

The Continued Impact of Multilateral Debt on the Population Health Outcomes of Low- and Middle-Income Countries

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Abstract

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Background: The primary aim of this study is to examine the association of national economic indicators on national population health outcomes in low- and middle-income countries. We hypothesize that countries with higher shares of external debt to multilateral institutions will have worse population health outcomes when compared to countries with lower shares of external debt to these same institutions between 2000 and 2019.

Methods: Population health data in the pre-COVID 21st century were collected for 103 low- and middle- income countries. These dependent variables were infant mortality rate (IMR), under 5 mortality rate (U5MR), maternal mortality ratio (MMR), and life expectancy (LE). A multivariable regression panel analysis assuming random effects was conducted on these countries. The independent variables were gross national income per capita purchasing power parity (GNI), share of Multilateral and IMF debt out of Total External debt (MITE), debt service as a percentage of GDP (DSGDP), the level of export commodity concentration (EPC), the number of IMF conditionalities in effect, and the share of wealth in a country concentrated in the top 1% of the population.

Results: The multivariable panel regressions for each dependent variable were found to have significant negative associations between the population health outcomes and GNI, MITE, EPC, IMF conditionality and DSGDP. The concentration of wealth in the top 1% of the country was found to be significantly negatively associated with all population health outcomes apart from MMR.

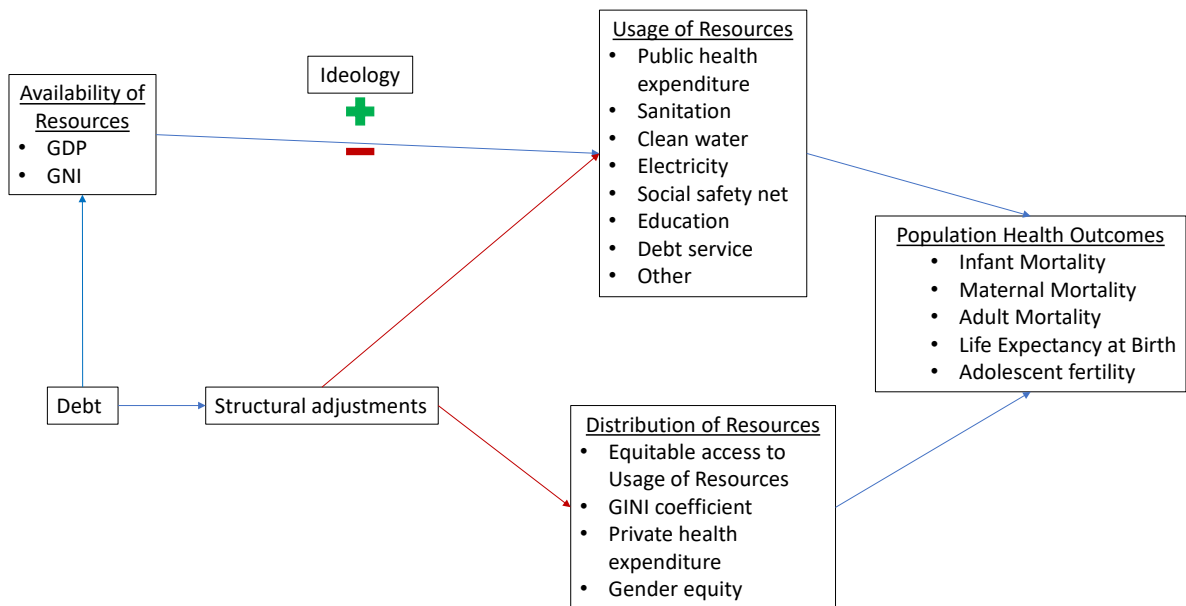
Conclusion: This study provides evidence that MITE is a novel variable of significance that could be utilized when conditionality data are difficult to extract on a large scale to examine the impact of debt in other settings and in combination with other variables. Debt, including that owed to multilateral lending institutions, continues to have negative associations with population health outcomes in the 21st century.

Introduction

A significant amount of research has been done to identify what the largest determinants of health are at the national level. A large portion of this research examines intranational indicators with a goal to provide countries specific areas to focus on in order to increase the health outcomes of their population. This includes, but is not limited to, indicators such as sanitation, access to clean water, public health expenditure, measures of gender equity, vaccination coverage, and prevalence of HIV/AIDS.¹⁻⁴ International health, international economic, and intranational economic indicators are studied less and are often combined with the aforementioned indicators which could potentially result in confounding.^{3,5-9}

The theoretical framework of the current study is represented in Figure 1.

Figure 1. Conceptual Diagram



Many of the previous studies have focused either on what we refer to here as the Usage of Resources or on the Distribution of Resources.^{2-6,10} Usage of Resources is the allocation by sector and industry by which the Available Resources are utilized to provide the population with conditions that can foster positive population health outcomes, and the lack thereof results in negative population health outcomes. Usage of Resources also includes the need to repay the interest and principal on debts, debt service, which in turn reduces the availability of these resources for other programs. Figure 1 enumerates selected sectors most pertaining to population health outcomes, however there are many other resource expenditures that would fall under the “Other” category such as military spending.

