

**Final Evaluation of the  
Salud Mesoamérica Initiative:  
Impact of the Salud Mesoamérica Initiative on  
Maternal, Neonatal, and Under-5 Mortality**

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## Overview

The Salud Mesoamérica Initiative (SMI) is a regional public-private partnership that brings together Mesoamerican governments, private foundations and bilateral and multilateral donors with the purpose of reducing health inequalities affecting the poorest 20% of the population in the region. Funding focuses on supply- and demand-side interventions, including evidence-based interventions, the expansion of proven and cost-effective healthcare packages, and the delivery of incentives for effective health services. One of its defining features is the application of a results-based financing (RBF) model that relies on performance measurement and enhanced transparency and accountability. The Initiative focuses its resources on integrating key interventions aimed at reducing health inequalities that stem from the lack of access to quality reproductive, maternal, neonatal and child health services (including immunization and nutrition services) for the poorest quintile of the population.

In SMI's intervention model, improvements in health system performance are expected to lead to improvements in healthcare coverage and healthcare quality, which can lead to impacts on population health, for example, reductions in morbidity and mortality in target populations. SMI attempted to reduce maternal mortality by interventions such as provision of information and methods for contraception, active search of pregnant women, antenatal care with quality (and incentives for attendance), support of maternal waiting homes, birth plans and transportation for safe birth, active management of third stage of labor and proper patient management with partograph, management of obstetric complications, postpartum care to standard, and active search of postpartum women.

SMI attempted to reduce neonatal mortality through interventions such as active search of pregnant women, antenatal care with quality (and incentives for attendance), support of maternal waiting homes, birth plans and transportation for safe birth, management of neonatal complications, and routine neonatal care to standard. SMI attempted to reduce childhood morbidity and mortality through interventions such as strategies for Comprehensive Child Care and communication, vaccination against serious diseases (improvements to cold chain and vaccine distribution), proper treatment of childhood illness such as diarrhea and pneumonia, regular deworming, micronutrient supplementation, and detection and treatment of anemia.

In this report, we explore the research question, "What was the impact of SMI on maternal, neonatal, and/or children under-five mortality?" and provide recommendations for future analyses. Even after more than 10 years, it will be difficult to see an effect at the population level, especially nationwide, when interventions were geographically targeted. Mortality rates are already low in the region, so reductions brought about by SMI would be expected to be small and difficult to distinguish from the preexisting downward trend. The data are insufficient for causal attribution of observed effects. In this report we will use the Global Burden of Disease (GBD) data to examine the trends in three mortality indicators (the maternal mortality ratio, neonatal mortality rate, and under-5 mortality rate) in SMI countries, and account for the effects of socio-demographic factors in these trends. Using GBD data is in line with our previous work with SMI when we used GBD to provide input for setting targets.

## Methods

The GBD estimates worldwide health metrics such as population, morbidity, and mortality from 1950 to 2019 for 204 countries. The analytical framework and modeling methods have been described in detail elsewhere (1).

Mortality data used in the model are from a variety of sources, including national and multi-country vital registration sources, household surveys, disease surveillance point systems, and sample registration systems. Vital registration sources include the WHO Mortality Database, United Nations Demographic Yearbooks, and national vital statistics systems.

A key methodological challenge in GBD estimation is variability in data completeness and quality across locations. When available, vital registration is the preferred data source. For child mortality data, when vital registration is not available, complete birth histories from household survey microdata are used when available (this is not a factor in the SMI areas, but IHME has a comprehensive approach that we explain here). Because respondents provide the age at each live birth and their children's birth dates, age of child can be determined and used to determine age of death in cases where the child did not survive, and period and age-specific mortality rates can be calculated for the time period before the survey. These birth histories are an especially relevant source for under-5 mortality in low-income nations, where vital registration data is less likely to be available. Thus, GBD estimates at the national level may not align precisely with estimates from administrative sources. Uncertainty is estimated as a part of the GBD modeling process, and though not presented here, uncertainty interval estimates are available from the GBD database.

In this report, we utilize GBD estimates of mortality indicators for the SMI intervention countries of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, and Panama, as well as the state of Chiapas, Mexico. We examine the trends in the maternal mortality ratio, neonatal mortality rate, and under-5 mortality rate from 1990 to 2019, (the most recent year for which estimates are available), and analyze how performance of these indicators compares to a proxy match using the Socio-Demographic Index (SDI). SDI is a summary measure that places all GBD locations on a spectrum of socioeconomic development. It is constructed as the geometric mean of 0 to 1 indices of fertility rate under age 25, mean education for those aged 15 and older, and lag-distributed income per person. As a composite, a location with an SDI of 0 would have a theoretical minimum level of development relevant to health, while a location with an SDI of 1 would have a theoretical maximum level. The neonatal mortality rate is defined as the probability of dying during the first 28 days of life per 1,000 live births. The under-5 mortality rate is the probability of dying before the age of 5 years. The maternal mortality ratio is defined as the number of maternal deaths among women aged 15-29 years per 100,000 live births.

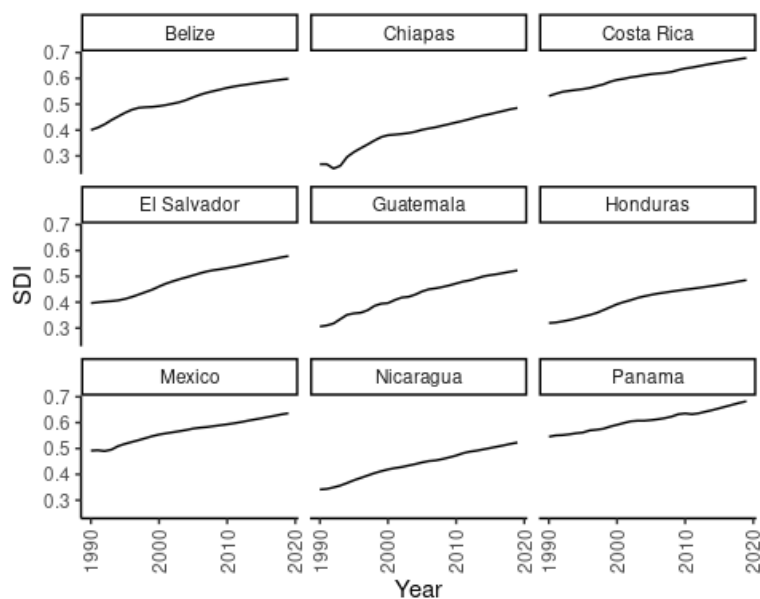
In this report, we treat the value of each mortality indicator for an SMI country as "observed". We then look at the values of the same mortality indicator in GBD countries with an equivalent or lower SDI. If another country with a lower SDI had a better performance (which we refer to as an "exemplar" country) we set this value as "expected" performance for the country and indicator. By comparing observed values with expected (observed over expected), we can determine if a country is performing at a better level than expected given its SDI. We examine the trend in mortality indicators prior to SMI interventions (1990-2013) and compare it to the trend in mortality indicators during the SMI intervention period (2014-2019). We compare estimated 2019 mortality in each pair of countries to determine if SMI countries performed better or worse than expected. This analysis includes the seven

countries that have participated in SMI (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama), and we conduct an equivalent analysis comparing Chiapas to the other states of Mexico. Analyses are conducted using R version 4.

