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# DATA THAT SAVES LIVES? STATISTICAL CAPACITY AS A PILLAR OF HEALTH GOVERNANCE: EVIDENCE FROM 99 COUNTRIES

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**Abstract**

*This study investigates whether stronger national statistical systems are associated with changes in recorded health outcomes, focusing primarily on maternal mortality and secondarily on child mortality across 99 countries from 2013 to 2023. Motivated by the heightened awareness of data gaps during the COVID-19 pandemic, the analysis evaluates whether statistical infrastructure—measured through the World Bank's Statistical Performance Indicator (SPI_ALL)—is associated with changes in recorded preventable mortality, consistent with differences in reporting completeness and governance capacity. Using dynamic panel estimators, specifically the two-step System GMM estimator within the Arellano–Bond / Blundell–Bond framework, we control for macroeconomic, institutional, and demographic factors. Results show that higher statistical capacity is significantly associated with higher recorded maternal mortality across both low- and high-income countries. In contrast, its effect on child mortality is statistically significant only in high-income settings. This asymmetry highlights the role of institutional capacity in mediating the effectiveness of data systems, particularly governments' ability to translate information into actionable governance responses. The findings suggest that statistical capacity functions not merely as a monitoring tool but as a foundational component of public health governance. By linking national data systems to improvements in the measurement, coverage, and usability of mortality statistics, this study supports WHO's strategy for interoperable health information systems and reinforces global priorities under the 2030 Sustainable Development Goals (SDGs).*

**Keywords**:Statistical capacity; Health governance; Maternal mortality; Institutional quality; Panel data; Public health policy
**JEL Classification**: I18; C23; H51; O17; O57

## 1. Introduction

The role of reliable data in shaping public health policy has gained renewed global prominence, particularly in the aftermath of the COVID-19 pandemic and within the broader framework of the Sustainable Development Goals (SDGs). Robust statistical systems are not only vital for monitoring progress but also serve as critical infrastructure for designing and implementing, targeting, and evaluating public health interventions, particularly by improving the completeness and reliability of mortality

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statistics. However, despite growing attention to data-driven governance, few empirical studies have directly examined how national statistical capacity translates into observable changes in recorded health outcomes—especially beyond aggregate governance indicators.

This study addresses this gap by analyzing whether stronger national statistical systems—measured through the World Bank's Statistical Performance Indicator (SPI_ALL)—areassociated with changes in recorded maternal and child mortality across 99 countries from 2013 to 2023. Using dynamic panel estimators (Arellano–Bond GMM), the analysis investigates both the average and context-dependent effects of statistical capacity on mortality rates.

The study offers three main contributions. First, it introduces SPI_ALL as a multidimensional institutional variable in cross-national health regressions, moving beyond narrower proxies such as survey frequency or donor reporting requirements. Second, it reveals heterogeneous effects across income levels: while SPI_ALL is significantly associated with higher recorded maternal mortality in both low- and high-income countries, its impact on child mortality is significant only in high-income settings. Third, it demonstrates that statistical capacity operates as a distinct policy lever—independent of traditional inputs like health expenditure—highlighting the strategic role of data infrastructure in strengthening public health governance and monitoring. These findings suggest that investments in national data systems, particularly when embedded within capable institutional frameworks, can be a critical driver of monitoring, accountability, and governance capacity under the health-related SDGs.

## 2. Literature Review

While statistical capacity has been studied across sectors like education, poverty, and development, this study focuses on health outcomes due to their developmental significance and the availability of quality cross-national data. The literature is reviewed selectively, emphasizing insights relevant to maternal and child mortality.

### *2.1. Conceptual Framework: How Data Quality Shapes Development Outcomes*

National statistical systems are central to evidence-based development policy. High-quality, timely, and disaggregated data help governments allocate resources efficiently, identify priorities, and monitor interventions—especially in complex sectors like health. Conversely, weak data systems lead to poor decisions, distorted metrics, and inefficient spending.

Statistical capacity is both a technical resource and an institutional asset. As Andrews, Pritchett, and Woolcock (2017) note, effective policy relies on feedback enabled by reliable data—especially in health systems where adaptability is key. Poor data, as Jerven (2013) emphasizes, undermines planning and credibility, often excluding vulnerable groups from services.

The World Bank's Statistical Performance Index (SPI_ALL) captures this capacity across five domains—data use, services, products, sources, and infrastructure—providing a standardized tool for cross-country comparisons (World Bank, 2021).

Empirical studies confirm this link. Kiregyera (2020), Carr-Hill (2013), and Glassman and Temin (2016) find that strong data systems improve targeting, reduce inequities, and support monitoring in maternal health and early care. Yet, as Crespo Cuaresma and Raggl (2021) and Sandefur and Glassman (2015) show, these effects are conditional on governance quality; even sophisticated systems may falter in weak institutional contexts.

This study builds on that literature by examining how SPI_ALL scores relate to maternal and child mortality across 99 countries, exploring not just whether data systems matter, but when and where they produce observable changes in health outcomes.

### *2.2. Statistical Capacity and Governance Interaction*

While statistical capacity is critical to policymaking, its impact depends on the broader institutional context. Data systems are only effective when supported by capable, transparent, and responsive governance. In low-corruption settings with strong bureaucracies, data is more likely to inform planning and service delivery. This study aligns with growing evidence that statistical capacity's developmental impact is conditional on institutional readiness.

Although formal interaction terms are not included, this hypothesis is tested indirectly by stratifying the analysis by income—proxying for governance quality. Rajkumar and Swaroop (2008) show that public spending yields greater returns in well-governed countries, a finding echoed by Boundioa and Thiombiano (2025), who identify governance thresholds below which spending and data fail to reduce mortality.

Sommer (2023) emphasizes the role of fiscal accountability in translating health spending into lower child mortality, while Hausman et al. (2023) find that governance enhances the effectiveness of maternal health interventions, even when spending levels are similar. The WHO (2023) similarly stresses that civil registration and vital statistics systems require strong governance to support health monitoring under the SDGs.

Crespo Cuaresma and Raggl (2021) confirm that data systems have greater marginal returns in strong institutional environments. In poorly governed contexts, improvements in data may yield little impact; in well-governed ones, they enhance accountability and service delivery.

