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Surviving the first five years: the economic and healthcare determinants of child mortality in Sri Lanka

Vageesha Rajapakse¹ and Ruwan Jayathilaka^{1*} 

Abstract

Background This study investigates the role of economic growth, healthcare investment, immunization coverage, and malnutrition in reducing under-five mortality rates (U5MR) in Sri Lanka. Understanding how these factors interact within socio-economic ecosystems is essential to formulating sustainable strategies to improve child survival outcomes.

Methods This study employs multiple linear regression to analyze the statistical associations between economic growth, healthcare investment, immunization, malnutrition, and under-five mortality in Sri Lanka. Using secondary data from the World Bank and UNICEF (2000–2021), U5MR was modeled against economic growth (per capita GDP), government healthcare expenditure (GHE), immunization coverage (DTP1), and malnutrition (MLN), with significance assessed through p-values and model fit via R^2 .

Results The multiple linear regression model demonstrated strong explanatory power, accounting for 85% of the variation in under-five mortality ($R^2 = 0.85$). Economic growth and immunization coverage were negatively associated with U5MR and found to be statistically significant ($p < 0.05$ and $p < 0.10$ respectively), indicating their potential role in reducing child mortality. Malnutrition showed a strong positive association ($p < 0.01$), emphasizing its continued threat to child health. Although government healthcare expenditure had a negative association, it was not statistically significant, suggesting possible inefficiencies in resource utilization.

Conclusion The study highlights the significant role of economic growth, healthcare expenditure, immunization coverage, and nutrition in shaping U5MR trends in Sri Lanka. The findings emphasize the need for targeted policy interventions to enhance child health outcomes and ensure sustainable progress in reducing child mortality.

Keywords Under-Five mortality, Economic growth, Healthcare investment, Malnutrition, Sustainable social ecosystems

*Correspondence:

Ruwan Jayathilaka

ruwan.j@slit.lk

¹SLIIT Business School, Sri Lanka Institute of Information Technology, New Kandy Road, Malabe, Sri Lanka



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Introduction

The under-five mortality rate (U5MR) serves as a crucial indicator of a nation's overall health and well-being, reflecting the interconnected socio-economic and healthcare systems within the country. Despite global efforts that have significantly reduced U5MR over the past few decades, disparities remain, especially in low- and middle-income countries (LMICs) where economic conditions, healthcare infrastructure, and nutritional factors significantly influence child survival outcomes [1]. Addressing these disparities is crucial for fostering a sustainable socio-economic ecosystem, where economic development and health outcomes are mutually reinforcing.

Sri Lanka, classified as a lower-middle-income country, has achieved notable success in reducing under-five child mortality, outperforming many of its peers in the region. This success is evidenced by a decline in the under-five mortality rate from 21.1 per 1,000 live births in 2000 to 7.4 per 1,000 live births in 2021 [2, 3]. This success can be attributed to the country's existent healthcare infrastructure, strategic implementation of healthcare programs, and innovation in maternal and child health initiatives [4]. However, persistent challenges such as malnutrition highlight the need for a deeper understanding of the systemic factors that continue to influence U5MR in Sri Lanka [5].

Economic growth, government health expenditure (GHE), immunization coverage, and nutritional status are widely recognized as key determinants of child mortality across both South Asian and African nations. Recent studies indicate that while Sri Lanka has made notable progress, similar challenges persist in comparable lower-middle-income countries. For instance, research in Bangladesh and Nepal highlights that sustained economic growth has a direct association on child mortality reduction, primarily through improved healthcare access and maternal education [6, 7]. In contrast, studies focusing on African countries such as Ethiopia, Rwanda and Senegal suggest that despite economic improvements, disparities in healthcare infrastructure continue to hinder progress in reducing child mortality [8]. Higher per capita GDP (PGDP) is generally associated with improved access to healthcare, better living conditions, and higher nutritional standards, all of which contribute to lower U5MR [9, 10]. However, findings from Ethiopia and Nigeria suggest that GDP growth alone does not translate into better child health outcomes unless coupled with targeted public health interventions and equitable resource distribution [11].

