

## Economic crises, child mortality and the protective role of public health expenditure

Cesar Augusto Oviedo Tejada (<https://orcid.org/0000-0002-8120-5563>)<sup>1</sup>  
Livia Madeira Triaca (<https://orcid.org/0000-0001-7192-6554>)<sup>1,2</sup>  
Nathiele Hellwig Liermann (<https://orcid.org/0000-0003-4618-1591>)<sup>3</sup>  
Fernanda Ewerling (<https://orcid.org/0000-0003-3668-7134>)<sup>4</sup>  
Janaína Calu Costa (<https://orcid.org/0000-0002-7912-8685>)<sup>4</sup>

**Abstract** *The aim of the study was to analyze how economic crises affect child health globally and between subgroups of countries with different levels of income. Data from the World Bank and the World Health Organization were used for 127 countries between 1995 and 2014. A fixed effects model was used, evaluating the effect of the change on macroeconomic indicators (GDP per capita, unemployment and inflation rates and misery index) in neonatal, infant and under-five mortality rates. Moreover, we evaluated whether there was a change in the association effect according to the income of the countries and also analyzed the role of public health expenditure in this association. Evidence has shown that worse economic indicators (lower GDP per capita, higher inflation, unemployment rates and misery index) are associated with higher child mortality rates. In the subsamples by income strata, the same association is observed, but with effects of greater magnitude for low- and middle-income countries. We also verified that a higher percentage in public health expenditures alleviates the effects of economic indicators on child mortality rates. Thus, more attention needs to be paid to the harmful effects of the macroeconomic crises to ensure improvements in child health.*

**Key words** *Infant mortality, Unemployment, Inflation, Per capita income.*

---

<sup>1</sup> Programa de Pós-Graduação em Organizações e Mercados, Universidade Federal de Pelotas. R. Gomes Carneiro 1, Centro. 96010-610 Pelotas RS Brasil. cesaroviedotejada@gmail.com

<sup>2</sup> Departamento de Economia, Universidade Federal do Rio Grande. Rio Grande RS Brasil.

<sup>3</sup> Departamento de Economia, Universidade Federal de Pelotas. Pelotas RS Brasil.

<sup>4</sup> Centro Internacional de Equidade em Saúde, Universidade Federal de Pelotas. Pelotas RS Brasil.

## Introduction

The infant mortality is an important health indicator, as it reflects the social, economic and environmental conditions under which children and members of society are living<sup>1</sup>. One of the Millennium Development Goals (MDGs) proposed by the United Nations in 1990 was to reduce child mortality by two thirds by 2015. The goal has not been met in many countries, but a 53% drop in child mortality has been achieved in this period, decreasing from 91 to 43 deaths per 1,000 live births<sup>2</sup>. However, not all income subgroups have shared these advances equitably, and children from the poorest groups remain disproportionately vulnerable compared to richer groups<sup>2</sup>. The infant mortality rate is almost two-fold higher among the poorest children compared to the richest ones<sup>3</sup>. Most of these deaths are preventable with simple measures such as vaccination, breastfeeding, hygiene, access to drinking water and medication<sup>4</sup>.

The MDGs did not include the health equity issue, but in the new Sustainable Development Goals (SDGs), released in 2015, this is a central topic. The SDG 3 aims to “ensure a healthy life and promote the well-being of all people at all ages” and includes among its goals a reduction in infant mortality and ensuring universal access to health services. Moreover, it aims to increase health financing for developing countries, especially among the less developed ones<sup>2</sup>.

Studies have shown that infant mortality is influenced by both aggregate factors such as the country’s economic development level, current health system, fertility and urbanization rates, as well as individual factors, such as maternal schooling, socioeconomic status of the family, access to sanitation and drinking water, among other factors<sup>5</sup>. Another issue raised in the literature is the possible effect of economic crises on the population’s health<sup>6-8</sup>.