Overall, these studies highlight the complementarity between statistical capacity and governance. Without institutional support, data alone cannot drive development. Effective data use requires not just technical upgrades but systemic reform—an essential lesson for policymakers and donors alike.

### *2.3. Sectoral Context: Why Health Matters Most*

Among development indicators, child health stands out as both empirically appropriate and normatively urgent. Modeling child mortality provides a clear lens through which to assess state capacity, as it reflects the ability to deliver essential services and protect vulnerable populations. As shown in Health at a Glance 2023 (OECD, 2023), lower under-five mortality is strongly associated with maternal care, immunization, early interventions, urbanization, and health spending - factors this study includes as covariates.

Yet inputs alone are not sufficient; governance quality determines whether resources translate into effective service delivery and monitoring. Studies in International Health (2015–2018) show that effective regulation and low corruption correlate with lower child mortality, reinforcing the inclusion of CORRUPTION and GOV_EFFECT in the model. Adegoke et al. (2022) further confirm that good governance, public investment, and macroeconomic stability predict better maternal and infant outcomes—each tied to effective data systems.

The COVID-19 pandemic underscored the importance of reliable health data. AbouZahr et al. (2021) argue for sustained investment in SPI-like infrastructures to strengthen health system resilience and real-time response.

Broad health literature supports this approach. Black et al. (2013) identify key drivers of child mortality—undernutrition, unsafe water, and limited care—while Marmot and Bell (2012) stress the role of inequality and governance. Schiavo (2008) highlights how effective data systems enhance both service delivery and public trust.

Together, these insights affirm child mortality as a sensitive, multidimensional indicator that captures how well statistical systems are embedded in broader institutional and economic frameworks.

### *2.4. Empirical Justification for Controls*

To robustly estimate the effects of statistical capacity on child mortality, this study includes empirically validated control variables that capture key socioeconomic, institutional, and infrastructural factors.

WATER_ACC reflects access to clean water, a direct determinant of child survival. Studies by Boone and Zhan (2006) and Fewtrell et al. (2005) confirm the role of WASH interventions in reducing under-five mortality.

CPI_2010 proxies inflation, which affects household purchasing power and access to health services (Deaton, 2003; Lokshin and Yemtsov, 2005).

CORRUPTION and GOV_EFFECT measure governance quality. These indicators influence how effectively health resources are allocated (Kaufmann et al., 2009; Gupta et al., 2002).

GDP_PC captures income-driven improvements in health through better nutrition and services (Preston, 1975; Filmer and Pritchett, 1999).

HEALTH_EXP reflects government commitment to health. Spending is linked to mortality reductions, especially when well-targeted (Bokhari et al., 2007; Anyanwu and Erhijakpor, 2009).

EXP_VAL and IMP_VAL represent trade openness, which can enhance access to medical technologies and fiscal capacity (Dollar, 2001; Owen and Wu, 2007).

URBAN_POP accounts for spatial access to care. While urbanization generally lowers mortality, it may also stress health infrastructure if unmanaged (Montgomery et al., 2003).

## 3. Data and Variables

This study employs a balanced panel dataset comprising 99 countries observed annually over an eleven-year period from 2013 to 2023, resulting in a total of 1,089 country-year observations. The dataset includes countries from all major world regions and across various stages of development. For analytical clarity, the sample is stratified into two income-based groups—low-income (51 countries) and high-income (48 countries)—based on average GDP per capita calculated over the sample period (see Appendix Table A2 for classification details).

The primary dependent variable is the maternal mortality ratio (MAT_MORT), defined as the number of maternal deaths per 100,000 live births. This indicator is widely regarded as a core measure of public health system performance, reflecting both the accessibility and quality of maternal healthcare services. In addition, a secondary outcome—the under-five mortality rate (CHILD_MORT), measured as the number of deaths of children under five years of age per 1,000 live births—is examined to test the robustness of findings and to explore possible institutional asymmetries between maternal and child health systems.

The key explanatory variable is the Statistical Performance Index (SPI_ALL), a composite indicator developed by the World Bank that ranges from 0 to 100 and measures the overall capacity and performance of national statistical systems. The index aggregates performance across five core dimensions: data use, data services, data products, data sources, and statistical infrastructure. Each dimension reflects a distinct aspect of statistical system functionality, from data collection and processing to dissemination and application in policymaking. Higher SPI_ALL scores indicate more robust, timely, and policy-relevant statistical systems. According to World Bank (2021), SPI_ALL "reflects performance across methodology, data sources, timeliness, and frequency, capturing the operational quality of national statistical systems" and provides a structured basis for cross-country comparisons.

To isolate the effect of statistical capacity on health outcomes, the model includes a comprehensive set of control variables drawn from the literature on public health and development. These variables capture a range of macroeconomic, institutional, and infrastructural factors that are theoretically associated with mortality outcomes. Access to basic drinking water services (WATER_ACC) is included as a proxy for infrastructure quality and public service provision. Macroeconomic stability is captured through the Consumer Price Index (CPI_2010, base year 2010 = 100). Institutional quality is represented by two indicators from the World Bank's Worldwide Governance Indicators: the Control of Corruption index (CORRUPTION), where higher values indicate stronger control, and the Government Effectiveness index (GOV_EFFECT), which reflects perceptions of the quality of public services and policy formulation.

Trade openness is represented through two measures: the export value index (EXP_VAL, base year 2000 = 100) and the import value index (IMP_VAL, base year 2015 = 100), both of which reflect the degree of a country's integration into the global economy. GDP per capita (GDP_PC), measured in constant 2015 U.S. dollars, is included as a standard control for the level of economic development. Health system financing is captured by current health expenditure as a percentage of GDP (HEALTH_EXP). Finally, urban population as a share of the total population (URBAN_POP) is included to control for differences in access to urban health infrastructure and services.

In addition, the analysis explicitly controls for women's education through female adult literacy (MAT_LIT), defined as the percentage of women aged 15 and above who can read and write. Female literacy is a central structural determinant of maternal and child health outcomes, operating through multiple channels, including improved health knowledge, greater autonomy in reproductive and health-related decision-making, higher utilization of prenatal and delivery care, and more effective interaction with health institutions. The inclusion of MAT_LIT is particularly important in the present context, as statistical capacity (SPI_ALL) is itself correlated with broader dimensions of socioeconomic development and human capital accumulation. Controlling for women's education therefore reduces the risk that SPI_ALL captures underlying educational gradients rather than the functioning of statistical systems per se, allowing a clearer separation between measurement and governance effects and structural human-capital effects on mortality outcomes.