Additionally, adequate investment in healthcare services, including maternal and child health programs, plays a vital role in reducing child mortality, though its effectiveness depends on efficient resource allocation

[12–14]. Studies focusing on Pakistan and West Africa suggest that allocation of public healthcare investments have been relatively inefficient in lowering U5MR where resource misallocation and governance issues remain significant barriers [15, 16].

Immunization coverage, particularly for vaccines such as DTP1, remains a crucial intervention in preventing childhood diseases and reducing mortality [17]. Studies from Rwanda and Malawi highlight that digital health platforms and community-based vaccination programs have been instrumental in increasing immunization rates, offering valuable lessons for Sri Lanka in addressing logistical challenges [18]. Despite high vaccination rates in Sri Lanka, logistical barriers and vaccine hesitancy present ongoing challenges [1].

Furthermore, malnutrition continues to be a pressing issue, particularly in economically disadvantaged regions, where poor nutritional status increases vulnerability to infections and mortality risks [19, 20]. Studies commenting on malnutrition trends in South Asian countries indicate that while Sri Lanka has made progress in reducing childhood stunting, economic crises and food insecurity still pose significant risks, requiring continued policy focus on food security and nutritional interventions [21, 22].

Despite extensive research on child mortality determinants, there is a lack of focused studies that examine how economic growth, healthcare investments, immunization, and malnutrition collectively influence under-five mortality in Sri Lanka. Most existing studies on child mortality determinants have been conducted in high-income contexts, with limited research exploring how these variables interact specifically within Sri Lanka's socio-economic and policy environment. Furthermore, current research often overlooks how Sri Lanka's unique healthcare system, economic conditions, and policy initiatives have influenced child mortality trends. Adopting a time-series exploratory approach using secondary data, this study aims to address this gap by analyzing the statistical association between economic and healthcare variables and U5MR in Sri Lanka from 2000 to 2021. The use of secondary data from reliable sources (World Bank, UNICEF) allows for a robust long-term analysis, capturing trends that would be difficult to measure through primary data collection. Given that child mortality is influenced by broader socio-economic factors, an ecological analysis is appropriate for identifying macro-level patterns rather than individual causation. This study provides a unique contribution by integrating economic, healthcare, and nutrition determinants in a Sri Lankan context, offering evidence-based insights to inform policy and interventions. As such, the study hypothesizes that economic growth, healthcare investments, immunization coverage, and malnutrition are associated with U5MR.

This study makes several key contributions. First, it provides a comprehensive analysis of economic, healthcare, and nutritional factors influencing child mortality, offering a holistic perspective on their combined association with U5MR. Second, it extends existing research by focusing on a lower-middle-income country, addressing a gap in the literature dominated by high-income country analyses. Third, by employing a time-series exploratory approach, it enhances the understanding of long-term child mortality trends and the role of economic and health policies in shaping outcomes. Finally, the study's findings offer valuable insights for policymakers, emphasizing the need for integrated strategies that align economic growth with healthcare investments and nutritional policies to create resilient, equitable healthcare systems that support child well-being.

Methodology

Data

This study utilizes data from multiple credible sources to examine the factors influencing under-five mortality (U5MR) in Sri Lanka from 2000 to 2021, which is presented in Appendix A. The data is sourced from World Bank and UNICEF where the data availability played a significant role in determining the necessary variables and the time period for the analysis. The dataset was examined for completeness and consistency. Outliers were assessed using descriptive statistics and visual inspection through box plots, but none required further adjustments. As no missing values were detected in the dataset from 2000 to 2021, data completeness was confirmed, ensuring reliability for the analysis. The dataset was assessed for normality using histogram plots and summary statistics. No severe violations of normality or multicollinearity were detected, confirming the suitability of the data for regression analysis. The selected variables for this study are crucial in understanding and fostering a sustainable socio-economic ecosystem in Sri Lanka. These variables highlight the importance of aligning economic and social policies within sustainable socio-economic ecosystems to improve child health outcomes.