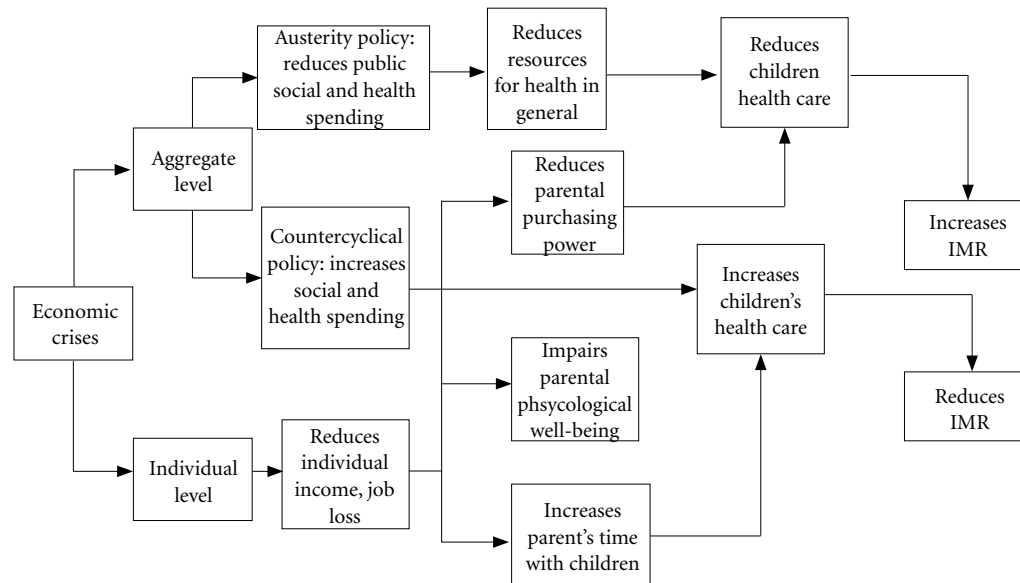
An economic crisis is a situation in which a country’s economy deteriorates rapidly and substantially. Usually, during a crisis, the Gross Domestic Product (GDP) decreases and unemployment rises. The empirical literature shows contradictory effects of the economic crisis on the population’s health. Using data at the aggregate level, a group of economists identified that the crisis can have a beneficial effect on health by reducing rates of total mortality and multiple causes of death<sup>9-11</sup>. However, another study using data at the individual level found a negative effect,

indicating that worse economic conditions would worsen the population’s health<sup>9</sup>. These studies focus on different health measures and population groups.

Most studies on the effect of economic crises on health indicators focus on the economically active population. However, children’s health can also be strongly affected through different mechanisms (Figure 1). At an aggregate level, economic crises directly affect government budget resources and may lead to a reduction in health care spending. This effect is probably stronger in low- and middle-income countries and those with deficient social welfare systems<sup>6</sup>. Another possible effect is related to the increase in poverty and extreme poverty and the possible reduction in social spending by governments<sup>12,13</sup>. At an individual level, the crisis has an impact on family income, affecting family decisions, including expenses with caring for the child<sup>6</sup>. According to Figure 1, the crisis can have negative and positive effects on child health. Household income reductions or rising unemployment, especially in low- and middle-income countries, can negatively affect child health. With a lower family income, spending on health care is reduced, affecting the children’s health and, as a consequence, there may be an increase in the infant mortality rate<sup>6</sup>. On the other hand, being at home allows parents to provide better care for their children, reducing infant mortality<sup>14</sup>. Moreover, economic contractions can improve child health by reducing air pollution<sup>15</sup> and health-damaging behaviors – parental alcohol consumption and smoking – and by increasing the likelihood of neonatal care and preventive actions<sup>11,16</sup>.

Few studies in the literature have analyzed the impact of economic crises on child health. The existing studies have observed that infant mortality rates increase when the *per capita* GDP decreases<sup>6,8,14,17-19</sup> and when unemployment<sup>7</sup> and inflation rates increase<sup>7</sup>. However, these studies are based on groups of countries, whether high-income<sup>19,20</sup>, or middle- and low-income ones<sup>5,7,14,17,18</sup>. Only one has assessed high-, middle- and low-income countries altogether<sup>6</sup>.