Descriptive statistics for all variables are presented in Appendix Table A1, showing considerable variation across countries and years, and underscoring the global diversity represented in the panel. All variables are sourced from internationally recognized databases. Data on mortality outcomes, macroeconomic indicators, infrastructure, trade, and population are drawn from the World Bank's World Development Indicators (WDI). SPI_ALL is obtained from the World Bank's Statistical Capacity Indicators (SCI), and the institutional quality measures are taken from the World Bank's Worldwide Governance Indicators (WGI) database.

## 4. Methodology

To investigate the relationship between national statistical capacity and health outcomes, this study employs dynamic panel data techniques tailored for macroeconomic datasets with a relatively short time dimension. Specifically, we employ the two-step System Generalized Method of Moments (System GMM) estimator, which combines the difference-GMM approach of Arellano and Bond (1991) with the system extension proposed by Blundell and Bond (1998). This estimator is well-suited for addressing endogeneity, autocorrelation, and unobserved heterogeneity in dynamic panels.

The analysis is based on a balanced panel of 99 countries observed annually over the 2013–2023 period, with health outcomes captured through two key dependent variables: under-five mortality (deaths per 1,000 live births) and maternal mortality (deaths per 100,000 live births). These indicators serve as proxies for the overall effectiveness of national health systems and broader population wellbeing.

The primary explanatory variable of interest is the Statistical Performance Indicator (SPI_ALL), a composite index developed by the World Bank to assess the quality of national statistical systems. Ranging from 0 to 100, SPI_ALL reflects country performance acrossfive dimensions: methodological soundness, source data adequacy, and the periodicity and timeliness of data production. The core hypothesis guiding this study is that higher levels of statistical performance are associated with systematic changes in recorded mortality, reflecting differences in reporting completeness, measurement quality, and governance capacity.

Given the strong likelihood of persistence in mortality rates and the potential for reverse causality between health outcomesand institutional performance, we estimate a dynamic panel model of the following general form:

$$Y_{i,t} = \alpha_i + \lambda_t + \delta Y_{i,t-1} + \beta \cdot D.SPI\_ALL_{it} + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

where $Y_{i,t}$ denotes the mortality outcome for country i in year t, specifically either maternal mortality (deaths per 100,000 live births) or under-five child mortality (deaths per 1,000 live births). $Y_{i,t-1}$ is the one-period lag of the dependent variable, capturing persistence in health outcomes. The country fixed effects $\alpha_i$ ontrol for time-invariant heterogeneity across countries, while, $\lambda_t$ accounts for year-specific shocks common to all countries.

The key explanatory variable is $SPI\_ALL_{it}$, the World Bank's Statistical Performance Indicator, which measures the quality and capacity of national statistical systems. The vector $X_{it}$ includes a set of time-varying control variables, specifically: access to basic drinking water services (WATER_ACC), consumer price index (CPI_2010), corruption control (CORRUPTION), export value index (EXP_VAL), GDP per capita (GDP_PC), government effectiveness (GOV_EFFECT), health expenditure as a share of GDP (HEALTH_EXP), import value index (IMP_VAL),the urban population share (URBAN_POP), and female adult literacy (MAT_LIT) as a proxy for women's education. The error term $\varepsilon_{it}$ captures idiosyncratic shocks.

Mortality outcomes are modelled in levels and year dummies are included, so the SPI_ALL coefficient is interpreted as a within-country association after netting out common global shocks. Therefore, a positive coefficient should not be described as an "accelerated decline". A plausible explanation is a detection/reporting effect: improvements in statistical capacity (including CRVS and surveillance) can increase the completeness and timeliness of death reporting, mechanically raising recorded maternal or child mortality even if true mortality is falling. Accordingly, the results are discussed as reflecting improved measurement and governance capacity rather than direct causal reductions in mortality, and we treat remaining bias from unobserved structural factors (e.g., demographic change) as a limitation.

All control variables identified as non-stationary using the Harris–Tzavalis test are entered in first differences to address unit root concerns and reduce omitted variable bias. Stationary variables are retained in levels to preserve information efficiency.

The empirical strategy employs the two-step System Generalized Method of Moments (System GMM) estimator, appropriate for dynamic panels with short time dimensions. Robust standard errors are corrected for finite-sample bias following Windmeijer (2005). The model addresses endogeneity, unobserved heterogeneity, and serial correlation by using internal instruments derived from lagged variables, consistent with Arellano and Bover (1995) and Blundell and Bond (1998). Specifically, lagged dependent variables are instrumented using deeper lags in levels for the differenced equation and in differences for the levels equation, assuming weak exogeneity.

To examine contextual heterogeneity, the sample is stratified into “LOW” and “HIGH” income groups based on average GDP per capita over the study period, comprising 51 and 48 countries respectively (Appendix Table A2). The same System GMM specification is applied within each group using a GDP_PC_SPLIT indicator, allowing comparative insight into how institutional and economic context moderates the effects of statistical capacity.

Diagnostics support the model’s reliability. The correlation matrix (Appendix Table A3) shows low multicollinearity, and VIF scores (Appendix Tables A4–A5) remain below the threshold of 5. Unit root tests (Appendix Table A6) confirm that variables such as SPI_ALL, WATER_ACC, CPI_2010, GDP_PC, and URBAN_POP are non-stationary and are therefore differenced. Stationary variables—including CORRUPTION, GOV_EFFECT, HEALTH_EXP, EXP_VAL, and IMP_VAL—are kept in levels.

Empirical results indicate that SPI_ALL is consistently significant and positively associated with recorded maternal mortality across both income groups, a pattern consistent with improved reporting and measurement capacity. For child mortality, SPI_ALL is significant only in high-income contexts, underscoring the conditional effectiveness of data systems.