Usage of Resources is separate from Distribution of Resources, which broadly speaking refers to equitable access to the Resources and can be measured through gender equity (educational attainment, participation in government, prevalence of disease discrepancies), private health expenditure, and the Gini coefficient. The Gini coefficient is a statistical method used to represent income inequality.¹¹ Usage of Resources is limited by the Availability of Resources, which can be measured in GDP or GNI, and can be modified via ideology. This has been previously demonstrated in comparisons of socialist and capitalist countries, as well as comparing general ideological categories.^{12,13} For example, while the United States (US) has a high GDP and high health care expenditures, but due to capitalist ideology these resources have not materialized into population health outcomes that are comparable for similarly economically situation countries. This is in stark comparison to Cuba, which has a much lower GDP, but has prioritized public health in line with its socialist system and values. This has resulted in the US having an infant mortality of 5.8 per 100,000 when compared to Cuba’s of

4.1 per 100,000 with GDPs of \$54,270 vs \$7,480 respectively.^{14,15} A similar phenomenon has been previously described providing a framework with which to categorize high-income countries as various types of welfare states.¹⁶ Those welfare states with the most robust and generous systems have systems in place to better impact the social determinants of health which then results in better population health outcomes.¹⁷ One example that has been studied is the impact of generosity of unemployment benefits. It has been shown that higher coverage levels result in both less health deterioration as well as less mortality due to suicide when compared to countries with lower coverage levels.^{18,19}

External debt can impact the availability of resources. If a nation gets a loan, this can in the short term increase the availability of resources, and if it is utilized for something such as a clean water system, this could have positive impacts on the population health outcomes. However, as external debt is taken on, and the annual payments, debt service, can decrease the availability of resources thus essentially reducing the availability of resources. This can have a combined negative effect if the money was not utilized for anything that would benefit the population or the population health outcomes. This is in particular a problem when individuals or institutions use the national debt for personal financial gain. Some external debt, particularly from multilateral institutions such as the World Bank (WB) or the International Monetary Fund (IMF), have required structural adjustments in countries.²⁰ These structural adjustments often require the privatization of various services and industries, the removal of worker and environmental protections, and the elimination of subsidies.^{8,20-22} The multilateral institutions by and large officially ended structural adjustment programs at the turn of the 21st century, replacing them with “poverty reduction strategy policies”, but many of the policies remained

the same with the exception of allowing slightly more social spending.^{23,24} These changes were the result of not only institutional and academic criticism of the negative impact of programs, but also the growing pressure from the outside during what was called the “anti-globalization” movement.²⁵ This movement is most notoriously remembered by the protests that shut down the World Trade Organization meeting in Seattle in the fall 1999.

As demonstrated by Kentikelenis *et al.* although the peak mean of structural adjustments active per calendar year in IMF loans was in 1999 they continue to remain higher than at any time prior to 1994 and actually saw an increase starting in 2011.²⁵ These conditionalities can greatly reduce the ability for a nation to provide a strong welfare state as it is in essence an enforced ideology. Through this process the state loses much of its agency and power to distribute resources, as these mechanisms are eliminated or privatized.²⁰ Direct causality of these and other economic factors on population health outcomes is difficult to establish as the situation is quite complicated.

Previous studies have examined the negative impact that the debt agreements and conditionalities imposed by the IMF, the World Bank, or African Development Bank has on population health outcomes and health equity.^{3,7-9,20,26-34} These studies have often found negative associations with the conditionalities imposed by multinational institutions and the health aspects examined. However, the collection of these data can be extremely resource intensive as it often requires thoroughly examining documents by country and by agreement.²⁵ A single agreement for a single country is often fifty pages or more, with the conditionalities starting and ending at different time points as new documents become available. These documents are then often updated biannually or quarterly when reviews take place.²⁵ There

has been a growth in research on IMF conditionality after Kentikelenis *et al.* created a database that includes IMF conditionalities, by country, year and category from 1985-2014.²⁵ This work required the examination of 4,590 separate documents.

With these limitations of the available data in mind this study aims to bridge that gap by creating a simple metric, share of Multilateral and IMF debt out of Total External debt (MITE), to examine the portion of external debt in a country that is due to multilateral institutions. While not all lending agreements nor multilateral institutions have conditionality or the same set of conditionalities, a broad definition can give insight to the vast impact of these institutions on population health. This study also aimed to examine these possible impacts on a larger scale than previously studied, by including all relevant countries with the necessary data.