The present study contributes to the literature by analyzing the effect of economic crises on child mortality through a multi-country analysis from 1995 to 2014, with low-, middle-, and high-income countries. Moreover, we sought to assess the modification of this effect according to the country’s income level and to understand how public health spending can interfere in this association.



**Figure 1.** Impact of economic crises on infant mortality rate.

## Methods

### Data and variables

Data from the World Bank were used, available for 127 countries for the 1995-2014 period, thus constituting a panel with 2,540 country-year observations. The inclusion of countries in the sample depended on the availability of data for that period. The analyzed outcomes were neonatal mortality rate (death before 28 days of life), infant mortality rate (death in the first year of life) and under-five mortality. All rates indicate the number of deaths in the specific age groups per 1,000 live births.

In economics, by definition, the country is going through an economic crisis when it has a fall in GDP in two consecutive quarters. As quarterly data are not available for all countries, we chose to use a methodology found in previous studies<sup>6,7,18</sup> and the effects of the crisis were considered by analyzing the impacts of fluctuations of economic indicators on child health. Thus, four economic indicators were selected: *per capita* GDP, inflation rate, unemployment rate and misery index. *Per capita* GDP was calculated in constant 2010 figures and included in logarithm. The inflation rate is determined by the consumer

price index and constructed using Laspeyres index. Following the World Bank definitions, the unemployment rate is defined as the percentage of the population that is unemployed but available and looking for a job. The misery index, created by Arthur Okun in the 1970s, measures economic malaise through the sum of the unemployment rate and the inflation rate. According to Okun, economic discomfort tends to stem from the increase in these two indicators.

Moreover, the role of public health expenditure, measured as a percentage of GDP, was also explored. The following were included in the model as controls: percentage of population with access to drinking water, urbanization growth rate, fertility rate and total female enrollment in elementary school (as a proxy for maternal education, an important factor for child health<sup>20</sup>), percentage of children immunized against measles, a major cause of infant death<sup>21</sup>, and the number of inhabitants. The controls were chosen according to the literature and data availability.

### Statistical analysis

A multivariate regression model with the countries' fixed effects was defined to analyze how economic crises affect child mortality worldwide:

$$M_{it} = \alpha_i + \delta C_{it} + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where  $M_{it}$  is the response variable for neonatal, infant, and under-five mortality based on information from the  $i$ -th country  $i$  ( $i=1, \dots, 127$ ) in the year  $t$  ( $t=1995, \dots, 2014$ );  $\alpha_i$  is the fixed effect of the countries, which controls for characteristics of time-invariant countries;  $C_{it}$  is the economic-crisis variable;  $X_{it}$  represents a vector of independent variables, including economic indicators and controls;  $\beta$  is the coefficient of the independent variables; and  $\varepsilon_{it}$  is the error term. Initially, the impact of each economic indicator on mortality was individually investigated. The model was then replicated in two subsamples, according to country income: low- and middle-income countries and high-income countries. This income stratification follows the 2017 World Bank classification, which takes into account the GDP (*per capita*) in the previous fiscal year<sup>22</sup>. Additionally, for the total sample, an interaction term between the economic indicator and public health spending was included to analyze how variations in spending may affect the association. Robust standard errors, grouped at the level of the country, were employed. Data were analyzed using Stata software, version SE 14.0 (Stata Corporation).

## Results

Table 1 shows the association between economic indicators (GDP *per capita*, inflation, unemployment, and misery index) and mortality for the three age groups analyzed (neonatal, infant and under-five) considering the 127 countries of the sample. The 1% reduction in GDP *per capita* was associated with an increase between 0.06 and 0.12 in the three mortality rates, i.e., neonatal (coefficient: -5.98, 95%CI: -7.59; -4.37), infant (coefficient: -11.86, 95%CI: -16.95; -6.77), and under-fives (coefficient: -10.58, 95%CI: -20.28; -0.88). Using the inflation, the observed results show a statistically significant and positive association for the three outcomes, i.e., an increase in inflation increases mortality rates. As previously noted for the *per capita* GDP, the magnitude of the effect is greater for the infant mortality rate (coefficient: 0.02, 95%CI: 0.00; 0.04) and for children under five years (coefficient: 0.03, 95%CI: 0.00; 0.05). The effect observed for the neonatal mortality rate once again shows a magnitude well below the others.