Instrument validity is confirmed by Hansen J-tests, with the null hypothesis not rejected in any specification (Table A8). Arellano–Bond tests detect no second-order autocorrelation in differenced residuals, supporting the model’s assumptions. To avoid overfitting, only lags of two periods or more are used, and all models include year dummies to account for time-specific shocks.

This estimation framework provides robust, unbiased inference on the role of statistical capacity in shaping health outcomes. By integrating dynamic panel methods, stratified estimation, and rigorous diagnostics, the model addresses key methodological challenges and reinforces the central hypothesis that the effectiveness of data systems is institutionally conditional.

## 5. Results

This section presents the empirical findings on the relationship between national statistical capacity and health outcomes, using two dynamic panel datasets: one focused on maternal mortality (MAT_MORT) and another on under-five child mortality (CHILD_MORT). Results are shown for the full sample as well as for income-stratified subsamples (LOW and HIGH, based on average GDP per capita). Across all models, dynamic Generalized Method of Moments (GMM) estimators are employed with lagged dependent variables, two-step robust standard errors, and internal instruments based on the System GMM framework (Arellano–Bond / Blundell–Bond). A summary of statistical significance across specifications is provided in Appendix Table A7.

*5.1. Maternal Mortality – Full Sample and Subgroups*

Table 1 reports the dynamic GMM estimates for maternal mortality. Across all samples, the lagged dependent variable is positive and highly significant, with coefficients ranging between 0.77 and 0.83. This confirms strong persistence in maternal mortality outcomes and justifies the use of a dynamic specification.

**Table no. 1: Dynamic GMM Results for Maternal Mortality (Full Sample and by Income Group)**

| MAT_MORT | ALL | LOW | HIGH |
|---|---|---|---|
| L.MAT_MORT | 0.83 *** (20.77) | 0.79 *** (14.5) | 0.77 *** (9.64) |
| D.SPI_ALL | 2.25 *** (4.52) | 3.52 *** (3.67) | 1.11 *** (4.39) |
| D.WATER_ACC | -8.89(-0.98) | -8.48(-0.86) | 5.06(1.87) |
| D.CPI_2010 | -0.0004(-1.46) | -0.0006 * (-1.83) | -0.03 * (-1.73) |
| CORRUPTION | 0.72(0.13) | -2.36(-0.29) | -0.09(-0.06) |
| EXP_VAL | 0.13 *** (3.59) | 0.14 *** (3.16) | 0.0104(0.23) |
| D.GDP_PC | 0.0001(0.18) | -0.01(-0.33) | -0.0002(-0.55) |
| GOV_EFFECT | -12.04 * (-1.41) | -34.17 * (-1.69) | -3.98* (-2.01) |
| HEALTH_EXP | 0.99(1.36) | 0.09(0.08) | 0.43 * (1.53) |
| IMP_VAL | -0.12(-1.83) | -0.09(-0.92) | -0.05(-0.96) |
| D.URBAN_POP | 4.78(0.5) | 12.31(0.6) | 0.44(0.11) |
| MAT_LIT | -0.86 ** (-2.15) | -0.82 **(-1.99) | -0.9 **(-1.77) |
| Constant | 78.04 ** (2.1) | 60.91 ** (1.67) | 92.41 ** (1.96) |

*Source: Authors' own creation*

SPI_ALL is also positive and highly significant in all specifications. In a levels specification with year dummies, this sign indicates that higher statistical capacity is associated with higher recorded maternal mortality within countries over time. We interpret this pattern primarily as consistent with a detection and reporting mechanism: as statistical systems improve—through better vital registration, cause-of-death certification, and surveillance—under-reporting declines and a larger share of maternal deaths is captured in official statistics. This interpretation is also consistent with the possibility of residual confounding from unobserved structural change that is correlated with both institutional development and mortality reporting.

Subsample estimates reveal clear heterogeneity. In the LOW-income group, the SPI_ALL effect is stronger (3.52, $t = 3.67$, $p < 0.01$), highlighting the greater relevance of statistical capacity improvements where institutional infrastructure and baseline reporting systems are weaker. Persistence remains high (L.MAT_MORT = 0.79, $t = 14.50$). In the HIGH-income group, SPI_ALL remains statistically significant (1.11, $t = 4.39$), but the smaller magnitude suggests diminishing reporting gains in already data-rich settings. Autoregressive effects are also slightly weaker (0.77, $t = 9.64$), consistent with lower baseline mortality levels.

Among control variables, the export value index (EXP_VAL) is positive and statistically significant in the ALL (0.13, $t = 3.59$) and LOW (0.14, $t = 3.16$) samples, while remaining insignificant in HIGH-income countries (0.0104, $t = 0.23$). This pattern suggests that trade expansion may co-move with broader fiscal and health-system activity or health-system activity in lower-income contexts, but yields limited marginal effects in advanced economies.

Inflation (D.CPI_2010) exhibits a modest negative association with maternal mortality in the LOW-income group (–0.0006, $t = –1.83$) and in the HIGH-income group (–0.03, $t = –1.73$), with both effects marginally significant. These results suggest that macroeconomic instability may indirectly affect maternal health outcomes, although estimates remain imprecise.

Government effectiveness (GOV_EFFECT) is negatively associated with maternal mortality in the ALL (–12.04, t = –1.41) and LOW (–34.17, t = –1.69) samples, with borderline statistical significance, in line with theoretical expectations that better governance improves health service delivery. In HIGH-income countries, the coefficient (–3.98, t = –2.01) is negative and reaches conventional significance, though its magnitude is comparatively small, likely reflecting limited within-group variation.

Health expenditure (HEALTH_EXP) is positively associated with maternal mortality only in the HIGH-income group (0.43, t = 1.53), where it is weakly significant. This counterintuitive sign is plausibly driven by improved reporting practices, compositional effects, or diminishing returns to additional spending in already well-funded systems. In the ALL (0.99, t = 1.36) and LOW (0.09, t = 0.08) samples, the coefficients are statistically insignificant.

Female adult literacy (MAT_LIT) displays a negative and statistically significant association with maternal mortality across all samples (–0.86, –0.82, and –0.90, respectively), confirming its role as a key structural determinant of maternal health and strengthening the identification of SPI_ALL effects by accounting for women's educational attainment.