## Results

SDI in the region has been on an upward trend since 1990, including over the period of intervention for SMI (see Figure 1).

Figure 1. SDI in Mesoamérica, 1990-2019



Among the countries of interest, SDI ranges from 0.4855 in Honduras to 0.6825 in Panama (see Table 1).

Table 1. SDI of Salud Mesoamérica Countries in 2019

Country	2019 SDI
Honduras	0.4854609
Guatemala	0.5228568
Nicaragua	0.5230492
El Salvador	0.5784979
Belize	0.5983965
Mexico	0.6363742
Costa Rica	0.6788800
Panama	0.6824831

Within Mexico, Chiapas (SDI = 0.0.4857) had the lowest SDI in 2019. Guerrero (SDI = 0.5485) had the next lowest (see Table 2).

Table 2. SDI of Mexican States in 2019

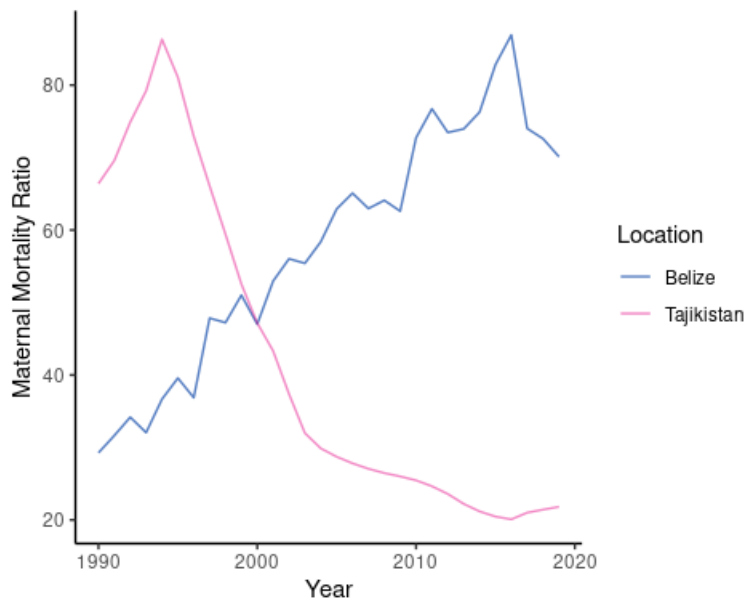
State	2019 SDI
Chiapas	0.4856651
Guerrero	0.5484620
Oaxaca	0.5629664
San Luis Potosi	0.5705757
Michoacan De Ocampo	0.5734626
Veracruz De Ignacio De La Llave	0.5785228
Durango	0.5870159
Tabasco	0.6059257
Puebla	0.6177931
Coahuila	0.6193100
Nayarit	0.6209150
Jalisco	0.6211668
Hidalgo	0.6238099
Zacatecas	0.6400175
Guanajuato	0.6441454
Tlaxcala	0.6463521
Tamaulipas	0.6468588
Morelos	0.6475636
Yucatan	0.6505186
Sinaloa	0.6507456
Campeche	0.6583501
Nuevo Leon	0.6583739
Chihuahua	0.6705421
Mexico State	0.6712249
Baja California	0.6750538

State	2019 SDI
Sonora	0.6751935
Colima	0.6753309
Queretaro	0.6772207
Quintana Roo	0.6815036
Aguascalientes	0.6850882
Baja California Sur	0.7065831
Mexico City	0.7453975

## Maternal Mortality Ratio

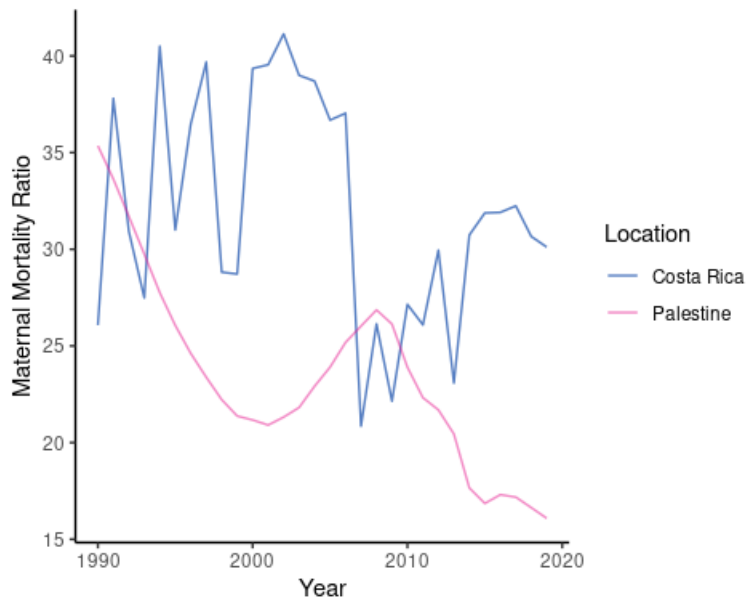
This section explores trends in the maternal mortality ratio for each SMI country, comparing against an “exemplar” country with lower SDI in 2019, but also lower maternal mortality in 2019. As a robustness check, we carried out the same analysis with age-standardized maternal mortality ration, and we observed no differences in the results using the age-standardized maternal mortality ratio (which is not reported here).

Figure 2. Maternal Mortality in Belize



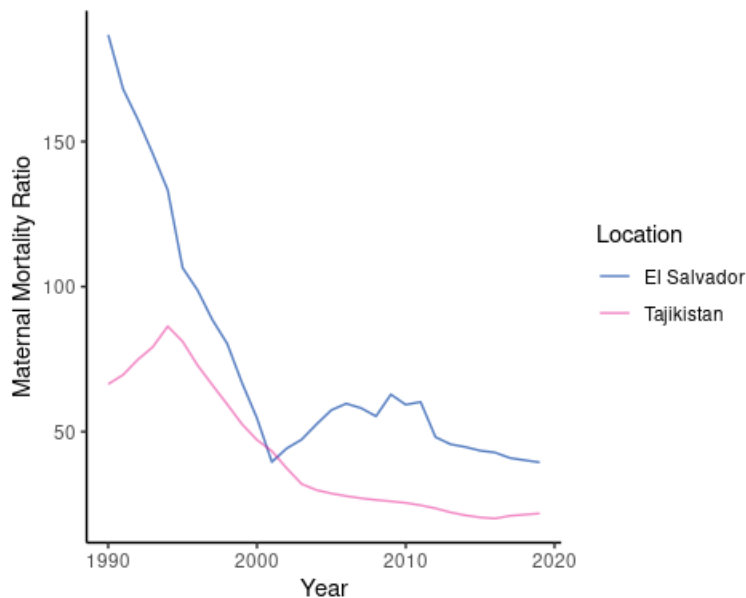
Of all the countries with lower SDI than Belize, Tajikstan is the most exemplar, representing the expected outcome. We can see that Belize’s maternal mortality ratio actually increased over time and did not meet expected performance, while Tajikstan’s decreased considerably. However, we find a sharp decrease in maternal mortality ratio in Belize beginning in the mid-2010s. While this coincides with the timing of SMI interventions, the data are insufficient to attribute causality for the decline.