For estimates using the unemployment rate, statistically significant associations are observed only for infant and neonatal mortality rates, showing that increases in the unemployment rate lead to increases in mortality rates (infant: coefficient 0.16, 95%CI: 0.00 to 0.32; neonatal: 0.07, 95%CI: 0.00 to 0.15). Regarding the misery index, the results show that an increase in misery index results in mortality rate increases, corroborating the previously disclosed results. Once again, the effects of greater magnitude are observed for infant and under-five mortality rates.

Table 2 shows the results for the middle- and low-income countries. The associations are very close to those observed for the total sample, showing the same statistically significant and negative associations for *per capita* GDP and positive for inflation and misery index for the three mortality rates. Contrary to what was observed before, for low- and middle-income countries, a significant association was found only for the unemployment rate in the analysis of the neonatal mortality rate.

For the subsample of high-income countries, the association is somewhat different (Table 3). A statistically significant association persists in all mortality rates when the effects of *per capita* GDP and the misery index are analyzed, but there is a significant effect for inflation only regarding the infant mortality rate. The effects found for the *per capita* GDP are substantially lower in this analysis when compared to the effect observed in the low- and middle-income subsample. The unemployment rate showed no statistically significant effect on this analysis.

In Table 4, we investigate how the association behaves according to variations in public health spending in the overall sample. For that purpose, we introduced in the models a term of interaction between the economic indicator and the variable "public health spending". The results show that public health spending mitigates the effects of the economic crisis when it is measured by *per capita* GDP and this effect is consistent with the three mortality rates analyzed in the study. The results differ for the inflation rate and the misery index, as we only found evidence that public health spending affects the association between economic crisis and mortality rates for infant and under-five mortality rates. When the unemployment rate is used, no statistically significant interaction was observed. Nevertheless, the majority of analyses suggest that an increase in public health spending reduces the effect of the economic crisis on mortality rates.

**Table 1.** Adjusted effects\* of economic indicators (per capita GDP, inflation, unemployment rate, and misery index) on mortality measures for the total sample of 127 countries.

	Coefficient	95%CI	P-value**
Per capita GDP			
Infant mortality rate	-11.86	(-16.95; -6.77)	0.000
Under-5 mortality rate	-10.58	(-20.28; -0.88)	0.033
Neonatal mortality rate	-5.98	(-7.59; -4.37)	0.000
Inflation			
Infant mortality rate	0.02	(0.00; 0.04)	0.012
Under-5 mortality rate	0.03	(0.00; 0.05)	0.023
Neonatal mortality rate	0.01	(0.00; 0.01)	0.003
Unemployment rate			
Infant mortality rate	0.16	(0.00; 0.32)	0.048
Under-5 mortality rate	0.14	(-0.10; 0.38)	0.250
Neonatal mortality rate	0.07	(0.00; 0.15)	0.037
Misery index			
Infant mortality rate	0.02	(0.00; 0.04)	0.011
Under-5 mortality rate	0.03	(0.00; 0.05)	0.022
Neonatal mortality rate	0.01	(0.00; 0.01)	0.003

\*All estimates were adjusted for: public health expenditure, access to clean water, urbanization growth rate, fertility rate, total female enrollment in elementary school, percentage of immunized children, and population size. \*\*P-value related to Wald test under the null hypothesis of equality of coefficients.

**Table 2.** Adjusted effects\* of economic indicators (per capita GDP, inflation, unemployment rate, and misery index) on mortality measures for the sample of 86 low- and middle-income countries.