Other variables—including D.WATER_ACC, CORRUPTION, D.GDP_PC, IMP_VAL, and D.URBAN_POP—are statistically insignificant across all models. While some coefficients exhibit theoretically expected signs, their effects may be obscured by short-run fluctuations, measurement limitations, or the strong persistence captured by the lagged dependent variable.

The constant term is positive and statistically significant in all specifications, reflecting baseline differences in maternal mortality levels after controlling for dynamics and covariates. Variance Inflation Factor diagnostics (Appendix Table A4) confirm low multicollinearity, supporting the stability and reliability of the estimated coefficients. Overall, the results highlight the central role of statistical capacity—particularly in lower-income settings—in shaping the measurement and governance of maternal mortality, rather than indicating a direct causal reduction in deaths.

### *5.2. Child Mortality – Full Sample and Subgroups*

**Table no.2: Dynamic GMM Results for Child Mortality (Full Sample and by Income Group)**

| CHILD_MORT | ALL | LOW | HIGH |
|---|---|---|---|
| L.CHILD_MORT | 0.52 *** (4.42) | 0.45 ** (2.41) | 1.01 *** (52.85) |
| D.SPI_ALL | 0.25(1.16) | 0.49(1.14) | -0.01 ** (-2.34) |
| D.WATER_ACC | -2.75(1.38) | -3.03(-1) | -0.37(-1.7) |
| D.CPI_2010 | 0(-1.14) | -0.0002(-1.51) | -0.00004(-0.13) |
| CORRUPTION | 1.29(1.37) | 2.76(0.68) | 0.15(1.91) |
| EXP_VAL | 0.03 * (1.86) | 0.03 * (1.81) | 0.0001(0.03) |
| D.GDP_PC | 0.0001(0.82) | 0(-0.44) | 0(-0.56) |
| GOV_EFFECT | -7.64(-1.53) | -17.96(-1.65) | 0.03(0.32) |
| HEALTH_EXP | 0.14(-0.75) | -0.27(-0.46) | 0(0.32) |
| IMP_VAL | -0.0153(0.11) | 0.02(0.28) | 0.002(0.7) |
| D.URBAN_POP | -0.33(-0.14) | -2.74(-0.41) | 0.26(1.9) |
| MAT_LIT | -0.45 * (1.74) | -0.46 *** (-2.69) | -0.01 (-0.37) |
| Constant | 47.43 * (2.74) | 44.56*** (3.58) | 0.04 (0.03) |

*Source: Authors' own creation*

In the child mortality models, the lagged dependent variable (L.CHILD_MORT) is positive and statistically significant across all subsamples, confirming strong persistence in under-five mortality outcomes. The effect is particularly pronounced in the HIGH-income group (1.01, t = 52.85), indicating near-unit-root behavior and very slow convergence. In the ALL (0.52, t = 4.42) and LOW (0.45, t = 2.41) samples, persistence is lower but remains statistically significant, reflecting path dependence across different development contexts.The coefficient slightly above unity in the high-income sample suggests near-unit-root behavior, implying extremely slow adjustment dynamics rather than explosive processes, a pattern consistent with low-variance mortality series. Although the Harris–Tzavalis test indicates stationarity of CHILD_MORT in the full panel, the coefficient close to unity in the high-income subsample reflects strong persistence within that group rather than a unit-root process.

SPI_ALL is statistically insignificant in the ALL (0.25, t = 1.16) and LOW (0.49, t = 1.14) samples, suggesting that improvements in statistical capacity do not yield measurable changes in recorded child mortality in lower-income contexts. This may reflect institutional lags, weak implementation capacity, or the fact that child mortality outcomes depend on broader multisectoral interventions that are less immediately responsive to improvements in statistical systems. These null findings contrast with the maternal mortality results, where SPI_ALL is strongly significant.

In HIGH-income countries, SPI_ALL is negative and statistically significant (–0.01, t = –2.34), indicating that incremental improvements in statistical capacity are associated with lower recorded child mortality. Unlike maternal mortality, where improved reporting may increase measured deaths, this result suggests that in data-rich institutional environments statistical systems may enhance monitoring, targeting, and evaluation of pediatric health interventions rather than merely improving detection.

The export value index (EXP_VAL) is weakly significant in the ALL (0.03, t = 1.86) and LOW (0.03, t = 1.81) samples, while remaining insignificant in the HIGH-income group (0.0001, t = 0.03). This pattern suggests that trade openness may support child health indirectly in lower-income settings, potentially through improved access to resources or fiscal space, but yields no marginal gains in advanced economies.

Government effectiveness (GOV_EFFECT) exhibits negative coefficients in the ALL (–7.64, t = –1.53) and LOW (–17.96, t = –1.65) samples, though both fall short of conventional significance thresholds. In the HIGH-income group, the coefficient is small and statistically insignificant (0.03, t = 0.32), likely reflecting limited within-group variation.

Health expenditure (HEALTH_EXP) is statistically insignificant across all samples, including the HIGH-income group (0.00, t = 0.32), suggesting that variations in spending alone are insufficient to explain differences in child mortality once persistence and institutional factors are accounted for.

Female adult literacy displays a consistently negative association with child mortality and is statistically significant in the ALL and LOW-income samples, while remaining insignificant in high-income countries.

Other control variables—including D.WATER_ACC, D.CPI_2010, CORRUPTION, D.GDP_PC, IMP_VAL, and D.URBAN_POP—are statistically insignificant across all specifications. While some coefficients display theoretically plausible signs, their effects may be obscured by short-run fluctuations, measurement limitations, or the strong persistence captured by the lagged dependent variable.

The constant term is positive and statistically significant in the ALL (47.43, t = 2.74) and HIGH-income (0.04, t = 0.03) samples, while remaining statistically insignificant in the LOW-income group (44.56, t = 3.58), reflecting baseline heterogeneity across country groups. Variance Inflation Factor diagnostics (Appendix Table A5) confirm low multicollinearity, supporting the stability of the estimated coefficients.

### *5.3. Robustness Check*

To assess the stability of the empirical findings, a series of robustness checks were conducted by re-estimating the dynamic GMM model using a parsimonious specification that excludes all control variables. This approach isolates the direct association between statistical capacity (SPI_ALL) and health outcomes, reducing risks of multicollinearity or overfitting that may arise from an extensive set of covariates. Consistent with best practices in dynamic panel estimation (Roodman, 2009; Blundell & Bond, 1998), the simplified model retains only the lagged dependent variable and the differenced SPI_ALL indicator, ensuring that persistence and endogeneity are still appropriately addressed.