Figure 3. Maternal Mortality in Costa Rica



Palestine is the most exemplar of all countries with lower SDI than Costa Rica. We see it had consistently lower maternal mortality ratio than Costa Rica over time. The maternal mortality ratio in Costa Rica has varied substantially since 1990, with an upward trend in the last 10 years. Though the number of maternal deaths in Costa Rica remains much lower than other countries in the region, the observed performance did not match the expected (as represented by the estimate in Palestine).

Figure 4. Maternal Mortality in El Salvador

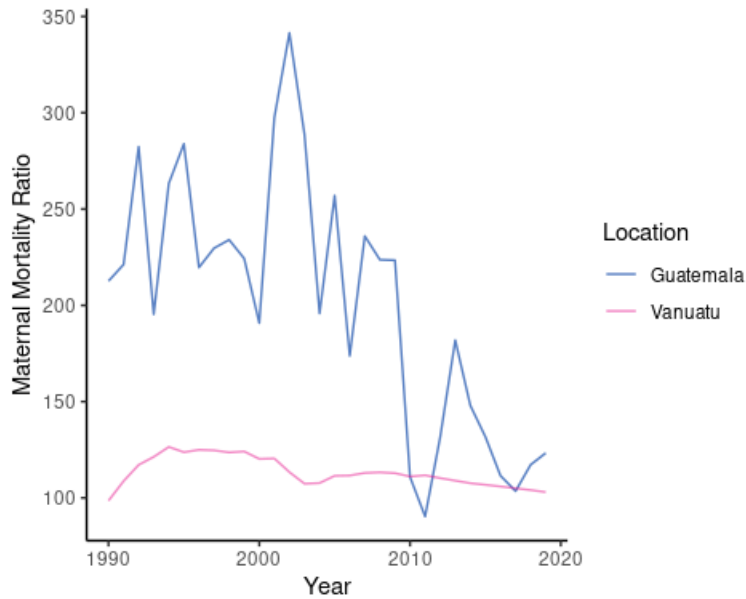


Similar to Belize, the most exemplar country with lower SDI than El Salvador is Tajikistan. Though El Salvador shows consistently higher maternal mortality ratio than Tajikistan, it decreases considerably through 2000, and is lower



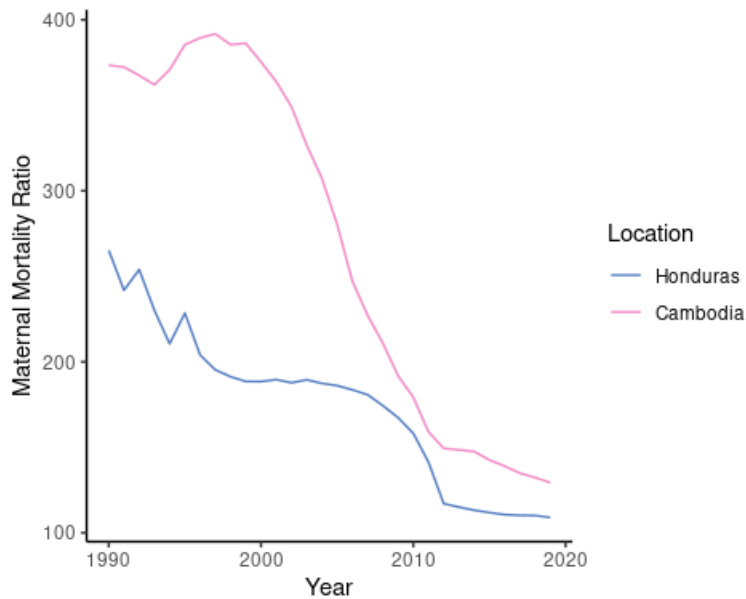
than other countries in Mesoamérica. We see further decreases from roughly 2011 onward, coinciding with the period of intervention for SMI, though the expected performance is not achieved.

Figure 5. Maternal Mortality in Guatemala



Vanuatu is the most exemplar match for Guatemala. Guatemala’s maternal mortality ratio has been highly variable over the last 30 years, but has decreased on average beginning in roughly 2013. Though it has dropped below the expected mortality rate during two years, it was above the expected rate for 2019.

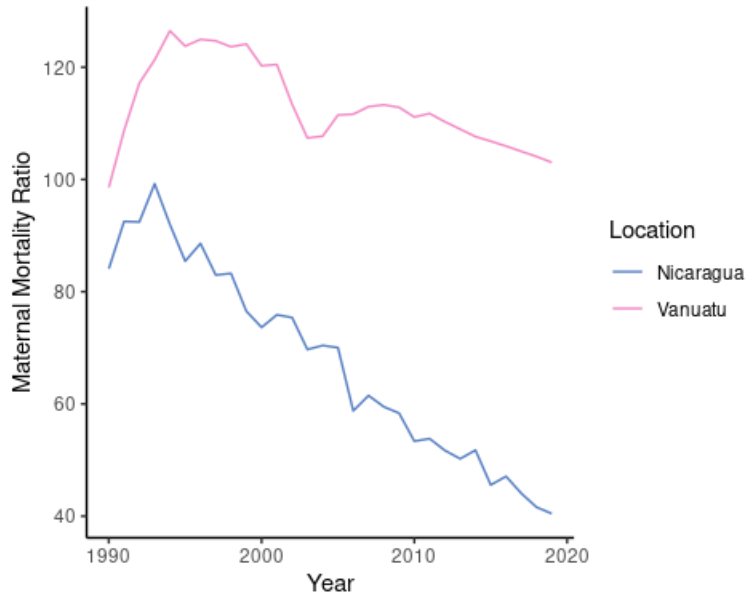
Figure 6. Maternal Mortality in Honduras



Cambodia is the most exemplar match for Honduras. Across the 204 countries estimated in the GBD, no country had a lower 2019 SDI and also a lower 2019 maternal mortality ratio . Honduras’s maternal mortality ratio shows a

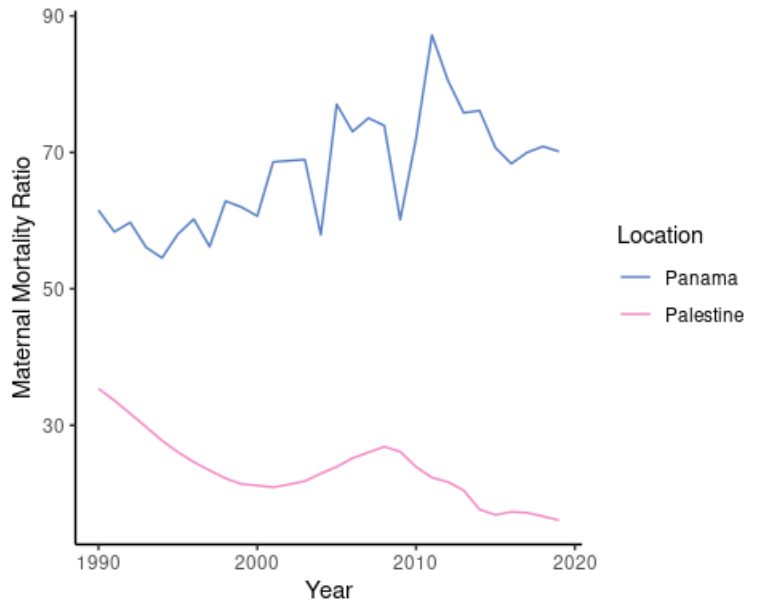
general decrease over time and remains lower than Cambodia's. The rate of decline in both countries has slowed since 2010.