The primary aim of this study is to examine the association of MITE with national population health outcomes in low- and middle-income countries while accounting for their general national economic indicators. We hypothesize that countries with higher shares of external debt to multilateral institutions will have worse population health outcomes when compared to countries with lower shares of external debt to these same institutions between 2000 and 2019.

Methods

Software and Statistical Analysis

Stata/BE 17.0 was utilized to run the statistical analyses. The data were set as panel data by country. Multivariable regression analysis on the panel dataset, assuming random effects, was then run on the variables described.

Complete case analysis was utilized without imputing missing data. There was one county that had bilateral loans but no multilateral loans, Palestine. For Palestine, the primary variable of interest, MITE, was zero.

Variables

The independent variables are the national economic indicators of GNI per capita (purchasing power parity in thousands of dollars), share of total external debt owed to multilateral agencies and the IMF (MITE), debt service as a percentage of GDP (DSGDP), the level of export commodity concentration (EPC), the number of IMF conditionalities in effect, and the share of wealth in a country concentrated in the top 1% of the population (Wealth). This latter variable was utilized to examine the potential impact of wealth inequality. These data were extracted from the International Debt Statistics 2021 Release with the exception of IMF conditionality that was extracted from IMF Monitor, and wealth which was extracted from World in Debt (Table 1).^{14,25,35} MITE was calculated by taking the sum of multilateral debt and IMF credit and dividing by the total external debt (Table 1). Debt service as a percentage of GDP was calculated by dividing the debt service by the GDP of the country (Table 1). All other indicators are available without additional calculation or transformation (Table 1).

Table 1. Model inputs, by country and year

Variable	Notes	Years	Source
IMR		2000-2019	36
U5MR		2000-2019	36
MMR		2000-2017	36
LE		2000-2019	36
MITE	(PPG,multilateral (DOD, current US\$) + Use of IMF credit (DOD, current	2000-2019	14

	US\$)/External debt stocks, total (DOD, current US\$)		
GNI per capita	(current US\$)/1000	2000-2019	14
Wealth		2000-2019	35
EPC		2000-2019	37
IMFCond	Total conditions in a year	2000-2015	25
DSGDP	= Debt service on external debt, public and publicly guaranteed (PPG) (TDS, current US\$)/GDP(current US\$)	2000-2019	14

DOD – Disbursed and outstanding debt, DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, IMR – Infant mortality rate, LE – life expectancy, MITE – Multinational & IMF share of Total External debt, MMR – maternal mortality ratio, PPG – Public and publicly guaranteed, TDS – Total debt service, U5MR – Under 5 years of age mortality rate

Most of the previous studies that examine the impact of conditionality or debt on population health outcomes have utilized GDP, primarily as an economic control, as this has historically been the standard economic indicator and is almost always found to be a significant variable.^{3,5,7-10} Gross National Income (GNI) was chosen as it has been considered a better indicator to account for the income of individuals in a country, when compared to Gross Domestic Product (GDP) that measures economic size and performance.³⁸ GNI includes the incomes of cross-border workers, as well as any repatriated profits, the former can be of particular importance in developing countries. GNI can be a better measure than GDP as GNI is the sum of all goods and services, capital coming in from or going out to the rest of the world, other externalities, and less the depreciation of capital.³⁹ Purchasing power parity was then utilized as it allows the conversion of national currencies to a common currency while considering the price differences between countries thus better reflecting cross country comparisons of standard of living.⁴⁰ This was chosen as it has previously been utilized to control

for GDP or GNI per capita particularly when taking wealth inequality into consideration.⁴¹⁻⁴⁴ GNI was chosen as the primary method of measuring the Availability of Resources (Figure 1). However, GNI per capita does have strong associations with population health outcomes and has been transformed in some of the previous analyses.^{45,46} These have utilized net national income, GNI less debt per capita, and have been found to be positively associated with mortality indicators.¹

Export commodity concentration (EPC) is an index that estimates a country's reliance on a limited group of commodities.³ For example, a country that almost only exports a single commodity, such as oil, would have a value approaching 1. A country with a higher value for EPC is thus more reliant on a few commodities as their primary source of foreign exchange income. Thus, the availability of their country to purchase foreign currency, necessary for not only importations but also debt service is more vulnerable to changes in the global market which can lead to economic instability. Thus, EPC leads to instability in the Availability of Resources (Figure 1). This variable has been previously found to be negatively associated with infant mortality.³

Debt service is an important indicator that directly measures the impact that debt is having on the annual availability of resources. To use it in a multinational study it must be normalized for comparison across countries. While some studies have utilized the ratio of debt service to exports, debt service as a share of GDP would more directly consider the impact.^{5,6,26,30,32} Debt Service impacts the Availability of Resources as it is a required Usage of Resources that thus will take away from other spending priorities which may include those that are conducive to fostering population health (Figure 1).⁴⁷ Debt service has been previously

found to be associated with increased infant mortality as well as with decreased economic growth.^{5,26,32}

The share of wealth held by the top 1% in a country was chosen as a measure of inequality. While traditionally the Gini coefficient has been widely used it has faced criticism as it is possible to show a decreasing relative inequality, based on rate, while there is actually an increase in absolute inequality.²³ Thus we chose to build on the work done by Piketty that shows that unequal ownership of wealth, not income, is the prime driver of income disparities.⁴⁸ This is a measure of the Distribution of Resources (Figure 1), however to the authors knowledge this specific indicator has not been previously utilized in this type of research.