The U5MR serves as a primary measure of child health and overall societal well-being, reflecting the interconnections of economic and social policies. Economic stability and growth, represented by PGDP, are foundational to sustaining public health and social services, ensuring that the benefits of economic progress reach all segments of society. High immunization rates, such as those measured by DTP1 coverage, are essential for preventing disease outbreaks and sustaining public health, which is critical for maintaining a resilient population. Government healthcare expenditure (GHE) reflects the government's commitment to investing in healthcare infrastructure and services, a vital component of

sustainable development. Finally, addressing malnutrition, well depicted the prevalence of underweight children [14, 33, 34], is crucial for ensuring equitable health outcomes and sustaining a healthy population. Together, these variables illustrate the interconnectedness of economic growth, public health, and social equity in building a sustainable socio-economic ecosystem.

Methods

The Multiple Linear Regression model was used to analyze the associations between economic and healthcare factors and U5MR over time. This approach allows for the simultaneous assessment of multiple predictors, ensuring that each variable's relationship with U5MR is examined while accounting for the effects of the others [35]. In fact, alternative models, such as panel regressions, were considered but were deemed unsuitable due to the single-country focus and lack of cross-sectional variation in the dataset.

$$U5MR_t = \alpha_0 + \alpha_1 PGDP_t + \alpha_2 DTP1_t + \alpha_3 GHE_t + \alpha_4 MLN + \varepsilon_t$$

The above equation is used to assess the time-series relationship between PGDP, DTP1, GHE, and MLN on U5MR in Sri Lanka from 2000 to 2021. The subscript 't' denotes time, as the study focuses on a single-country time-series dataset spanning 2000–2021. The error term (ε_t) accounts for variations in U5MR that are not explained by the included variables. The intercept (α_0) and coefficients ($\alpha_1, \alpha_2, \alpha_3, \alpha_4$) represent the estimated effects of each independent variable on U5MR.

In the process of conducting the analysis, the data reliability and availability were ensured. Furthermore, descriptive statistics were generated to highlight the mean of all variables alongside with line graphs for each variable to track the behaviour and trends. Finally, multiple linear regression analysis was conducted to examine the relationships between PGDP, DTP1, GHE, MLN, and U5MR, with the latest data available. The regression model was assessed using summary statistics and graphical methods to ensure its suitability for analysis. To further validate the consistency of the regression outcomes, robustness checks were conducted using two alternative model specifications: a log-linear model and a semi-log model. These specifications allowed to test the sensitivity of coefficient directions and statistical significance under different functional forms. The key predictors, including DTP1 and MLN, remained statistically significant ($p < 0.10$) across all models, and the direction of associations remained consistent with theoretical expectations. A summary of these models is provided in Appendix B. To assess potential multicollinearity among the independent variables, a Variance Inflation Factor (VIF) test was

conducted. These results presented in Appendix C, suggest that multicollinearity is unlikely to significantly compromise the stability or interpretability of the regression coefficients.

Results

The study uses data of Sri Lanka from 2000 to 2021 to provide insights into the behavior of the variables under study, including U5MR, PGDP, immunization coverage (DTP1), GHE, and MLN as predictors of U5MR. These variables are crucial indicators of the health and sustainability of Sri Lanka's socio-economic ecosystem.

The descriptive statistics in Appendix D, reveal a mean U5MR of 12.28 per 1,000 live births ($SD=5.25$), reflecting steady improvement over the study period. PGDP had substantial variation (mean = 2667.68 USD, $SD=1361.10$), with growth interrupted by downturns in 2004, 2009, and 2020. Immunization coverage remained high (mean DTP1 = 98.60%), though minor declines aligned with periods of national disruption. GHE showed moderate fluctuation (mean = 1.83% of GDP), while MLN averaged 299.06, with a downward trend over time.

The violin plots indicated in Appendix E, further illustrate these patterns, confirming a left-skewed distribution of U5MR and consistently high DTP1 rates, with more variability in PGDP and GHE. These visualizations support the temporal trends observed, including dips in health investment and economic performance during periods of political and global crises.