Figure 7. Maternal Mortality in Nicaragua



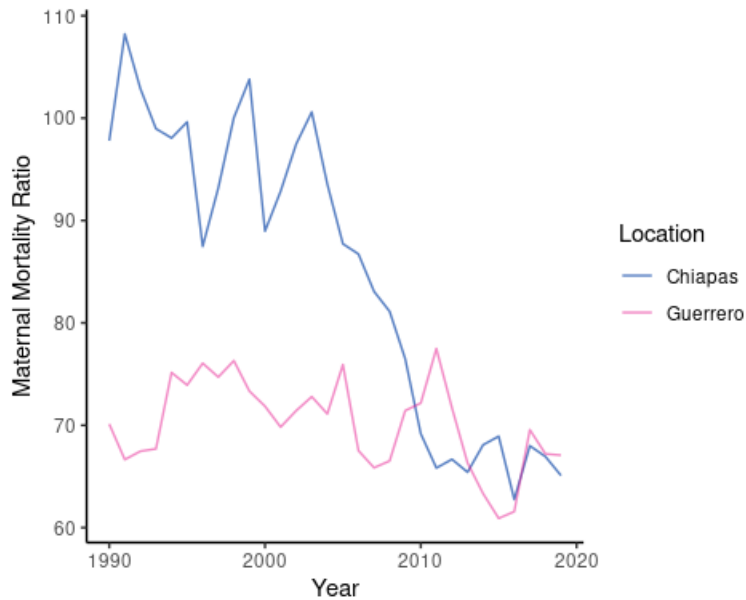
The most exemplar nation to compare to Nicaragua is Vanuatu. Nicaragua shows lower maternal mortality ratio and with larger decreases over time than Vanuatu. Nicaragua's maternal mortality is lower than its Mesoamerican peers with similar SDI. During the time of SMI, the downward trend continued at a similar rate as during 1990-2010.

Figure 8. Maternal Mortality in Panama



The most exemplar match to Panama is Palestine. Panama has consistently higher maternal mortality ratio than Palestine across all years. On average, maternal mortality has risen in Panama since 1990.

Figure 9. Maternal Mortality in Chiapas

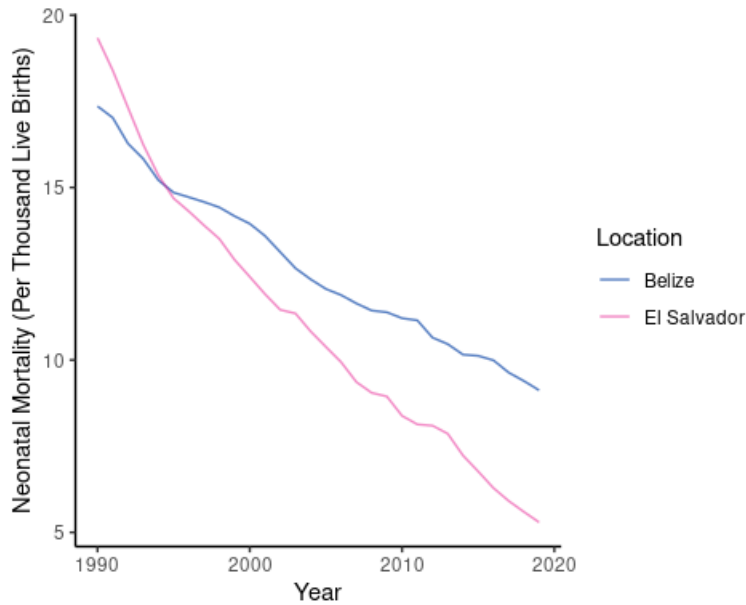


Chiapas has the lowest SDI of all Mexican states. The next lowest SDI in 2019 is Guerrero. Guerrero has lower maternal mortality ratio until the late 2000s. From that time onward, Chiapas had comparable maternal mortality to Guerrero, showing slightly lower maternal mortality some years and slightly higher maternal mortality in other years. Further, beginning in the early 2000s, the rate of decline in Chiapas has generally been steeper. Overall, we observe only a small and variable change in maternal mortality in Chiapas since 2010.

### Neonatal Mortality (Per Thousand Live Births)

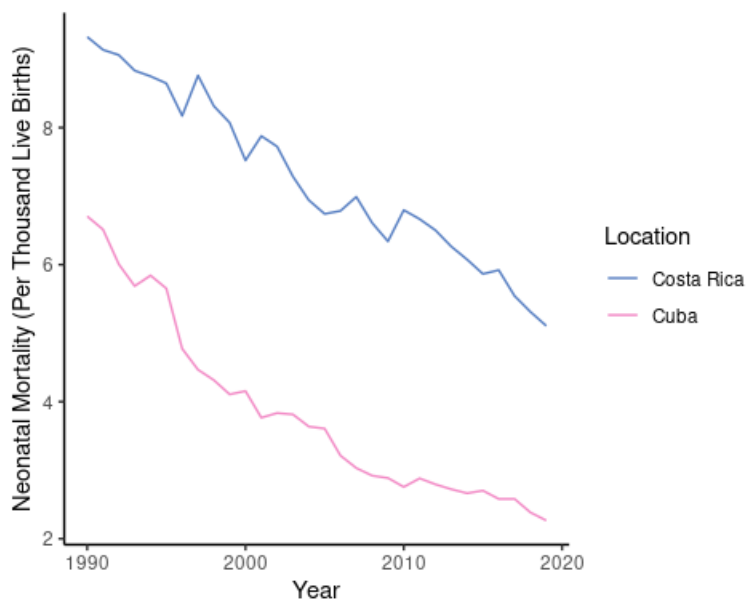
This section explores trends in the neonatal mortality ratio for each SMI country, comparing against an “exemplar” country with lower SDI in 2019, but also lower neonatal mortality in 2019.

Figure 10. Neonatal Mortality in Belize



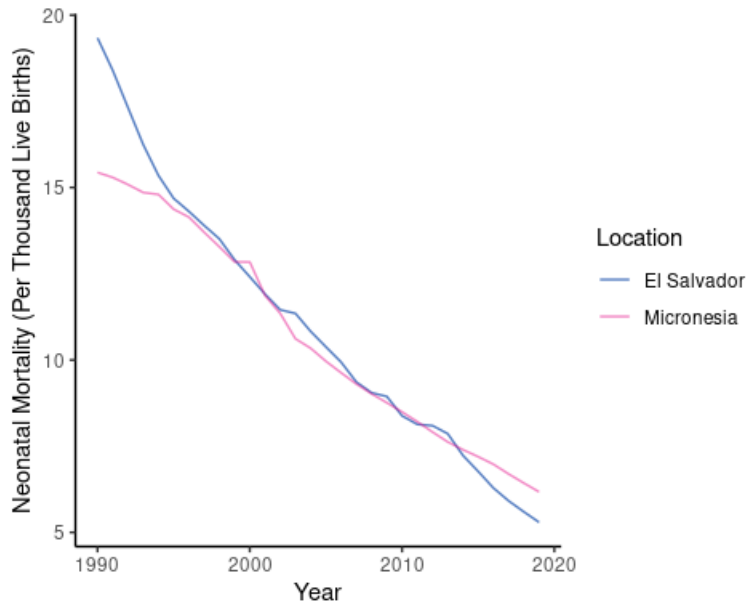
The most exemplar match with Belize is El Salvador, and El Salvador has consistently lower neonatal mortality than Belize since the mid-1990s. Further, we see a relatively consistent decrease in neonatal mortality over time in both countries, though at a slower rate in Belize, and no notable change in the rate since SMI interventions began in the early 2010s. Thus, Belize did not attain the expected mortality rate.