	Coefficient	95%CI	P-value**
Per capita GDP			
Infant mortality rate	-14.87	(-21.25; -8.49)	0.000
Under-5 mortality rate	-14.03	(-21.23; -1.84)	0.025
Neonatal mortality rate	-7.03	(-8.96; -5.11)	0.000
Inflation			
Infant mortality rate	0.02	(0.00; 0.04)	0.014
Under-5 mortality rate	0.03	(0.00; 0.05)	0.030
Neonatal mortality rate	0.01	(0.00; 0.01)	0.004
Unemployment rate			
Infant mortality rate	0.24	(-0.02; 0.51)	0.070
Under-5 mortality rate	0.19	(-0.21; 0.59)	0.355
Neonatal mortality rate	0.12	(0.00; 0.23)	0.043
Misery index			
Infant mortality rate	0.02	(0.00; 0.04)	0.013
Under-5 mortality rate	0.03	(0.00; 0.05)	0.029
Neonatal mortality rate	0.01	(0.00; 0.01)	0.004

\*All estimates were adjusted for: public health expenditure, access to clean water, urbanization growth rate, fertility rate, total female enrollment in elementary school, percentage of immunized children, and population size. \*\*P-value related to Wald test under the null hypothesis of equality of coefficients.

## Discussion

This study assessed data from 127 high-, middle-, and low-income countries and analyzed the association of economic crises, as measured by four

economic indicators (*per capita* GDP, inflation and unemployment rates, and misery index), and children's health, measured by three mortality rates (infant, under-five and neonatal). The results show that economic crises (as measured

**Table 3.** Adjusted effects\* of economic indicators (per capita GDP, inflation, unemployment rate, and misery index) on mortality measures for the sample of 41 high-income countries.

	Coefficient	95%CI	P-value
Per capita GDP			
Infant mortality rate	-5.98	(-8.07; -3.89)	0.000
Under-5 mortality rate	-7.28	(-9.99; -4.56)	0.000
Neonatal mortality rate	-4.10	(-5.57; -2.62)	0.000
Inflation			
Infant mortality rate	0.04	(0.00; 0.08)	0.048
Under-5 mortality rate	0.04	(-0.00; 0.09)	0.055
Neonatal mortality rate	0.03	(-0.00; 0.06)	0.055
Unemployment rate			
Infant mortality rate	0.02	(-0.01; 0.06)	0.147
Under-5 mortality rate	0.03	(-0.01; 0.07)	0.159
Neonatal mortality rate	0.02	(-0.00; 0.04)	0.137
Misery index			
Infant mortality rate	0.04	(0.01; 0.08)	0.016
Under-5 mortality rate	0.05	(0.01; 0.09)	0.019
Neonatal mortality rate	0.03	(0.00; 0.06)	0.020

\*All estimates were adjusted for: public health expenditure, access to clean water, urbanization growth rate, fertility rate, total female enrollment in elementary school, percentage of immunized children, and population size. \*\*P-value related to Wald test under the null hypothesis of equality of coefficients.

**Table 4.** Adjusted effect\* of economic indicators (per capita GDP, inflation, unemployment rate, and misery index) and the interaction between economic indicators and public health expenditure on mortality measures for the total sample of 127 countries.

	Coefficient	P-value	Interaction	P-value
Per capita GDP				
Infant mortality rate	-14.77	0.000	0.66	0.006
Under-5 mortality rate	-16.32	0.001	1.31	0.002
Neonatal mortality rate	-6.65	0.000	0.15	0.023
Inflation				
Infant mortality rate	0.06	0.000	-0.01	0.003
Under-5 mortality rate	0.07	0.002	-0.01	0.027
Neonatal mortality rate	0.00	0.074	0.00	0.544
Unemployment rate				
Infant mortality rate	0.12	0.440	0.00	0.736
Under-5 mortality rate	-0.13	0.657	0.00	0.964
Neonatal mortality rate	0.09	0.297	-0.00	0.859
Misery index				
Infant mortality rate	0.05	0.000	-0.01	0.004
Under-5 mortality rate	0.07	0.002	-0.01	0.029
Neonatal mortality rate	0.00	0.092	0.00	0.523

\*All estimates were adjusted for: public health expenditure, access to clean water, urbanization growth rate, fertility rate, total female enrollment in elementary school, percentage of immunized children, and population size. \*\*P-value related to Wald test under the null hypothesis of equality of coefficients

by reductions in *per capita* GDP and increases in inflation and unemployment rates) increase the analyzed mortality rates. This same pattern was also demonstrated when the analysis was performed using an important indicator of the

population's economic well-being, i.e., the misery index.