The behavioral patterns of U5MR and PGDP in Sri Lanka are illustrated in Appendix F. The figure reveals a general decline in U5MR, with noticeable increases in 2004 and 2009, possibly due to economic and political disruptions. Conversely, PGDP shows a consistent upward trend, with a dip in 2020 likely caused by the global pandemic and economic crisis. Similarly, Appendix G illustrates the trends in DTP1 immunization coverage and GHE. DTP1 coverage remains stable but shows reductions in 2004, 2009, and 2020, which correspond to periods of economic and political instability. GHE depicts a declining trend up to 2012, followed by fluctuations, with increases noted in 2018 and 2020. These patterns suggest that while economic growth and healthcare investments are crucial, they must be supported by stable governance and sustained public health efforts to ensure continuous improvement in child health outcomes. Evaluating MLN, a clear reduction in the rate is presented in Appendix H where the overall rate reduces in the time span of 2000–2021. These rates clearly show that children suffering from malnutrition are reducing which it significantly contributes to the reduction in under five deaths.

The MLR model as indicated in Appendix C, selected for its ability to assess associations over time, explains 85% of the variation in U5MR ($R^2 = 0.85$), with an

F-statistic of 26.50 indicating strong model significance ($p < 0.01$). Log-transformed PGDP (lnPGDP) exhibits a statistically significant negative association with U5MR ($\beta = -0.27$, $p < 0.05$), aligning with economic theory and empirical literature suggesting that rising incomes improve household living standards, healthcare affordability, and nutrition, thereby reducing child mortality [26, 27]. This finding supports existing global evidence that economic development often correlates with improved health outcomes through multiple indirect pathways such as sanitation, infrastructure, and health literacy [28, 29].

DTP1 immunization coverage (lnDTP1) is also negatively associated with U5MR ($\beta = -11.08$, $p < 0.10$), highlighting the preventive role of vaccines in child survival. Although the association is modestly significant, the direction and magnitude are consistent with studies from other LMICs where expanded immunization programs have contributed to reduced mortality [30, 31]. The slightly lower significance level may be due to the consistently high baseline coverage in Sri Lanka [32], leading to limited within-country variation over the study period, which can attenuate statistical power.

Malnutrition (lnMLN) demonstrates a strong and highly significant positive association with U5MR ($\beta = 3.21$, $p < 0.01$), highlighting it as a persistent and critical determinant of child mortality. This relationship is theoretically grounded in biomedical and public health literature, which links malnutrition to weakened immunity, developmental delays, and higher susceptibility to infectious diseases [33–35]. The strength of this association reflects the urgency of integrating nutrition-focused interventions into broader child health strategies.

In contrast, government healthcare expenditure (lnGHE) is negatively associated with U5MR ($\beta = -0.19$), but the relationship is not statistically significant ($p > 0.10$). This non-significance may arise due to several factors. First, the effectiveness of spending depends not only on the volume of expenditure but also on how resources are allocated, being toward preventive vs. curative care [36], rural vs. urban services [37], or recurrent vs. capital investments [38]. Second, public spending in Sri Lanka during the observed period was relatively modest [39], and without systemic reforms or efficiency gains, its impact may not be immediately observable in mortality outcomes. Third, delays in outcome realization (i.e., time lags between spending and health improvements) could weaken the model's ability to detect immediate associations. Finally, inefficiencies or leakages in budget execution, as noted in similar developing contexts, may dilute the effectiveness of GHE [12, 40]. Therefore, while health expenditure remains important, it likely requires supportive governance, institutional capacity, and

targeted allocation to translate into measurable mortality reductions.

The predicted values of U5MR, as shown in Appendix I, demonstrate a declining trend over the study period, aligning with Sri Lanka's progress in socio-economic development and public health investment. Collectively, these findings affirm the importance of economic resilience, immunization systems, and nutrition programming, while also calling attention to the need for improved effectiveness and equity in healthcare financing.

