and policy makers seeking to address SDH. In 2005, the World Health Organization (WHO) established the Commission on Social Determinants of Health, a three-year project aiming to understand and act upon the social causes of poor health. The Commission's final report in 2008 highlighted the need for better data and improved policy approaches.[28]

The WoRLD initiative has several components. The first, which details labor laws relevant to adults and families, was recently released to the public. Over the next five years, other components will become available, including global databases on poverty policy, unemployment policy, social security, policies relevant to elderly and disabled citizens, education policy and programs, child labor legislation, and nondiscrimination and equity policy, among others.

To obtain the information on maternal leave necessary for this study, our research team, which had fluency in 10 languages, including five of the six UN languages, reviewed all national labor legislation collected by the International Labor Organization (ILO) and available through their NATLEX database[29] in original as well as translated form in these languages. We also reviewed legislation available through the World Bank's Doing Business online law library;[30] the Lexadin World Law Guide legislation database;[31] and in hard copy through Harvard University, McGill University, and the ILO headquarters library. In this manner, we were able to obtain primary-source maternity legislation for 153 countries. In addition, the team reviewed the social security frameworks of 164 countries, and data and legislation linked to the ILO's Maternity Protection Database for 159 countries. Together, this provided detailed information on maternity leave for 178 of the 192 UN member states—more than was ever available previously. These data have been made publicly available at www.raisingtheglobalfloor.org.

Outcomes examined

Neonatal mortality rate (2008). We used the standard metric for measuring neonatal mortality, the number of deaths in the first 28 days of life per 1,000 live births (both sexes), from WHO's World Health Statistics 2010.[32]

Infant mortality rate (2007). We used the standard metric for measuring infant mortality, the number of deaths of infants <1 year of age per 1,000 births (both sexes), from WHO's World Health Statistics 2009.[33]

Under-5 children's mortality rate (2007). We used the standard metric for measuring mortality of children <5 years of age, the number of deaths of children <5 years of age per 1,000 births (both sexes), from WHO's World Health Statistics 2009.[33]

Key independent variables

Maternal leave. For this study, "maternal leave" was defined as leave that the country guarantees employed women in connection with the birth of a child. It is the

sum of the leave available through national maternity leave policies for which only women are eligible and parental leave policies available to either women or men. Countries varied both in terms of the duration of maternal leave provided and the wage replacement rate. The wage replacement rate is the percentage of previous wages that a woman will receive while on maternal leave. To make valid comparisons across countries, we used a measure of full-time-equivalent (FTE) weeks that took into account both factors, calculated by multiplying the wage replacement rate of the leave policy by the permitted length of the leave, converted to weeks when stipulated in other time units. In cases where a flat amount is paid instead of a percentage of wages, wage replacement rate was calculated by dividing the flat amount paid by the average wages of full-time female employees. Average full-time earnings for female employees came from the ILO wage database,[34] the OECD earnings database,[35] Eurostat,[36] and national statistical agencies. In cases where the mother is entitled to a percentage of earnings up to an earnings cap, the percentage of earnings was used, unless the earnings cap was less than women's average wage in the country. For models estimating 2008 neonatal mortality rates, we used maternal leave policies in place as of 2007. For models estimating 2007 infant mortality rates and under-5 child mortality rates, we used maternal leave policies in place as of 2006.

Health-care expenditures. We obtained total national expenditures on health care as a percentage of GDP and government health expenditures as a percentage of total expenditures on health services and programs from the WHO Statistical Information System.[37]

Per capita GDP. Our indicator of national economic resources was the per capita GDP, drawn from the World Bank's World Development Indicators.[38] Data were measured in purchasing power parity-adjusted dollars. We entered a log transformation of per capita GDP instead of a linear term, to be consistent with common awareness that changes in income at the lower end of the income spectrum have a larger impact than changes in wealth at the higher end of the income spectrum.