The same pattern was found in the subsample analysis. For low- and middle-income countries, statistically significant associations were

observed for *per capita* GDP, inflation, and misery index for the three mortality rates, whereas for high-income countries, effects were observed for *per capita* GDP and misery index. The inflation rate was statistically significant only in the analysis of infant mortality rate. In this analysis, the unemployment rate had a statistically significant effect only for the subsample of low- and middle-income countries in the neonatal mortality rate analysis.

All results observed in the present study showed that economic crises are positively associated with child mortality rates. These findings are in agreement with the vast majority of evidence in the literature. Maruthappu et al.<sup>6</sup> found, for a sample of 207 low-, middle- and high-income countries, that economic crises are associated with significant increases in child mortality rates, with low-income countries being the most affected ones. Additionally, the authors also observed that public health spending is positively associated with a greater supply of medical care (availability of physicians, percentage of deliveries assisted by skilled health professionals, and total hospital beds per 1,000 inhabitants) and negatively associated with child mortality rates<sup>6</sup>.

Baird et al.<sup>14</sup> analyzed data from 59 African, Asian and Latin-American countries and observed a strong negative association of *per capita* GDP with infant mortality. The authors found that, on average, a 1% reduction in the *per capita* GDP implies a 0.24 to 0.40 increase in infant mortality per 1,000 live births. In a more recent study, O'Hare et al.<sup>17</sup> found effects of 0.33 for infant mortality and 0.28 for under-five mortality. These results are higher than those observed in the present study, which found an association of approximately 0.12 for infant mortality and 0.10 for under-five mortality rate for the total sample, and 0.15 and 0.14, respectively, for the subsample of low- and middle-income countries. This difference is probably due to the countries included in the sample, as Baird et al.<sup>14</sup> and O'Hare et al.<sup>17</sup> include only middle- and low-income countries in their analysis, while the present study included countries from the three income strata, with only 14% of the sample consisting of low-income countries. According to Maruthappu et al.<sup>6</sup>, the effect of economic crises on the health of children under five in the poorest countries is three-fold higher than the effect on children in high-income countries.

When analyzing only the Latin-American countries, Williams et al.<sup>7</sup> observed that increases in the unemployment and inflation rates are as-

sociated with child health deterioration, and the effects of the unemployment rate showed a much higher magnitude than that of inflation. Differently from what was observed in the present study, the authors found virtually no significant effects of *per capita* GDP on health outcomes<sup>7</sup>. Other studies focusing only on European countries found that a higher *per capita* GDP reduces infant mortality rates<sup>19,23</sup>; however, contrary to the expectations, Tavares<sup>19</sup> did not observe a significant association with public health spending. According to the author, this absence of effect may be due to the imposition of a stricter control of expenditures, given the economic crisis in the analyzed period.

Studies have suggested that the effects of economic crises on children's health occur through two mechanisms, which are shown in Figure 1: through the family budget, which influences the care given to the child, and through government financial resources, which influence public health spending<sup>6</sup>. Living under worse economic conditions, the decrease in income or uncertainty about future incomes may lead households to reduce food consumption or substitute food items for lower-quality ones. This behavior can have an effect on children's nutrition, making them more vulnerable<sup>6,24-26</sup>. Additionally children's relatives may suffer from psychological problems that may affect the care provided to the children<sup>27,28</sup>.

Economic crises can also worsen medical care offered to the children, especially in countries where the proportion of direct private health spending is high in relation to the total spending<sup>29,30</sup>. This worsening in medical care can also be due to reduced public spending. Economic crises can lead to marked reductions in available health budgets, affecting the quality of the provided medical care<sup>31</sup>. All these factors can harm children's health and, consequently, increase mortality rates<sup>6</sup>.