**Table no. 3: Dynamic GMM Results for Maternal Mortality (Full Sample and by Income Group) – robustness check**

| MAT_MORT | ALL | LOW | HIGH |
|---|---|---|---|
| L.MAT_MORT | 0.925 *** (74.2) | 0.889 *** (46.7) | 0.821 *** (11.4) |
| D.SPI_ALL | 1.963 *** (5.17) | 2.892 *** (4.07) | 1.231 *** (3.94) |
| Constant | 0.934 (0.56) | 12.363 ** (2.21) | 2.240 (1.12) |

*Source: Authors' own creation*

When the dynamic GMM model is re-estimated, as seen in Table 3, using a parsimonious specification that excludes all control variables, the results for maternal mortality remain strikingly consistent with those reported in the baseline models. Across the full sample as well as the income-stratified subsamples, the lagged dependent variable continues to display a large, positive, and highly significant coefficient, reaffirming the strong autoregressive structure that characterizes maternal mortality dynamics. More importantly, the coefficient on SPI_ALL retains both its sign and statistical significance in every specification. In the full sample, the SPI_ALL coefficient is 1.963 and highly significant; in the LOW-income group it rises to 2.892, while in the HIGH-income group it remains positive and significant at 1.231. These findings demonstrate that the association between statistical capacity and maternal mortality does not depend on the inclusion of additional covariates. Rather, it reflects a stable structural relationship, consistent with the argument advanced in the main analysis that improvements in national statistical systems are consistent with improved capacity for targeting resources, monitor service delivery, and strengthen accountability mechanisms—effects that are especially pronounced in low-income contexts where institutional capacity is more constrained.

**Table no.4: Dynamic GMM Results for Child Mortality (Full Sample and by Income Group) – robustness check**

| CHILD_MORT | ALL | LOW | HIGH |
|---|---|---|---|
| L.CHILD_MORT | 0.854 *** (11.1) | 0.725 *** (6.81) | 0.974 *** (72.3) |
| D.SPI_ALL | 0.135 (0.75) | 0.490 (1.08) | −0.012 ** (−1.98) |
| Constant | 3.523 (1.51) | 12.413 * (1.95) | 0.043 (0.36) |

*Source: Authors' own creation*

The robustness checks for child mortality, as seen in Table 4, similarly mirror the pattern observed in the primary results. When controls are removed, the SPI_ALL coefficient remains statistically insignificant in both the full sample and the LOW-income group, while it continues to be negative and significant in the HIGH-income sample (approximately –0.012 with a t-value near –2.0). This replication of results under a simplified specification reinforces the interpretation that statistical capacity improves child health outcomes only where institutional structures are sufficiently mature to convert data into effective multisectoral interventions. Child mortality is shaped by a complex array of determinants—ranging from immunization systems and nutrition programs to sanitation, early childhood services, and household conditions—that demand substantial administrative coordination. The emergence of a statistically significant effect of SPI_ALL exclusively in high-income settings, even after removing controls, underscores the importance of institutional readiness in mediating the influence of national data systems on pediatric health outcomes.

The persistence parameters remain positive and strongly significant across all robustness models, and in both outcomes they increase slightly relative to the full specification. This is expected in models without controls, as a larger share of the serial correlation is absorbed by the lagged dependent variable. The consistency of these autoregressive patterns confirms that the dynamic structure of mortality is intrinsic to the data and not a by-product of specification choices. Taken together, these results validate the use of a dynamic panel framework and align with the methodological reasoning outlined in the manuscript.

The simplified models also maintain the integrity of GMM diagnostics. Because the specification includes only the lagged dependent variable and SPI_ALL, the danger of instrument proliferation is substantially reduced, and the identifying assumptions of the Arellano–Bond estimator remain satisfied. This closely aligns with the estimation strategy described in the methodology section, which emphasizes the use of internal instruments, avoidance of overfitting, and application of Windmeijer-corrected standard errors. The absence of diagnostic warnings in the robustness models therefore strengthens confidence in the validity of the main empirical results.

Overall, the robustness analysis demonstrates that the study's central conclusions are not sensitive to model specification. For maternal mortality, the effect of statistical capacity remains strong, positive, and significant across all samples, with the largest impacts observed in low-income settings. For child mortality, the primary asymmetry between country groups is fully preserved: SPI_ALL has no measurable effect in the full and LOW-income samples but displays a significant negative association in high-income countries. The close alignment between the main and robustness results indicates that SPI_ALL is a stable and policy-relevant predictor whose influence is not driven by model complexity or the inclusion of auxiliary controls. Rather, the findings reflect underlying institutional mechanisms that link national data systems to health system performance.

*Summary of Key Findings*

The results consistently show that lagged mortality is highly significant across all models, confirming strong temporal persistence in both maternal and child health and validating the use of a dynamic panel framework.

SPI_ALL, a proxy for national statistical capacity, is significantly associated with changes in recorded maternal mortality in both income groups, with larger coefficients observed in low-income countries. This pattern is consistent with improvements in reporting completeness, measurement accuracy, and institutional capacity, rather than direct reductions in underlying mortality risks. For child mortality, SPI_ALL is statistically significant only in the high-income group, suggesting that national data systems influence recorded pediatric outcomes primarily where institutional capacity allows for effective monitoring, targeting, and implementation. In the full sample and the low-income group, no statistically significant association is detected, reflecting heterogeneity in the ability of countries to translate statistical capacity into observable changes in recorded child mortality.

Because mortality is modelled in levels and year dummies absorb common global trends, coefficients should be interpreted in the usual way. In particular, a positive coefficient on SPI_ALL implies higher measured mortality, which is plausibly driven by improved reporting completeness as statistical capacity strengthens (detection effect), rather than faster mortality reductions.
Trade openness (EXP_VAL) is positively associated with improved health outcomes in low-income settings, likely reflecting enhanced access to medical goods and fiscal resources. This effect vanishes in high-income countries, where health systems are less trade-dependent.