Previous sociological studies examining the relationship between national economic factors and population health have focused primarily on infant mortality and maternal mortality.^{3,5,6,9,10,26,27,30,31} In the current study, the outcomes of interest, the dependent variables, are infant mortality (IMR), maternal mortality ratio (MMR), life expectancy at birth (LE), and under five mortality (U5MR). These data were also acquired from the World Bank Databank as they annualize the national data from the United Nations World Population Prospects.^{36,49}

Since IMF conditionality data were only available through 2015, three sets of models were developed. The first was run 2000-2015 excluding IMF conditionality data, the second included IMF conditionality data, and the third group was 2000-2020 excluding IMF conditionality data. The first two sets of models were run in order to better compare MITE and

IMF conditionality data within a standardized set of years. Once this was examined, the entire time series could then be analyzed with the exclusion of IMF conditionality.

Inclusions and Exclusions

All countries classified in 2019 by the World Bank as middle and low income were initially considered⁵⁰. Countries with a population under 1 million were excluded as were countries with discordant debt data, meaning countries in which there are no data available in the International Debt Statistics, but quarterly data was available in the Joint External Debt Hub.^{14,36} The sum of the data in the Joint External Debt Hub was not equal to data provided in the International Debt Statistics in three separate test runs of countries with data in both databases. Thus, Equatorial Guinea, Iraq, Malaysia, Namibia, and South Sudan were excluded. There are no data for GDP or GNI for the Democratic Peoples' Republic of Korea so it was also excluded. Due to the lack of GNI data for Cuba and Syria they were both excluded as well. Libya was the only country that had no official debt and was also excluded. This results in a total of 103 countries for the analysis, a full list of which are available in the Appendix. The period of the study is the 21st century, between 2000 and 2019. Any 2020 data available were excluded due to the impact of COVID-19 on population health outcomes and economies.

Testing for Multicollinearity

As the economic indicators that have previously shown to be of interest can be highly correlated a few steps were taken to test for such potential problems. All independent variables

included were examined via a bivariate correlation matrix. Previously, it has been theorized that when each independent variable is regressed upon the other independent variables, the Lewis-Beck test, if the R^2 from these equations are less than the R^2 from the original analysis then collinearity should not be a concern.^{3,51,52} Finally, the variance inflation factor scores were calculated and it was assumed that multicollinearity is unlikely to a problem if the values did not exceed a value of 10.⁵³

Results

Multicollinearity

All of the bivariate correlations for the independent variables were found to be low to moderate. The Lewis-Beck test for multicollinearity did not result in any R^2 value of independent variables exceeding those of any of the presented models. Finally, none of the variance inflation factor scores exceeded a factor of 5. All of these data are available in the Appendix.

Multivariable Panel Regression Analyses, 2000-2015

The multivariable panel regressions that were conducted on all dependent variables with the exception for IMF Conditionality from 2000-2015 were found to have R^2 values ranging from a high of 0.60 for IMR and a low of 0.45 for the MMR (Table 2).

Table 2. Multivariable Panel Regression Analysis – Excluding IMF Conditionality, 2000-2015

	IMR – Coefficient (CI)	U5MR – Coefficient (CI)	MMR – Coefficient (CI)	LE – Coefficient (CI)
R ²	0.60	0.59	0.45	0.56
MITE (%)	0.12‡ (0.08, 0.16)	0.23‡ (0.15, 0.31)	0.81‡ (0.35, 1.27)	-0.03‡ (-0.04, -0.02)
1% Share of Wealth (%)	0.17* (0.04, 0.30)	0.56‡ (0.31, 0.80)	0.31 (-1.19, 1.80)	-0.11‡ (-0.15, -0.08)
EPC	0.14‡ (0.09, 0.20)	0.26‡ (0.16, 0.36)	0.84‡ (0.21, 1.46)	-0.04‡ (-0.05, -0.02)
DSGDP (%)	0.51‡ (0.30, 0.72)	0.85‡ (0.46, 1.25)	4.34‡ (2.04, 6.64)	-0.11‡ (-0.17, -0.05)
GNI per capita (thousands)	-1.82‡ (-2.02, -1.62)	-2.72‡ (-3.11, -2.34)	-8.38‡ (-10.67, -6.10)	0.57‡ (0.51, 0.63)

DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, IMR – Infant mortality rate, LE – life expectancy, MITE – Multinational & IMF share of Total External debt, MMR – maternal mortality ratio, U5MR – Under 5 years of age mortality rate, * P<0.05, †P<0.01, ‡P<0.001

Across all models MITE, export product concentration, IMF conditionality, and debt service as a percentage of GDP were found to be independently significantly associated with negative population health outcomes. The variable 1% share of wealth was found to be independently significantly negatively associated with IMR, U5MR and LE but not for MMR. GNI per capita was found to be independently significantly positively associated with all dependent variables. The effects of all aforementioned variables remain significant once accounting for the Holm-Bonferroni correction for testing four hypotheses.