As mentioned before, some of the studies in literature sought to analyze the effect that variations in public health spending would have on children's health<sup>6,19</sup>; however, there is a type of literature that analyzes how governmental actions, such as social security programs and increased public health care spending can mitigate the economic effects observed in health measures. Aiming to explore this issue, in addition to analyzing the association of this variable with the outcomes, we also explored its interaction with the economic crisis measures, thus investigating a possible interference of public health spending on the observed effects. The results showed that

the effects of the economic crisis on child mortality are sensitive to public health spending; that is, as the government increases its public health spending, the effect of the economic crises on children's health decreases. Although studies in the literature seek to analyze the association – between public health spending and child health – they do not address the association as it is assessed in this study, but there is similar evidence for other social protection measures for other mortality rates, such as labor market and social assistance programs<sup>32,33</sup>. Given the effects observed here and in other studies in the literature, it is essential that government policies seek to promote the population's protection at its most vulnerable moment.

The study has some limitations. First, the analysis is based on the overall effect of economic crises on mortality rates, i.e., the results are not directly applicable at the national or subnational level. Second, we used child mortality as child health measures. Other child health measures can be used as the outcome and could yield different results. Third, we investigate short-term effects only, but it is possible that economic crises have lasting effects<sup>10</sup>. Fourth, other economic, socio-economic, and demographic variables could be integrated into the analysis, aiming to establish other associations between health and economy. Since this analysis is an ecological study, there is no information on the status of each person. The study, based on the aggregate level, only contains the data total numbers, not inferring the data individually.



## Collaborations

CAO Tejada, LM Triaca, NH Liermann contributed with the study conception, design, writing and critical review of the manuscript. LM Triaca analyzed and interpreted the data. F Ewerling and JC Costa contributed with the study analysis and critical review of the manuscript.

## References

1. Lundquist JH, Anderton DL, Yaukey D. *Demography: the study of human population*. Long Grove, IL: Waveland Press; 2014.
2. United Nations (UN), Department of Economic and Social Affairs. *The Millennium Development Goals Report 2015*. New York: UN; 2015.
3. World Health Organization (WHO). *Global status report on alcohol and health, 2014*. Geneva: WHO; 2014.
4. Amouzou A, Velez LC, Tarekegn H, Young M. *One is too many: ending child deaths from pneumonia and diarrhoea*. New York: UNICEF; 2016.
5. Kuruvilla S, Schweitzer J, Bishai D, Chowdhury S, Caramani D, Frost L, Cortez R, Daelmans B, Francisco A, Adam T, Cohen R, Alfonso YN, Franz-Vasdeki J, Saadat S, Pratt BA, Eugster B, Bandali S, Venkatachalam P, Hinton R, Murray J, Arscott-Mills S, Axelson H, Maliqi B, Sarker I, Lakshminarayanan R, Jacobs T, Jack S, Mason E, Ghaffar A, Mays N, Presern C, Bustreo F. Success Factors for Women's and Children's Health study groups. Success factors for reducing maternal and child mortality. *Bull World Health Organ* 2014; 92(7):533-544.
6. Maruthappu M, Watson RA, Watkins J, Zeltner T, Raine R, Atun R. Effects of economic downturns on child mortality: a global economic analysis, 1981-2010. *BMJ Global Health* 2017; 2(2):e000157.
7. Williams C, Gilbert BJ, Zeltner T, Watkins J, Atun R, Maruthappu M. Effects of economic crises on population health outcomes in Latin America, 1981-2010: an ecological study. *BMJ Open* 2016; 6(1):e007546.
8. Ensor T, Cooper S, Davidson L, Fitzmaurice A, Graham WJ. The impact of economic recession on maternal and infant mortality: lessons from history. *BMC Public Health* 2010; 10(1):727.
9. Burgard SA, Ailshire JA, Kalousova L. The Great Recession and health: People, populations, and disparities. *The Annals of the American Academy of Political and Social Science* 2013; 650(1):194-213.
10. Stuckler D, Meissner C, Fishback P, Basu S, McKee M. Banking crises and mortality during the Great Depression: evidence from US urban populations, 1929-1937. *J Epidemiol Community Health* 2012; 66(5):410-419.
11. Ruhm CJ. Are recessions good for your health? *The Quarterly Journal of Economics* 2000; 115(2):617-650.
12. Rasella D, Basu S, Hone T, Paes-Sousa R, Ocké-Reis CO, Millett C. Child morbidity and mortality associated with alternative policy responses to the economic crisis in Brazil: A nationwide microsimulation study. *PLoS Medicine* 2018; 15(5):e1002570.
13. Massuda A, Hone T, Leles FAG, Castro MC, Atun R. The Brazilian health system at crossroads: progress, crisis and resilience. *BMJ Global Health* 2018; 3(4):e000829.
14. Baird S, Friedman J, Schady N. Aggregate income shocks and infant mortality in the developing world. *Review of Economics and Statistics* 2011; 93(3):847-856.
15. Chay KY, Greenstone M. The impact of air pollution on infant mortality: evidence from geographic variation in pollution shocks induced by a recession. *The Quarterly Journal of Economics* 2003; 118(3):1121-1167.