Health expenditure (HEALTH_EXP) is significantly associated with lower maternal mortality only in high-income countries, suggesting that spending yields stronger returns where governance and system capacity are high. No significant effects are observed for child mortality, pointing to divergent mechanisms across outcome types.

Other controls, such as inflation (CPI_2010) and government effectiveness (GOV_EFFECT), show theoretically consistent but imprecise associations, particularly in maternal models for low-income countries. Their weak significance may reflect long-run structural effects or measurement limitations.

Overall, the findings underscore that the impact of statistical capacity on health is conditional. Robust data systems can enhance targeting and responsiveness, but their effectiveness depends on governance quality, institutional maturity, and economic context.

Although several theoretically relevant control variables (e.g., GDP per capita, water access, corruption, and urbanization) appear statistically insignificant in some model specifications, this does not undermine their theoretical role. These variables remain important controls because they reduce omitted-variable bias and isolate the effects of the primary predictors.

The lack of statistical significance likely reflects multicollinearity among socioeconomic indicators, limited within-subsample variation—particularly in the high-income group—and the strong persistence captured by the lagged dependent variable. Thus, non-significance should be interpreted as a limitation of statistical power rather than evidence against the theoretical importance of these controls.

## 6. Discussion

This study examines the relationship between national statistical capacity and health outcomes, with particular emphasis on maternal and child mortality. Using dynamic panel estimations based on the Arellano–Bond Generalized Method of Moments (GMM), the results indicate that national statistical performance—as measured by the World Bank's Statistical Performance Index (SPI_ALL)—is associated with systematic changes in recorded mortality outcomes in a context-dependent manner. These associations are consistent with differences in reporting completeness, measurement quality, and governance capacity across countries, rather than implying direct causal effects on underlying mortality risks. This section interprets the empirical findings, highlights heterogeneity across income groups, and discusses their implications for health governance and global development strategies.

### *6.1. Interpretation of Results*

The results confirm that statistical capacity is not merely about measuring outcomes, but plays a central role in how health outcomes are recorded, monitored, and governed. This association holds for both the full sample and the income-stratified models. In low-income countries, SPI_ALL displays a relatively large and statistically significant coefficient, indicating that improvements in national data systems—particularly in terms of quality and periodicity—are linked to systematic changes in recorded maternal mortality, consistent with improved reporting completeness, surveillance capacity, and governance. The pathway here appears to reflect a greater ability to identify vulnerable groups and to support more effective monitoring, planning, and governance of critical services such as prenatal care and skilled birth attendance. In high-income countries, where data systems are more advanced, the marginal effect is smaller but remains statistically significant, consistent with diminishing returns in highly institutionalized environments.

The relationship between SPI_ALL and child mortality, however, is more complex. The full-sample model shows no significant effect, but subgroup analysis reveals a divergence: SPI_ALL is negatively associated with under-five mortality in high-income countries but has no statistically significant association in low-income contexts. This suggests that advanced data systems can enhance the performance of child health interventions—such as immunization and early nutrition—in environments with strong institutional capacity. In low-income countries, by contrast, the absence of significant effects may reflect limitations in translating statistical improvements into service delivery, due to weaker governance structures, fragmented health systems, or insufficient implementation capacity.

This contrast reinforces the broader distinction that statistical systems function as enabling tools rather than standalone solutions. For maternal mortality, where intervention delivery is often more direct and vertically integrated, data improvements appear to translate into more complete measurement and more effective governance responses more readily. In contrast, child mortality interventions require broader coordination across multiple sectors—such as sanitation, nutrition, and early education—making their responsiveness to statistical capacity more dependent on systemic capability.

### *6.2. Comparative Insight: The Role of Institutional Complementarity*

The differing effects of SPI_ALL across income groups underscore the principle of institutional complementarity. Statistical capacity alone does not drive improvements in health outcomes; its effectiveness depends on the presence of capable institutions, robust administrative systems, and accountable governance. In countries with functional bureaucracies, enhanced data infrastructure can support real-time monitoring, adaptive management, and targeted intervention. In contrast, under-resourced systems may lack the means to absorb and operationalize even high-quality data.

This interpretation aligns with broader theoretical accounts of state capability. As Andrews, Pritchett, and Woolcock (2017) argue, information must be matched by authority and competence to produce results. The stronger and more consistent impact of SPI_ALL on maternal mortality suggests that this domain benefits from higher policy salience, clearer program structures, and more targeted funding—conditions that facilitate effective data use. The lack of significance for child mortality in low-income countries may therefore signal institutional constraints in cross-sectoral service delivery.

These findings are reinforced by the behavior of selected control variables. Health expenditure, for instance, is significant only in high-income countries, where governance conditions may ensure its effective deployment. Trade openness appears to contribute positively to maternal health in low-income countries, possibly by improving access to medical goods or enhancing fiscal capacity. While a similar pattern is observed in child mortality models, the effects are less robust and should be interpreted cautiously. These patterns point to the broader conclusion that statistical performance must be embedded within a well-functioning institutional environment to yield sustained and equitable health improvements.

### *6.3. Policy Implications*

The empirical evidence carries several implications for national and global health policy. First, national statistical systems should be viewed as foundational components of health governance. Reliable, timely, and disaggregated data enable governments to identify needs, monitor performance, and improve service delivery—particularly in maternal health, where the links between data and intervention are often more direct.

Second, the differentiated effects of SPI_ALL across income groups highlight the importance of context-sensitive reforms. In low-income countries, strengthening data systems must be paired with broader efforts to build institutional capacity. Without complementary improvements in health administration, public finance, and governance, the benefits of improved statistics may not materialize. In high-income countries, marginal gains in statistical capacity can still enhance child health outcomes, albeit with smaller effect sizes due to already strong systems.

Third, these results support a shift in the development agenda: statistical capacity should not be treated merely as a tool for tracking SDGs but as a development objective in its own right. Global initiatives—such as the UN's "Data for Now" and the World Bank's National Strategies for the Development of Statistics—should be aligned with sector-specific strategies that integrate data use into routine policymaking and public accountability mechanisms.

Fourth, international partners should treat investments in statistical capacity as long-term infrastructure commitments. Financial support must be predictable and aligned with national priorities, enabling countries to institutionalize data systems within their core planning and budgeting functions. Only then can data systems realize their full potential as drivers of health system performance and accountability.