MITE – Multinational & IMF share of Total External debt

MITE had significant associations with all population health outcomes measured (Table 2). Every one percentage increase of the share of debt that to multilateral agencies had a 0.12 deaths per 1,000 live births (CI: 0.08, 0.16) increase in the infant mortality rate (P<0.001). There was also a 0.23 per 1,000 live births (CI:0.15, 0.31) increase in the under-five mortality rate associated with every percentage increase of MITE (P<0.001). A percentage increase in MITE

was associated with a 0.81 per 100,000 live births (CI: 0.35, 1.27) increase in the maternal mortality ratio ($P < 0.01$). Every percentage increase in the share of debt due to multilateral institutions was associated with 0.03 (CI: 0.02, 0.04) fewer years of life expectancy ($P < 0.001$).

1% Share of Wealth

The 1% share of wealth had significant associations with all outcomes measured with the exception of maternal mortality ratio (Table 2). Every one percentage increase in the share of wealth held by the top 1% in a country was associated with a 0.17 (CI: 0.03, 0.30) increase in the infant mortality rate ($P < 0.05$). There was a 0.56 (CI: 0.31, 0.80) increase in the under-five mortality rate associated with every percentage increase of the indicator Wealth ($P < 0.001$).

There was no significant association found between maternal mortality ratio and the share of wealth held by the top 1%. Lastly, 0.11 (CI: 0.08, 0.15) years of life expectancy were lost with every percentage increase in the share of wealth held by the top 1% of a country ($P < 0.001$).

EPC – Export product concentration

The level of export product concentration had significant associations with all outcomes measured (Table 1). Every 0.01 increase in export commodity concentration was associated with a 0.14 (CI: 0.09, 0.20) increase in the infant mortality rate ($P < 0.001$). There was also a 0.26 (CI: 0.16, 0.36) increase in the under-five mortality rate associated with 0.01 increase of EPC ($P < 0.001$). A 0.01 increase in export product concentration was associated with an 0.84 (CI: 0.21, 1.46) increase in the maternal mortality ratio ($P < 0.01$). Lastly 0.04 (CI: 0.02, 0.05) years of life expectancy lost was associated with 0.01 increase in EPC ($P < 0.001$).

DSGDP – Debt service as a share of GDP

Every one percentage increase in the share of GDP that was due as debt service annually was associated with a 0.51 (CI: 0.30, 0.72) increase in the infant mortality rate ($P < 0.001$). There was also an 0.85 (CI: 0.46, 1.25) increase in the under-five mortality rate associated with every percentage increase of DSGDP ($P < 0.001$). Each percentage increase the debt service as a share of GDP was associated with a 4.34 (CI: 2.04, 6.64) increase in the maternal mortality ratio ($P < 0.001$). Lastly 0.11 fewer years of life expectancy (CI: 0.05, 0.17) was associated with every percentage increase in the portion of GDP that was due as debt service ($P < 0.001$).

GNI per capita (ppp) per \$1000

The GNI per capita purchasing power parity per \$1000 was found to be positively associated with all population health outcomes (Table 1). Every \$1000 increase in GNI per capita was found to be associated with a 1.82 (CI: 1.62, 2.02) decrease in the infant mortality rate ($P < 0.001$). There was also found to be a 2.72 (CI: 2.34, 3.11) decrease in the under-five mortality rate associated with every \$1000 increase in GNI per capita ($P < 0.001$). A \$1000 increase in GNI per capita was also found to be associated with a 8.38 (CI: 6.10, 10.67) decrease in the maternal mortality ratio ($P < 0.001$). Lastly almost half a year of life was gained in life expectancy (0.57 (CI: 0.51, 0.53) that was associated with every \$1000 increase in GNI per capita ($P < 0.001$).

Mediation Analysis

IMF conditionality was then added from the models to examine its possible impact in a mediation analysis (Table 3). This was done in part as all IMF conditionality countries would be included in MITE but not all MITE would have IMF conditionalities.