16. Ruhm CJ, Black WE. Does drinking really decrease in bad times? *J Health Econ* 2002; 21(4):659-678.
17. O'Hare B, Makuta I, Chiwaula L, Bar-Zeev N. Income and child mortality in developing countries: a systematic review and meta-analysis. *J R Soc Med* 2013; 106(10):408-414.
18. Pérez-Moreno S, Blanco-Arana MC, Bárcena-Martín E. Economic cycles and child mortality: A cross-national study of the least developed countries. *Econ Hum Biol* 2016; 22:14-23.
19. Tavares AI. Infant mortality in Europe, socio-economic determinants based on aggregate data. *Applied Economics Letters* 2017; 24(21):1588-1596.
20. Vogl TS. Education and health in developing economies. *Encyclopedia of Health Economics* 2012; 1453:246-249.
21. United Nations (UN), Department of Economic and Social Affairs. *The Millennium Development Goals Report*. New York: UN; 2009.
22. World Bank Group. *World development indicators 2014*. Washington, DC: World Bank Group; 2014.
23. Prisco G, Pennazio R, Serafini A, Russo C, Nante NJEJPH. Infant Mortality trend in Europe: socio-economic determinants. *Eur J Public Health* 2015; 25(Supl. 3):332.
24. Cardoso E. Inflation and poverty. *National Bureau of Economic Research* 1992; 4006:1-52.
25. Saunders P. Poverty, inequality and recession. *Economic Papers: A journal of Applied Economics and Policy* 1992; 11(3):1-22.
26. Bhattacharya J, Currie J, Haider S. Poverty, food insecurity, and nutritional outcomes in children and adults. *J Health Econ* 2004; 23(4):839-862.
27. Driscoll AK, Bernstein AB. Health and access to care among employed and unemployed adults: United States, 2009-2010. *NCHS Data Brief* 2012; (83):1-8.
28. Leivas PHS, Tejada CAO, Bertoldi AD, Santos AMAD, Jacinto PDA. Associação da posição socioeconômica e da depressão materna com a saúde das crianças: avaliação da PNAD 2008, Brasil. *Ciêns Saude Colet* 2018; 23(5):1635-1645.
29. Shahrawat R, Rao KD. Insured yet vulnerable: out-of-pocket payments and India's poor. *Health Policy Plan* 2011; 27(3):213-221.
30. Batavia AI, Beaulaurier RL, Welfare S. The financial vulnerability of people with disabilities: Assessing poverty risks. *J Soc & Soc Welfare* 2001; 28(1):139-162.
31. Chung H, Muntaner C. Political and welfare state determinants of infant and child health indicators: an analysis of wealthy countries. *Soc Sci Med* 2006; 63(3):829-842.
32. Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. *Lancet* 2009; 374(9686):315-323.
33. Karanikolos M, Mladovsky P, Cylus J, Thomson S, Basu S, Stuckler D, Mackenbach JP, McKee M. Financial crisis, austerity, and health in Europe. *Lancet* 2013; 381(9874):1323-1331.

Article submitted 20/03/2019

Approved 12/07/2019

Final version submitted 27/08/2019