Figure 11. Neonatal Mortality in Costa Rica



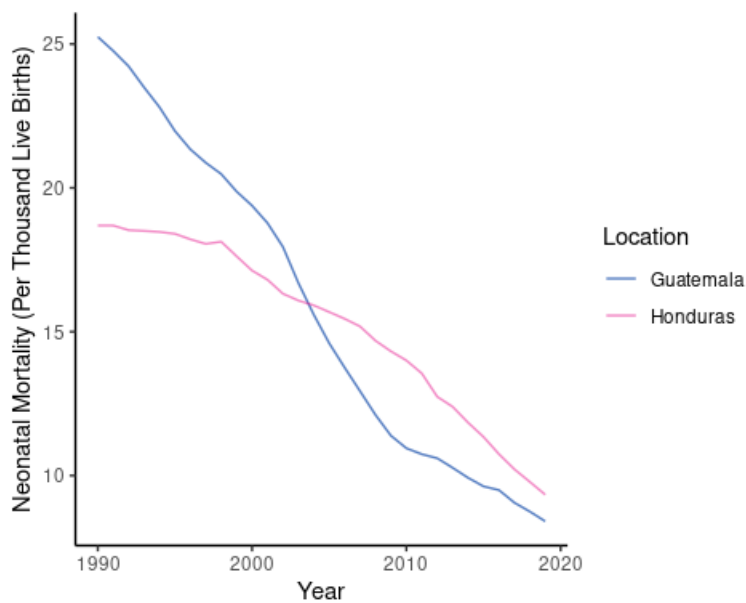
Cuba is the most exemplar comparison country with Costa Rica and has lower neonatal mortality than Costa Rica across all years. However, we do see an overall decrease in neonatal mortality over time in Costa Rica, with some variability year over year, but a fairly consistent downward slope.

Figure 12. Neonatal Mortality in El Salvador



The most exemplar comparison country to El Salvador is Micronesia. No country had lower SDI and lower neonatal mortality than El Salvador in 2019. El Salvador begins with higher neonatal mortality than Micronesia but shows lower neonatal mortality rates from roughly 2012 on, attaining the expected performance under the assumptions of this analysis. We also see that neonatal mortality in El Salvador consistently decreases over time, and at a marginally faster rate since the beginning of SMI in the early 2010s, though it is not possible to attribute the decrease directly to SMI with the existing data.

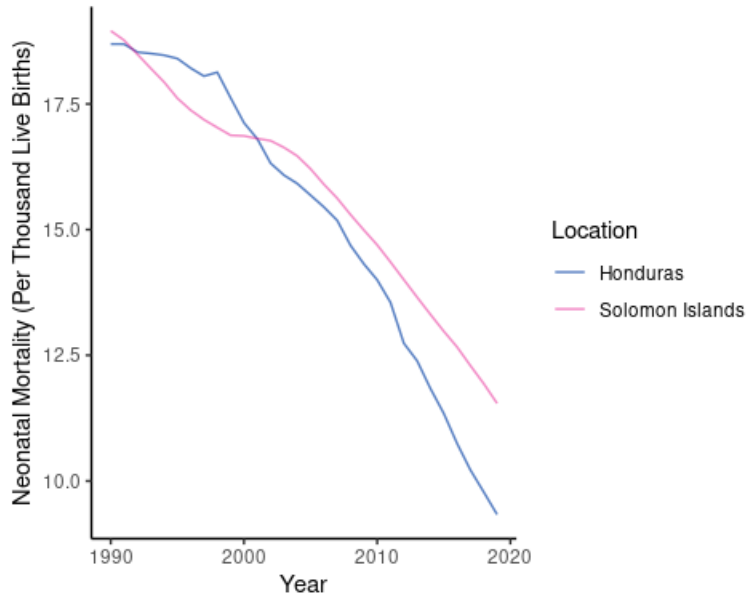
Figure 13. Neonatal Mortality in Guatemala



The most exemplar match to Guatemala is Honduras. No country had lower SDI and lower neonatal mortality than Guatemala in 2019. Guatemala shows higher neonatal mortality than Honduras until roughly 2004. It then shows

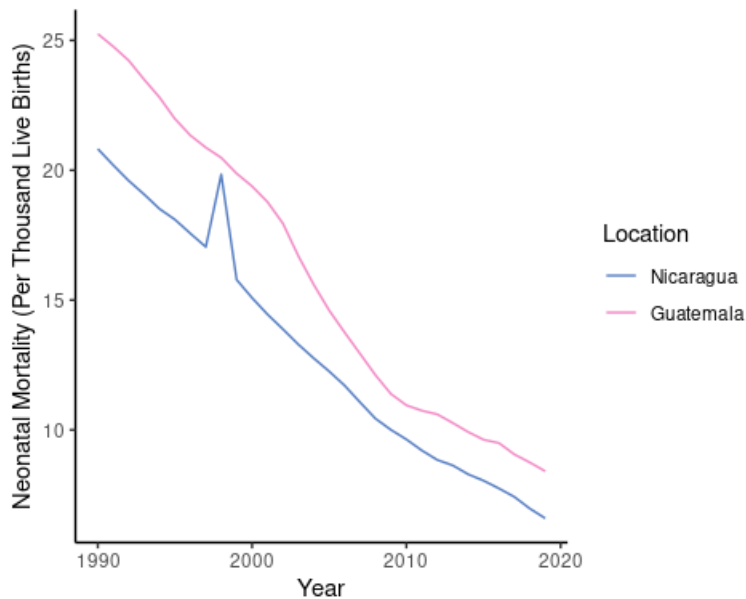
lower neonatal mortality than Honduras, achieving the expected performance for neonatal mortality. Overall, neonatal mortality decreases over time, and it decreases at a higher rate from roughly 2000 to 2010.