Table 3. Multivariable Panel Regression Analysis – All Variables, 2000-2015

	IMR – Coefficient (CI)	U5MR – Coefficient (CI)	MMR – Coefficient (CI)	LE – Coefficient (CI)
R ²	0.60	0.59	0.44	0.55
MITE (%)	0.10‡ (0.06, 0.14)	0.20‡ (0.13, 0.28)	0.65† (0.19, 1.11)	-0.03‡ (-0.04, -0.02)
1% Share of Wealth (%)	0.17* (0.03, 0.30)	0.55‡ (0.30, 0.79)	0.24 (-1.25, 1.72)	-0.11‡ (-0.15, -0.08)
EPC	0.15‡ (0.09, 0.20)	0.27‡ (0.17, 0.37)	0.87† (0.26, 1.49)	-0.04‡ (-0.05, -0.02)
IMFCond	0.07‡ (0.04, 0.10)	0.13‡ (0.07, 0.19)	0.73‡ (0.39, 1.08)	-0.02‡ (-0.03, -0.01)
DSGDP (%)	0.49‡ (0.28, 0.70)	0.81‡ (0.42, 1.21)	4.13‡ (1.85, 6.42)	-0.10† (-0.16, -0.04)
GNI per capita (thousands)	-1.75‡ (-1.96, -1.54)	-2.60‡ (-2.99, -2.21)	-7.59‡ (-9.89, -5.30)	0.55‡ (0.49, 0.61)

DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, IMR – Infant mortality rate, LE – life expectancy, MITE – Multinational & IMF share of Total External debt, MMR – maternal mortality ratio, U5MR – Under 5 years of age mortality rate, * P<0.05, †P<0.01, ‡P<0.001

The inclusion of IMF Conditionality slightly decreased the R² values for MMR and LE (Table 3).

The coefficients of MITE and EPC decreased in all models except LE, the coefficient of 1% share of wealth decreased in U5MR and MMR, and the coefficients of DSGDP and GNI per capita decreased in all models (Table 3). The only values of significance that changed with the addition of IMF Conditionality, was that of a decrease in the coefficient and significance of DSGDP in the Life Expectancy model and EPC in the MMR model (Tables 2 & 3). This mediation analysis provides evidence that MITE has a smaller magnitude of association when the number of IMF

conditionalities are included in the regression. Thus, MITE is in part associated with the population health outcomes via IMF conditionalites.

IMFCond – Total number of IMF conditionalities in effect in a given year

In the All-Variable Model, IMF conditionality was significantly associated with all population health outcomes examined. Each IMF conditionality was associated with a 0.07 (CI: 0.04, 0.10) increase in the infant mortality rate (P<0.001). There was also a 0.13 (CI:0.07, 0.19) increase in the under-five mortality rate associated with each IMF conditionality in a given year (P<0.001). Each increase in IMF conditionality was associated with a 0.73 (CI: 0.39, 1.08) increase in the maternal mortality ratio (P<0.001). Lastly, 0.02 years of reduced life expectancy (CI:0.01, 0.03) was associated with each IMF conditionality (P<0.001).

Multivariable Panel Regression for 2000-2019

The models were then run, excluding IMF conditionality, for the period of 2000-2019 (Table 4). MMR was excluded as data were only available through 2017.

Table 4. Multivariable Panel Regression Analysis – Excluding IMF Conditionality, 2000-2019

	IMR – Coefficient (CI)	U5MR – Coefficient (CI)	LE – Coefficient (CI)
R ²	0.60	0.58	0.56
MITE (%)	0.14‡ (0.10, 0.17)	0.26‡ (0.19, 0.33)	-0.04‡ (-0.05, -0.03)
1% Share of Wealth (%)	0.14* (0.01, 0.26)	0.49‡ (0.26, 0.72)	-0.12‡ (-0.15, -0.08)
EPC	0.19‡ (0.15, 0.25)	0.34‡ (0.24, 0.43)	-0.04‡ (-0.06, -0.03)
DSGDP (%)	0.57‡ (0.25, 0.68)	0.76‡ (0.35, 1.16)	-0.09† (-0.15, -0.02)
GNI per capita (thousands)	-1.58‡ (-1.74, -1.42)	-2.32‡ (-2.64, -2.02)	0.55‡ (0.50, 0.60)

DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, IMR – Infant mortality rate, LE – life expectancy, MITE – Multinational & IMF share of Total External debt, MMR – maternal mortality ratio, U5MR – Under 5 years of age mortality rate, * P<0.05, †P<0.01, ‡P<0.001

When the models are run through 2019, the R² value slightly decreases for U5MR but remains the same for IMR and LE (Tables 2 & 4). Across all models the coefficient increases for both MITE and EPC. However, it decreases for 1% share of wealth, with the exception of LE. DSGDP increases for IMR, but decreases for both U5MR and LE with the latter becoming less significant of an association. The coefficient for GNI per capita also decreases across all models though significance remains constant.