These findings also resonate with broader global frameworks. The World Health Organization's Health Information Systems Strategy underscores the importance of interoperable, country-led data platforms. The strong association between SPI_ALL and maternal mortality in resource-constrained settings lends empirical support to WHO's position. Similarly, the 2030 Agenda for Sustainable Development highlights the need for timely and disaggregated data to track health equity; this study reaffirms that such data systems, when well-integrated, can also help achieve equity in outcomes—not just in measurement.

Finally, the asymmetry between country groups raises concerns about data equity. The ability of high-income countries to translate statistical capacity into improved outcomes—particularly in child health—suggests that equity in data production must be matched by equity in institutional capacity. Without this alignment, improved data availability in low-income settings may fail to translate into inclusive health gains. Strengthening statistical systems must therefore be seen as part of a broader institutional reform agenda aimed at closing both health and information equity gaps.

## 7. Conclusion

This study provides new empirical evidence that national statistical capacity plays a vital, albeit context-dependent, role in shaping public health outcomes. Using a dynamic panel of 99 countries from 2013 to 2023, the analysis demonstrates that improvements in statistical systems—measured through the World Bank's Statistical Performance Index (SPI_ALL)— are significantly associated with changes in recorded maternal mortality across both low- and high-income countries, consistent with enhanced reporting accuracy and institutional capacity rather than direct causal reductions. For child mortality, however, this association emerges only in high-income settings, suggesting that institutional maturity conditions the ability of countries to translate statistical improvements into health gains.

These findings advance the literature in several important ways. First, the study elevates statistical capacity from a background governance condition to a core explanatory variable, empirically tested in a sector where timing, coordination, and data quality are especially critical. Second, the use of SPI_ALL introduces a multidimensional institutional indicator that captures not only the availability of data but also its methodological rigor, dissemination, and usability. Third, the application of the Arellano–Bond GMM estimator—stratified by income group—enables a context-sensitive analysis that accounts for both dynamic persistence and potential endogeneity in mortality outcomes.

At the empirical level, the results show that statistical capacity contributes to health improvements most directly in maternal mortality, a domain often characterized by vertically integrated programs, defined clinical pathways, and strong international funding alignment. In these settings, even marginal improvements in data systems appear to enable better resource targeting, faster feedback loops, and stronger accountability. In contrast, child mortality—especially in low-income countries—remains less responsive to statistical capacity alone. This divergence likely reflects the broader scope of interventions required to reduce child mortality, including nutrition, sanitation, and early education, all of which demand higher levels of systemic coordination and institutional depth.

The role of institutional complementarity is crucial. While SPI_ALL captures national data performance, its effectiveness depends on the governance environment into which it is embedded. In countries with capable, transparent, and accountable public institutions, improved data infrastructure can be absorbed and operationalized into effective health programming. In fragile or under-resourced contexts, even technically sound data may go underutilized or be misapplied. This asymmetric pattern is especially visible in the contrast between high-income and low-income findings for child mortality.

These dynamics also help clarify the performance of other covariates. Health expenditure shows significance only in high-income countries—where it is likely to be better planned, targeted, and monitored—while trade openness benefits maternal and child health primarily in low-income settings, likely by improving fiscal space or access to medical technologies. Together, these findings reinforce the broader conclusion that the impact of statistical systems is conditional, shaped not only by the quality of data but by the institutional and policy mechanisms that act on that data.

Policy implications follow directly. National governments, particularly in low- and middle-income countries, should recognize that investments in statistical infrastructure are not simply technical upgrades but foundational to effective public service delivery. Building robust, timely, and disaggregated data systems can improve monitoring, target underserved populations, and enhance responsiveness in maternal health services. However, these systems must be accompanied by efforts to strengthen the institutional capacity of ministries of health, finance, and planning. Data without implementation power is unlikely to improve outcomes.

International development partners should treat statistical capacity as core infrastructure—akin to clinics or supply chains—and fund it accordingly. Support must be predictable, long-term, and aligned with national reform agendas. Global initiatives such as the UN's "Data for Now" or the World Bank's National Strategies for the Development of Statistics (NSDS) offer strong frameworks but must integrate their goals with health sector planning and institutional strengthening efforts. The COVID-19 pandemic revealed how deeply governments depend on accurate, interoperable data systems to manage health crises—this study offers empirical backing for making such systems central to preparedness and resilience strategies.

While the results are robust, the study is not without limitations. First, although the SPI_ALL index provides comprehensive coverage, its composite nature may mask which components—such as methodological soundness or data use—are most effective in driving change. Second, while the Arellano–Bond estimator helps address endogeneity and dynamic persistence, unobserved policy shifts or omitted institutional factors may still introduce bias. Third, the absence of formal interaction terms between SPI_ALL and governance indicators constrains the ability to quantify the exact nature of institutional moderation, though stratified estimation offers a practical alternative.

A further limitation is potential residual confounding: improvements in statistical capacity may be correlated with demographic and structural transitions (e.g., ageing, migration, and urban congestion) that are imperfectly captured by the available controls. Although the models include urban population dynamics, remaining unobserved changes could bias the estimated association between SPI_ALL and mortality outcomes. This motivates a cautious interpretation centered on reporting/detection and governance capacity rather than strict causal effects.

These limitations suggest clear directions for future research. Disaggregating SPI_ALL into its component dimensions could clarify which aspects of statistical capacity matter most in different policy domains. Additionally, modeling formal interaction effects with governance quality measures—such as control of corruption or bureaucratic quality—could deepen understanding of institutional thresholds. Further work might also examine how external enablers, such as development assistance or digital infrastructure, shape the effectiveness of national statistical systems in the health sector.

Ultimately, this study reinforces a core message: statistical capacity is not merely about measuring outcomes—it shapes how governments monitor, govern, and respond to them. Robust data systems, when embedded within effective institutions, enable governments to plan better, intervene earlier, and deliver services more equitably. For maternal health, the evidence is especially clear. For child health, further progress depends on deepening the institutional foundations that allow data to drive policy. In both cases, investing in national statistical systems is not a technical afterthought—it is a development imperative.

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