Female literacy rate. Data on the female literacy rate, defined as the percent of adult women aged 15 years and older who are literate, were drawn from the UN Development Programme's 2009 Human Development Report[39] and were included as a control in the models, as higher levels of maternal education are generally associated with better health outcomes.

Access to improved water. We included the proportion of the population with access to improved water sources, drawn from the World Bank's Health, Nutrition, and Population Statistics (HNPStats),[40] as a control because access to improved water sources lowers rates of diarrhea and associated mortality.

Immunization rate. We included the percentage of children aged 12–23 months immunized for diphtheria, pertussis, and tetanus, obtained from the World Bank's HNPStats,[40] as a measure of immunization in the under-5 mortality models because of the significant number of vaccine-preventable deaths.

Skilled birth attendance. Our indicator for health care received during delivery was the percentage of births attended by skilled health staff, obtained from the World Bank's HNPStats.[40] The variable was included in the neonatal mortality models, where it had the greatest chance of impact.

Models

Models examined the impact of paid maternal leave on neonatal, infant, and child mortality outcomes. The models looked at paid maternal leave duration as the number of FTE weeks guaranteed. The natural log of the outcome (mortality rate) was modeled so that results could be interpreted in terms of the percent change that would result from a given increase in maternal leave. The models were analyzed for all countries globally, and then separately for non-OECD countries (as of January 1, 2010), to examine the effect of maternal leave in low- and middle-income countries. (For a list of OECD countries, visit http://www.oecd.org.)

Table 1 provides a summary of the measures in our models for all countries included in the study and for non-OECD countries.

RESULTS

Neonatal mortality

National guarantees of lengthier paid maternal leave were associated with significantly lower neonatal mortality. The lower neonatal mortality associated with maternal leave was observable even after controlling for countries' total health-care expenditures as a percent of GDP, the percentage of total health expenditures by the government, GDP per capita, female literacy rate, access to improved water sources, and skilled birth attendance. Ten additional FTE weeks of maternal leave were associated with a 10% lower neonatal mortality rate ($p \leq 0.001$) (Table 2, Model 1).

National guarantees of lengthier paid maternal leave were associated with significantly lower neonatal mortality when the analysis was restricted to non-OECD

Table 1. Descriptive statistics on variables used in this global study examining the impact of maternal leave on mortality

	All countries (n=141, unless otherwise noted)			*Non-OECD countries (n=111, unless otherwise noted)*		
Variable	*Minimum*	*Mean*	*Maximum*	*Minimum*	*Mean*	*Maximum*
Neonatal mortality rate (deaths per 1,000 live births)	1	17	53	1	21	53
Infant mortality rate (deaths per 1,000 live births)	2	36	155	2	44	155
Under-5 mortality rate (probability of dying before 5 years of age per 1,000 live births)	3	52	262	3	65	262
Maternal leave (FTE weeks)	0	18	86	0	16	86
PPP-adjusted per capita GDP (dollars)	349	12,927	72,783	349	7,916	63,588
Total health expenditures (percentage of GDP)	2	6	15	2	6	12
Government health expenditures (percentage of total expenditures on health)	12	58	91	12	53	87
Female literacy rate (percent)	15	79	100	15	74	100
Population with access to improved water (percent)	35	85	100	35	81	100
Births attended by skilled health personnel (percent)[a]	6	78	100	6	74	100
DPT immunization, (percentage of children aged 12–23 months)	20	86	99	20	83	99

[a]*n*=130 for all countries; *n*=110 for non-OECD countries

OECD = Organisation for Economic Co-operation and Development

FTE = full-time equivalent

PPP = purchasing power parity

GDP = gross domestic product

DPT = diphtheria-pertussis-tetanus

countries as well. Ten additional FTE weeks of maternal leave were associated with a 9% lower neonatal mortality rate for non-OECD countries ($p \leq 0.01$) (Table 2, Model 2).

Infant mortality

National guarantees of lengthier paid maternal leave were associated with significantly lower infant mortality. This association was observed even after controlling for countries' total health-care expenditures as a percent of GDP, percentage of total health expenditures by the government, GDP per capita, female literacy rate, and access to improved water sources. Ten additional FTE weeks of maternal leave were associated with a 10% lower infant mortality rate ($p \leq 0.001$) (Table 3, Model 1).