Figure 14. Neonatal Mortality in Honduras



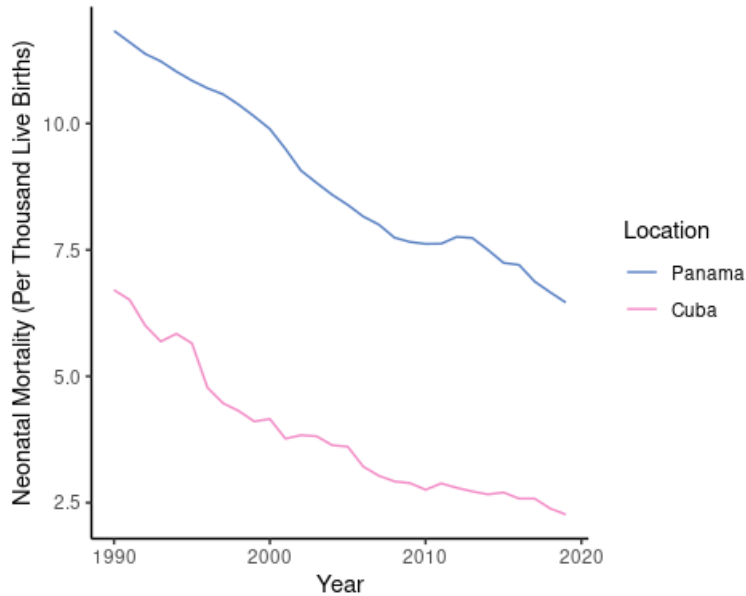
The most exemplar match with Honduras is Solomon Islands. No country had lower SDI and lower neonatal mortality than Honduras in 2019. Neonatal mortality in Honduras decreases across all years, showing a much steeper decrease in neonatal mortality over the 2000s and 2010s than in the 1990s. The steep decrease coincides with the years of SMI, but we cannot quantify a specific contribution of SMI to the decline with the existing data.

Figure 15. Neonatal Mortality in Nicaragua



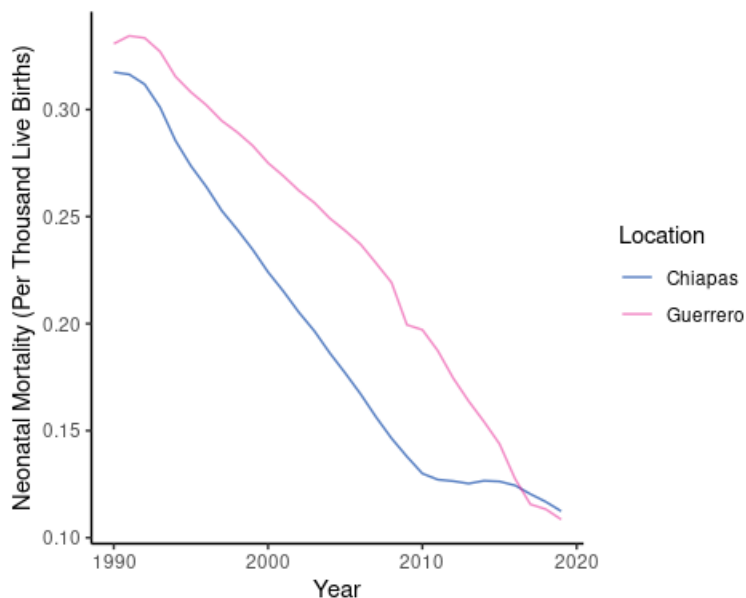
No country had lower SDI and lower neonatal mortality than Nicaragua, so Guatemala was identified as the match with lower SDI and the next highest mortality rate in 2019. Outside of a spike in neonatal mortality in the late 1990s, we see a steady decline in neonatal mortality across time in Nicaragua, and consistently lower rates than in Guatemala. Thus, Nicaragua attains the expected performance according to the parameters of this analysis.

Figure 16. Neonatal Mortality in Panama



Panama has consistently higher neonatal mortality than its comparison country Cuba. However, it also steadily decreases over time, with a slight increase in the early 2010s before further decrease over the period of SMI. It is unknown what portion of this decrease could be a result of SMI, and Panama does not achieve the expected trajectory represented by Cuba.

Figure 17. Neonatal Mortality in Chiapas

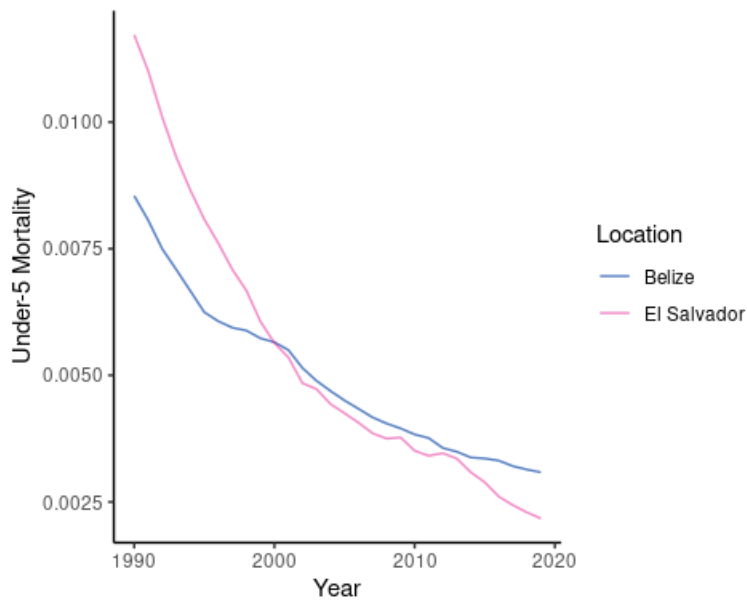


Chiapas had lower neonatal mortality than its comparison state Guerrero until the latter part of the 2010s. Neonatal mortality did decrease consistently in Chiapas until 2010, where neonatal mortality remained steady and even slightly increased some years before again decreasing the past few years.

## Under-5 Mortality

This section explores trends in the under-5 mortality ratio for each SMI country, comparing against an “exemplar” country with lower SDI in 2019, but also lower under-5 mortality in 2019.

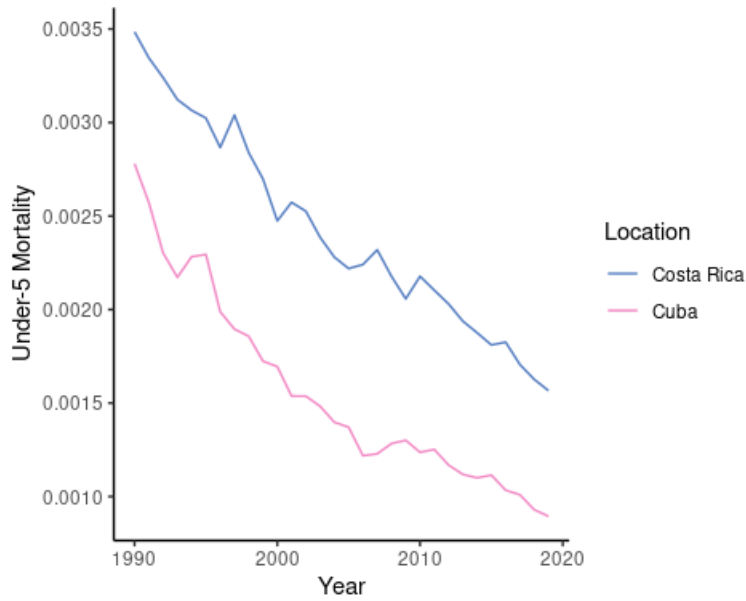
Figure 18. Under-5 Mortality in Belize



Belize has lower under-5 mortality than comparison country El Salvador until the end of the 1990s. For the duration of the 2000s, it has higher under-5 mortality and does not attain the trajectory expected under this analytical strategy. However, under-5 mortality still steadily decreases in Belize over this timeframe.