MITE, Wealth, EPC, and DSGP can all be more easily directly compared with each other in each model as they each only have possible values of 0-1. Among these variables, DSGDP has the largest negative association with population health outcomes with the exception of LE which 1% share of wealth was found to have a higher association. When the linear combination of coefficients was examined in the IMR and MMR model it was found that DSGDP did have a significantly larger impact than the other variables examined. In the IMR models, DSGDP was followed by EPC, MITE and then Wealth, while in the U5MR model DSGDP was followed by Wealth, EPC, and MITE respectively (Table 4). In the LE model Wealth was followed by DSGDP, MITE and then EPC.

Discussion

As expected, debt can have a major impact on population health outcomes as it directly impacts the availability of resources for nations to provide services. In the current study, this is supported by data that give evidence that the percentage of GDP that is required for debt service has a major impact on all population health outcomes investigated. Inversely, the models found that by increasing the availability of resources, measured through GNI per capita, there were positive impacts population health outcomes as has been previously demonstrated. Export product concentration also had a negative association with population health outcomes.³ This is due to the entire economy being more sensitive to price changes in their main export(s) thus leading to the availability of resources changing quite drastically and quickly.

While the coefficient for all population health outcomes looks small for the IMF conditionality variable that measures the impact of a single conditionality, it should be noted that in the time period which was examined the mean number of conditionalities per country ranged from 30.4 to 45.3.²⁵ Similarly, debt service of GDP, MITE, 1% wealth and export product concentrations are all percentages with mean values for the entire study period ranging from 31% to 36% with the exception of debt service of GDP which was 2%. Thus, while the impact of a single conditionality or single percentage point increase in the variables would have a small impact, the average total impact is quite large.

The current study found that countries with a higher share of their external debt to multilateral lending institutions have worse population health outcomes than those with lower shares. This would indicate, as observed elsewhere, that while there has been a change in language at many of these multilateral lending institutions starting in the early 2000s as a result

of widespread criticism, the association of their lending policies with population health outcomes unfortunately remain intact.^{9,24,25}

As previously described acquiring and analyzing the specific conditionality data can prove to be time intensive and difficult. The current study suggests that when specific multilateral lending conditionality data are not readily available, MITE, while measuring something different, can be used as an analog to examine the impact of multilateral lending institutions.

Wealth inequality also contributed to negative population health outcomes in our models, though not for MMR. This latter finding requires further investigation. The MMR data that were utilized are themselves modeled estimates and only go through 2018. An examination of the underlying assumptions for these data could provide clarity especially if indicators being used in the current study are also being used to estimate MMR data.

When IMF conditionality was added the regression, the magnitude of the coefficient of MITE was lowered, however not as much as initially expected. There appears to be a significant mediation of IMF conditionality with debt service as a share of GDP in relation of life expectancy. This shows that MITE in part, although not entirely, is associated with the population health outcomes via the IMF conditionalities. This is an interesting avenue for future research particularly as recent research has examined the impact of African Development Bank loans that include conditionalities on population health outcomes.^{26,27}

There are several limitations in the current study. There may be selection bias as countries that are in need of loans, may already have poor health outcomes. However, utilizing panel data from an economically diverse set of countries, while utilizing robust economic

control variables is an attempt to control for this bias. Previous authors have utilized UN voting alignment with G7 countries to control for selection bias in countries that receive IMF loans, however as the current study looked at all multilateral debt this relationship may not be as correlated if at all.^{8,54}

Focusing on the national level ignores any heterogeneity of the independent and dependent variables that may be present at the sub-national level or between various cultural or ethnic groups. While previously analyses have utilized lagged variables this study did not, however the results are still compelling.⁸ Infant mortality has been shown to be a more sensitive indicator for the factors that impact population health outcomes, thus under 5 mortality would be expected to follow a similar though slightly delayed pattern as well.⁵⁵⁻⁵⁹

By looking only at the pre-COVID 21st century there could have been variables that were associated with population health outcomes at a certain point of time but no longer are. This could be particularly problematic if any possible associations are only observed temporally such as within a certain period following structural adjustments or during particularly high levels of external debt.⁸ The changing share of external debt to multilateral institutions were measured as opposed to a fixed time after disbursement. The impact in a given time frame post-disbursement is challenging as with few exceptions, most countries have received multiple disbursements over decades and thus tracking the impact of each individual disbursement and taking into account the previous disbursements would prove difficult. This also proves to be a limitation of the IMF conditionality data. While the data for IMF conditionality were utilized, these were only available through 2015. The IMF is not the only institution that imposes

conditionality and even after the terms of conditionality have expired the public policies that changed as a result often remain.²³

Part of the purpose of this study in examining such a large swath of countries, 103, was to attempt to minimize the variations resulting from the limitations to get a broader picture of the impact of multilateral debt in the pre-COVID 21st century. While there still exists the potential for multicollinearity or confounding, attempts were made to minimize and quantify by the aforementioned processes.