National guarantees of lengthier paid maternal leave were associated with significantly lower infant mortality when the analysis was restricted to non-OECD countries as well. Ten additional FTE weeks of maternal leave were once again associated with a 10% lower infant mortality rate in non-OECD countries ($p \leq 0.01$) (Table 3, Model 2).

Child mortality

National guarantees of lengthier paid maternal leave were associated with significantly lower under-5 mortality. This association was observed even after controlling for countries' total health-care expenditures as a percent of GDP, percentage of total health expenditures by the government, GDP per capita, female literacy rate, access to improved water sources, and immunization rates. Ten additional FTE weeks of maternal leave were associated with a 9% lower under-5 mortality rate. ($p \leq 0.01$) (Table 4, Model 1).

National guarantees of lengthier paid maternal leave were associated with significantly lower under-5 mortality when the analysis was restricted to non-OECD countries as well. Once again, 10 additional FTE weeks of maternal leave were associated with a 9% lower under-5 mortality rate in non-OECD countries ($p \leq 0.01$) (Table 4, Model 2).

DISCUSSION

These analyses demonstrate a significant relationship between the duration of nationally guaranteed maternal leave and neonatal, infant, and under-5 child

Table 2. Ordinary least squares regression model estimating the effect of paid maternal leave on neonatal mortality using the new World Legal Rights Database

Variable	Model 1 (All countries, n=130) ß	Model 2 (Non-OECD countries, n=110) ß
Weeks of paid maternal leave	−0.010[a]	−0.009[b]
Per capita GDP	−0.466[a]	−0.378[a]
Total health expenditures (as a percentage of GDP)	−0.062[b]	−0.044
Government health expenditures	−0.001	0.001
Female literacy rate	−0.001	−0.002
Access to improved water	−0.010[c]	−0.010[c]
Skilled birth attendance	−0.001	−0.003
Constant	8.098[a]	7.373[a]
R^2	0.801	0.741

[a]$p \leq 0.001$

[b]$p \leq 0.01$

[c]$p \leq 0.05$

OECD = Organisation for Economic Co-operation and Development

GDP = gross domestic product

mortality. Additional weeks of paid maternal leave were significantly associated with lower mortality rates.

While the cross-sectional nature of available data allowed us to establish only a significant, strong association, there were several mechanisms that, in combination, make the case for a causal link between the length of maternal leave and lower neonatal, infant, and child mortality rates. First, as noted previously, extensive research has demonstrated that breastfeeding leads to a dramatic decrease in morbidity and mortality. For working mothers, maternal leave greatly enhances the probability of both initiating and continuing breastfeeding for a healthy period of time. WHO recommends a minimum of 26 weeks of exclusive breastfeeding to achieve maximum health benefits.[41] Second, prior research in individual countries has also demonstrated that, for parents, conflict between working hours and the hours when immunizations are offered can lead to delays in or neglect of needed vaccinations. Paid parental leave enhances the ability of parents to take time to get immunizations. When maternal leave is at least two months in duration, it is likely to be far easier for parents to ensure their infant receives the first set of vaccinations due at this time; when maternal leave is at least six months long, it facilitates several series of immunizations. Third, parental care is particularly important during the early months in poor settings to ensure that the infant receives adequate nutrition and lives in a setting where there is adequate sanitation. Finally, family income has been clearly demonstrated to be a strong predictor of infant and child morbidity and mortality rates. Paid parental leave increases the income available to both parents and children during a critical time. In addition, women who receive paid leave are more likely to stay employed after the child's birth and not suffer a long-term wage penalty or penalty in their household income.[42–44]