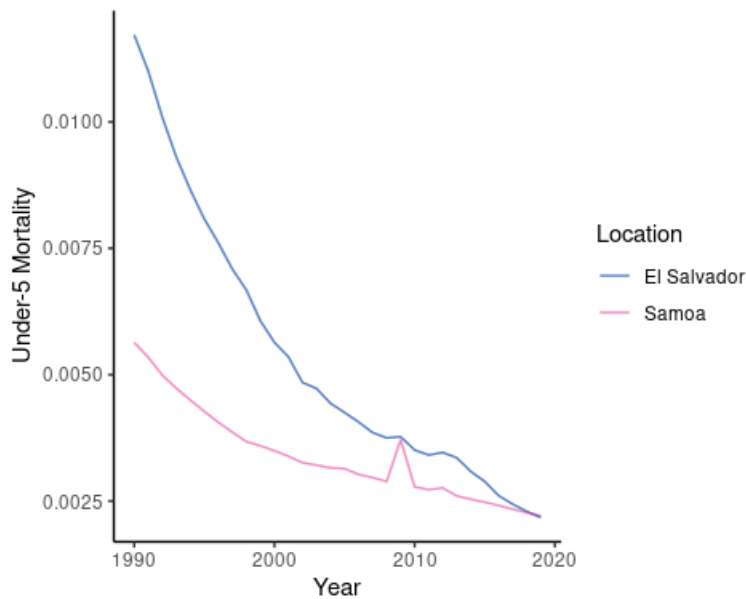


Figure 19. Under-5 Mortality in Costa Rica



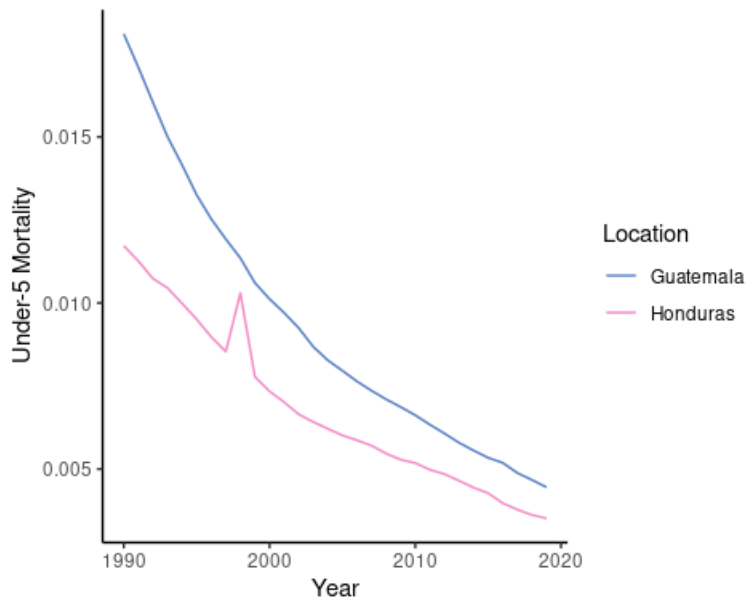
Costa Rica has consistently higher under-5 mortality than its comparison country Cuba and shows spikes in under-5 mortality some years, but it decreases overall across time.

Figure 20. Under-5 Mortality in El Salvador



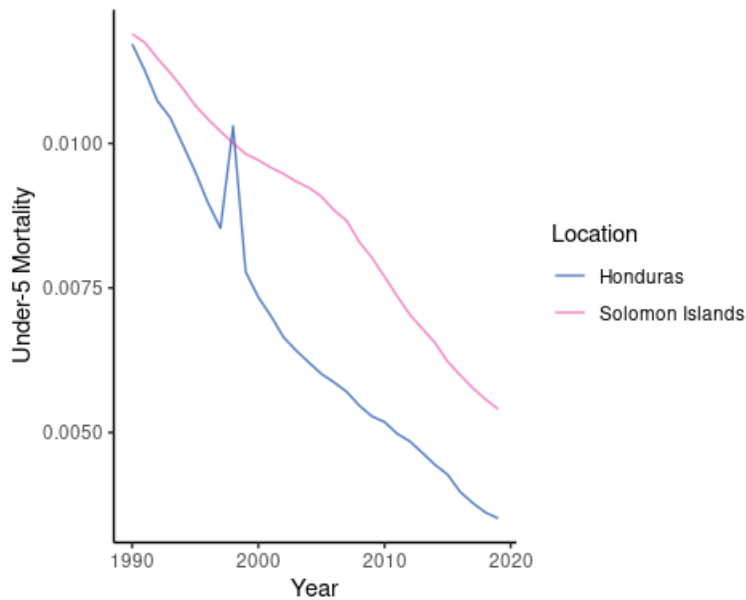
El Salvador has higher under 5 mortality than comparison country Samoa. However, the decline in under 5 mortality is much steeper over time in El Salvador than in Samoa. In fact, by 2019, El Salvador appears to have similar under 5 mortality to Samoa, meeting the expected performance. Under-5 mortality fell at a faster rate in the 2010s than in the 2000s, but it is unknown if SMI influenced this change in rate.

Figure 21. Under-5 Mortality in Guatemala



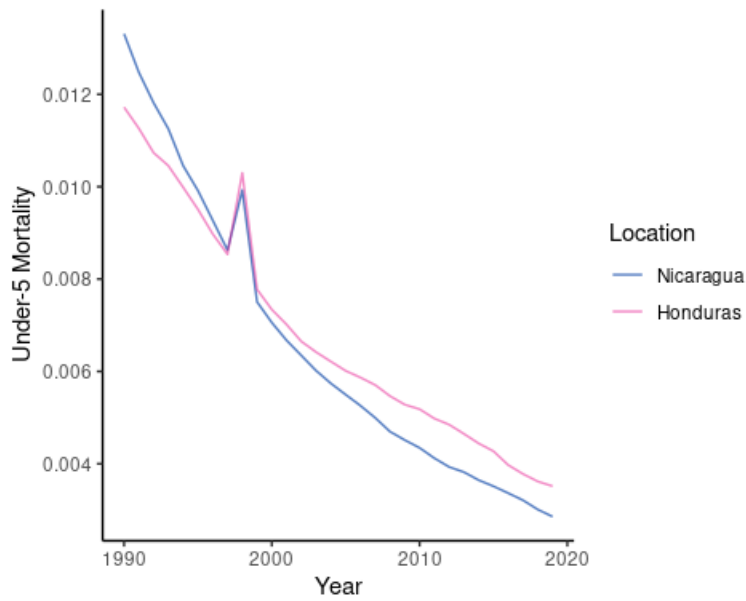
Guatemala has consistently higher under-5 mortality than exemplar country Honduras. Under-5 mortality in Guatemala consistently decreases over time, but the observed performance does not match expected performance.