By focusing on a few independent variables this study aims to not fall into the kitchen sink approach that others have utilized^{2,4}. However, there are economic factors not currently being included which may be impactful. Some of the most important ones are those that are not captured in GNI. Previously it has been suggested to utilize Gross National Disposable Income (GNDI) instead of GNI as it includes both remittances and foreign aid, however it is an indicator that is not easily available in the international reports and databases.³⁸

Lastly, the conceptual diagram depicts the importance of ideology however this factor is not being considered in the analysis. This is well beyond the scope of the current study but provides an opportunity for future research.

The R² values indicate that while the economic factors included in these models can account for large portions of the variance in population health outcomes, they do not account for all. The combination of these measures of availability of resources and impact on said resources with indicators for usage and distribution of resources would prove a valuable avenue for future research.

Conclusion

While the economic factors that impact the availability and usage of resources do not account for all variance in the population health outcomes in these middle- and low-income countries, they do account for a substantial portion. As there is a movement to transition from public health to population health, with a renewed focus on the social determinants of health, it is integral that these economic factors, including the impact of conditionalities and loans from multilateral institutions, are taken into consideration. There has been renewed interest in empirically examining the impact of IMF conditionalities with the release of the Kentikelenis et al. 2016 data. While the current study provides evidence that MITE is a novel variable of significance, further work could be undertaken to examine if there are any specific multilateral lending institutions that tend to be associated with poorer population health outcomes when compared to others. This simplified standardized ratio could also be utilized to examine possible associations between certain bilateral lenders and the population health outcomes at the national and international level.

Despite the small changes in policy and the large changes in public relations it is clear that in the pre-COVID 21st century countries that borrow larger shares of their debt from multilateral lending institutions tend to have worse population health outcomes. As countries continue to reel from the negative economic impacts of COVID-19, without substantial change in the terms set by lending institutions, the people of the countries in need of financial assistance could face further reduction in health outcomes for years to come.

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Appendix - The Continued Impact of Multilateral Debt on the Population Health Outcomes of Low- and Middle-Income Countries

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List of Countries

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Multivariable Panel Regression Analysis – Excluding MITE, 2000-2019

	IMR – Coefficient (CI)	U5MR – Coefficient (CI)	MMR – Coefficient (CI)	LE – Coefficient (CI)
R ²	0.59 [†]	0.58 [†]	0.45 [†]	0.56 [†]
IMFCond	14.53 [†] (10.85, 18.20)	27.42 [†] (20.61, 34.23)	90.34 [†] (48.97, 131.72)	-3.89 [†] (-4.99, -2.79)
1% Share of Wealth (%)	13.23 [‡] (0.69, 25.71)	48.82 [†] (25.73, 71.91)	29.82 (-111.52, 171.15)	-11.47 [†] (-15.26, -7.68)
EPC	20.59 [†] (15.30, 25.87)	35.00 [†] (24.35, 44.66)	112.10 [†] (52.67, 171.53)	-4.61 [†] (-6.22, -3.00)
DSGDP (%)	48.69 [†] (27.08, 70.31)	78.45 [†] (38.15, 118.76)	443.61 [†] (214.89, 672.34)	-9.40* (-15.82, -2.97)

GNI per capita (thousands)	-1.49 [†] (-1.65, -1.33)	-2.19 [†] (-2.49, -1.90)	-7.32 [†] (-9.23, -5.40)	0.52 [†] (0.47, 0.56)
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DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMR – Infant mortality rate, LE – life expectancy, MITE – Multinational & IMF share of Total External debt, MMR – maternal mortality ratio, U5MR – Under 5 years of age mortality rate, ‡ P<0.05, *P<0.01, †P<0.001.

Multicollinearity Test Results

Bivariate Correlation Matrix

	MITE	Wealth	EPC	IMFCond	DSGDP	GNIcap1K
MITE	1.0000					
Wealth	-0.0138	1.0000				
EPC	0.1662	0.0703	1.0000			
IMFCond	0.3747	-0.0431	0.0187	1.0000		
DSGDP	-0.1867	0.0866	-0.0168	0.0002	1.0000	
GNIcap1K	-0.5853	0.0479	-0.2247	-0.3006	0.1554	1.0000

DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, MITE – Multinational & IMF share of Total External debt

Lewis-Beck Test

	All Other Independent Variables (R ²)
MITE	0.38
Wealth	0.01
EPC	0.00
IMFCond	0.15
DSGDP	0.00
GNIcap1K	0.32

DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, MITE – Multinational & IMF share of Total External debt

Variance Inflation Factor Scores

Variable	VIF	1/VIF
MITE	1.74	0.574517
GNIcap1K	1.64	0.610507
IMFCond	1.18	0.849905
DSGDP	1.06	0.947428
EPC	1.05	0.956141
Wealth	1.02	0.983360
Mean VIF	1.28	

DSGDP – Debt service as a share of GDP, EPC – Export product concentration, IMFCond – Total number of IMF conditionalities in effect in a given year, MITE – Multinational & IMF share of Total External debt