Limitations

We took a number of steps in this study to address the potential limitations of cross-sectional studies. While maternity leave policies do not change frequently, efforts were made to collect maternity leave data that were current and yet preceded the outcomes. In theory, it is possible that maternal leave is associated with another causal factor that is, in fact, driving the lower infant and child mortality rates, but it seems unlikely in this case. While sample size and global data availability limit the number of covariates that can be included, these models have controlled for major contributors, including health-care delivery, as indicated by expenditures; gender equity, as indicated by female literacy; national resources, as indicated by GDP per capita; and relevant health care and public health provisions, as indicated by skilled birth attendance and access to improved water sources. Equally important,

Table 3. Ordinary least squares regression model estimating the effect of paid maternal leave on infant mortality using the new World Legal Rights Database

Variable	Model 1 (All countries, n=141) ß	Model 2 (Non-OECD countries, n=111) ß
Weeks of paid maternal leave	−0.010[a]	−0.010[b]
Per capita GDP	−0.507[a]	−0.380[a]
Total health expenditures (as a percentage of GDP)	−0.057[b]	−0.011
Government health expenditures	−0.003	−0.001
Female literacy rate	−0.001	−0.003
Access to improved water	−0.018[a]	−0.020[a]
Constant	9.687[a]	8.690[a]
R^2	0.851	0.782

[a]$p \leq 0.001$

[b]$p \leq 0.01$

OECD = Organisation for Economic Co-operation and Development

GDP = gross domestic product

Table 4. Ordinary least squares regression model estimating the effect of paid maternal leave on under-5 mortality using the new World Legal Rights Database

Variable	Model 1 (All countries, n=141) ß	Model 2 (Non-OECD countries, n=111) ß
Weeks of paid maternal leave	−0.009[a]	−0.009[a]
Per capita GDP	−0.528[b]	−0.408[b]
Total health expenditures (as a percentage of GDP)	−0.040[c]	0.007
Government health expenditures	−0.002	−0.001
Female literacy rate	−0.003	−0.005
Access to improved water	−0.015[c]	−0.017[b]
Immunization rate	−0.012[a]	−0.013[b]
Constant	10.906[b]	9.962[b]
R^2	0.876	0.826

[a] $p \leq 0.01$

[b] $p \leq 0.001$

[c] $p \leq 0.05$

OECD = Organisation for Economic Co-operation and Development

GDP = gross domestic product

there are clear pathways by which maternal leave is likely to affect neonatal, infant, and child mortality, as discussed previously.

CONCLUSIONS

While this new policy data initiative allowed us to conduct the first global studies to examine the association between national labor policies and health outcomes, the critical next step will be linking this data infrastructure on national policies to household-level survey data on individual outcomes. This linkage will enable us to conduct multilevel modeling to more rigorously assess the relationship between social policies and health outcomes.

Further research linking national-level policies to individual exposures and outcomes is essential. While this research is being carried out, however, our findings provide additional support for the importance of increasing the duration and availability of paid leave to working mothers globally. Currently, most of the world's countries have passed some form of paid maternity or parental leave legislation or put in place a social insurance system that provides paid leave for working mothers. However, the duration of leave available to women varies markedly around the world. Eighty-three countries provide less than 14 weeks, the number agreed upon in international conventions,[45] and 145 countries provide less than 26 weeks, the minimum duration of breastfeeding recommended by WHO.[41] Moreover, countries vary widely in the fraction of working women who are covered by their legislation and social insurance programs. While some social insurance programs cover women in both the informal and formal economy, a majority do not.[46]

Showing a highly significant association between the duration of maternal leave policies and neonatal, infant, and child survival, this research also provides a preliminary demonstration of the potential utility of collecting and using global policy data sources to examine SDH. Early studies of the impact of social inequalities on health were similarly conducted on a national level and only more recently using multilevel modeling. We anticipate that the next stage of this work will move to multilevel modeling as well. Importantly, the availability of a new global policy data infrastructure will allow us to move from discussing how social conditions may affect health to examining what can be done through policy tools to improve health and reduce health inequalities. Neonatal, infant, and child mortality are only a few of the many important health problems that are likely to require social, as well as medical, tools to successfully address them.

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