Figure 22. Under-5 Mortality in Honduras



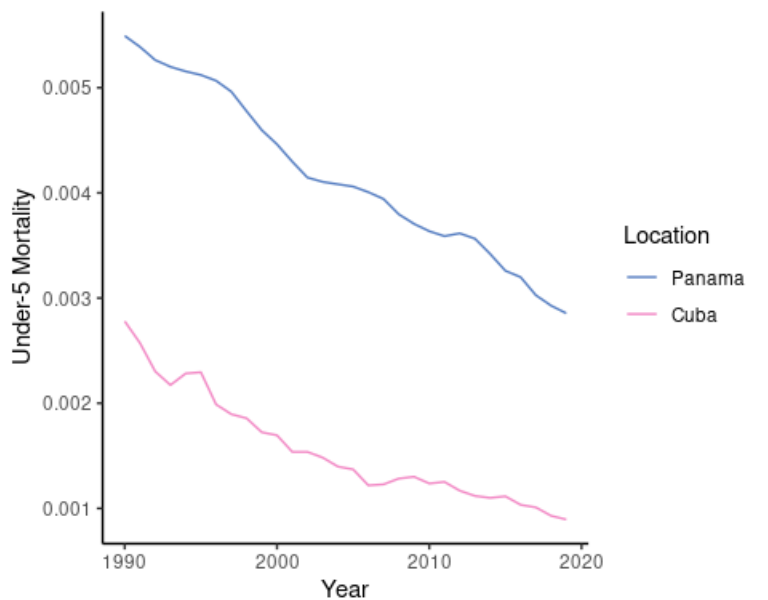
No country had lower SDI and lower under-5 mortality than Honduras in 2019. Honduras shows a lower under-5 mortality than comparison country Solomon Islands. Aside from a large spike in the late 1990s, under-5 mortality in Honduras also decreases consistently over time, exceeding expected performance.

Figure 23. Under-5 Mortality in Nicaragua



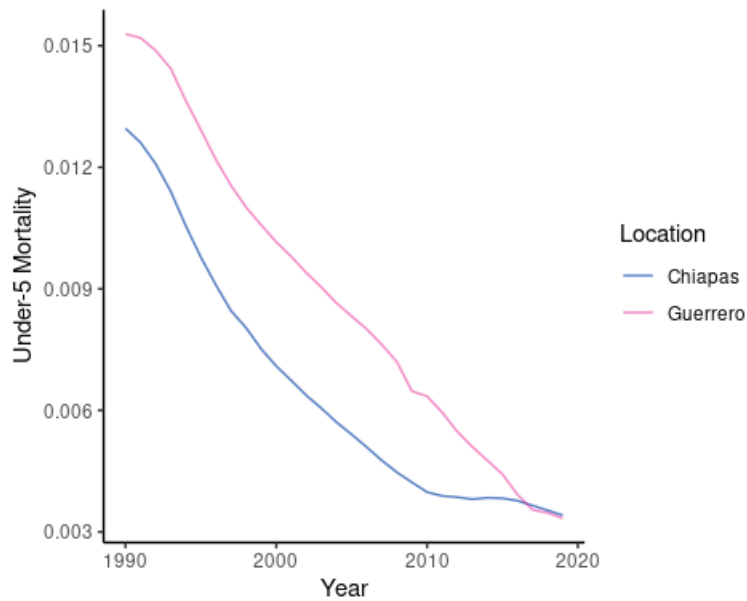
No country had lower SDI and lower neonatal mortality than Nicaragua in 2019. Honduras was identified as the closest match. Neonatal mortality in Nicaragua shows a very similar trend compared to Honduras. However, the observed performance of Nicaragua shows a steeper decline than the expected performance (Honduras) from the late 1990s onward.

Figure 24. Under-5 Mortality in Panama



Panama shows consistently higher under-5 mortality than comparison country Cuba. Though it does not meet expected performance, Panama's observed under-5 mortality does decrease steadily over time.

Figure 25. Under-5 Mortality in Chiapas



Chiapas had lower under-5 mortality compared to Guerrero up until the latter part of the 2010s. We see that under-5 mortality in Chiapas did decrease consistently and at a similar rate to Guerrero through 2010, but beginning around 2010, under-5 mortality leveled off and even increased some years in Chiapas.

## Recommendations for future analysis

Due to the small numbers of deaths, using administrative data for the numbers of livebirths, deaths in the relevant ranges, and population for SMI intervention and comparison regions in each country for the past years, ideally from 1990 to 2022, would provide for better analyses of the impact of SMI on maternal, neonatal, and under-5 mortality. These data were not available for the current analysis. The best method of analyses would be to project trends for the period 2014-2022 based on drivers of mortality and observed values in 1990-2013 (before SMI interventions began), then compare the observed values for 2014-2022 to the projected numbers. This would enable us to examine whether SMI had an impact on maternal, neonatal, and under-5 mortality.

## Conclusions

Mortality in the Mesoamerican region is already fairly low in comparison with peer countries worldwide, and has been on a downward trend since 1990 with few exceptions (maternal mortality in Belize and Panama has increased over time, and it has been on a variable trend in Costa Rica, Guatemala, and El Salvador in recent decades). Most of the countries whose observed performance exceeded the expected level had lower mortality continuously since before the genesis of SMI, for example, neonatal mortality in Guatemala, and all three mortality measures in Honduras and Nicaragua. El Salvador is the one country which surpassed expected performance more recently than 2010, for neonatal and under-5 mortality measures.

With estimates available only at the national level (and the state level in Mexico), it is impossible to distinguish a unique contribution of SMI, which would be expected in a downward direction, from an existing pattern of consistent decrease since 1990. It is hard to provide evidence that SMI accelerated the rate of decrease, or moderated the rate of increase, of the mortality measures examined. Many of the countries participating in SMI experienced unrest or political turmoil during the implementation period that resulted in setbacks. The economies of these countries also suffered setbacks that need to be taken into account in the evaluation. For these reasons, we provide this analysis for the years before COVID-19 spread, in order to view the trends in these major indicators prior to the effects of the pandemic. It is worth noting that the most improvement was observed in Nicaragua, where we have evidence of the implementation of lessons learned from SMI across the whole country. Attaining additional reduction in relatively low mortality rates was a stiff challenge faced by SMI implementers, whose strategy was to improve coverage and quality of care. We expect that any changes brought about by these coverage and quality interventions may take many months or years to manifest in lower mortality rates; thus, the rate of change in the mortality rate may not have been measurably different from the preexisting trend by 2019, the most recent year for which estimates are available. Opportunities exist in the region to continue to reduce the risk of death during pregnancy, postpartum, infancy, and childhood through access to quality healthcare.

## References

1. Wang H, Abbas KM, Abbasifard M. Global age-sex-specific fertility, mortality, healthy life expectancy (HALE), and population estimates in 204 countries and territories, 1950–2019: a comprehensive demographic analysis for the Global Burden of Disease Study 2019. *The Lancet*. 2020 October 17 [Appendix 1]

This report on the Final Evaluation of the Salud Mesoamérica Initiative (SMI) was produced in agreement with the Inter-American Development Bank (IDB). All analyses and writing were conducted by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington.

### **About IHME**

The Institute for Health Metrics and Evaluation (IHME) is an independent population health research center at UW Medicine, part of the University of Washington, that provides rigorous and comparable measurement of the world's most important health problems and evaluates the strategies used to address them. IHME makes this information freely available so that policymakers have the evidence they need to make informed decisions about how to allocate resources to best improve population health.

IHME aspires to make available to the world high-quality information on population health, its determinants, and the performance of health systems. We seek to achieve this directly, by catalyzing the work of others, and by training researchers as well as policymakers.

Our mission is to improve the health of the world's populations by providing the best information on population health.

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