Discussion

The findings of this study highlight key associations between macro-level indicators and under-five mortality in Sri Lanka, offering valuable insights for health policy in similar developing contexts. The observed negative association between per capita GDP (PGDP) and under-five mortality rate (U5MR) is consistent with a broad body of evidence [10, 41] suggesting that higher income levels are often linked with improved access to healthcare, better nutrition, enhanced living standards, and greater health awareness [42]. Similar patterns have been documented across developing nations, including Bangladesh and Vietnam, where economic growth has coincided with expanded health services and better child health outcomes [43, 44]. However, economic downturns, such as those triggered by the COVID-19 pandemic, have been associated with reversals in these gains due to disruptions in health services, rising poverty, and food insecurity [45].

The significant association between DTP1 immunization coverage and lower U5MR aligns with global findings that connect vaccination programs with improved child survival [17, 46]. While this study cannot infer a direct causal relationship, the observed link is consistent with prior research demonstrating the broad protective effects of immunizations in reducing preventable disease burdens and facilitating engagement with healthcare systems. Countries such as Nepal and Rwanda have documented similar associations where increased vaccine coverage correlated with reduced child mortality [1].

The positive association between malnutrition and U5MR in Sri Lanka reinforces long-standing concerns about the role of undernutrition as a correlating factor in child mortality [19]. Previous studies, including those focusing on Sri Lanka, have emphasized that malnutrition is widely recognized as a condition that coexists with elevated vulnerability to infectious diseases and other health complications [4, 47]. This pattern has also been observed in South Asian and Sub-Saharan African contexts, where stunting, wasting, and micronutrient deficiencies often accompany high child mortality rates [48]. Nonetheless, such associations highlight the importance of integrated

approaches that improve nutritional status, agricultural productivity, maternal health, and household income [45].

Interestingly, the lack of a significant association between GHE and U5MR in this study emphasizes the need for further exploration. This result may reflect inefficiencies in the allocation or effectiveness of healthcare spending, or it may signal that expenditures alone are insufficient without improvements in service delivery, access, and equity [3, 12]. Studies from Brazil and Indonesia have reported similar patterns where increased public spending did not correlate with reductions in child mortality, possibly due to systemic inefficiencies or fragmented health system governance [49]. The findings also suggest the importance of complementary strategies, such as workforce training, public accountability, and targeted investment in rural healthcare infrastructure.

In addition, broader macroeconomic and political events such as pandemics, inflation, and governance instability, are known to disrupt health systems and add to child health vulnerabilities [3]. While not directly measured in this study, existing literature documents how such crises are frequently associated with declines in health service coverage, increased malnutrition, and elevated child mortality. These indirect effects emphasize the need for policies that enhance health system resilience and social protection mechanisms during economic shocks. Additionally, to interpret these associations within a structured analytical framework, the Mosley and f model for child survival provides a useful conceptual foundation. This model emphasizes how socio-economic factors influence child health outcomes through proximate variables such as nutrition, disease exposure, and healthcare behaviors [50]. Framing the discussion within this theoretical perspective enhances the explanatory depth of the analysis and offers guidance for future research and policy design.

As such, this study highlights key associations between economic growth, healthcare access, malnutrition, and under-five mortality in Sri Lanka, aligning with global trends. The findings emphasize the importance of multi-sectoral approaches in improving child health outcomes, while the non-significant association of healthcare expenditure suggests a need to assess efficiency and equity in resource allocation. Grounding these insights within the Mosley and Chen framework strengthens their theoretical relevance, emphasizing the interconnected nature of socioeconomic and health determinants.

Policy implications

Promoting inclusive economic development with targeted social policies

Economic growth is closely associated with lower U5MR, but to maximize its benefits, policies must ensure

equitable distribution of economic progress. Sri Lanka can enhance social equity by implementing progressive taxation, social safety nets, and conditional cash transfers, following the models of Brazil's Bolsa Família program and Mexico's Progresa; both of which have significantly improved child health outcomes by linking financial assistance to healthcare and education access [51, 52]. Additionally, targeted livelihood support programs, particularly for women in rural areas, can improve household income stability, leading to better child nutrition, healthcare access, and overall well-being. Policies that promote food security, improve maternal education, and expand access to essential services will further strengthen economic resilience while reducing child health disparities [19]. By integrating inclusive economic policies with public health strategies, Sri Lanka can foster a sustainable socio-economic system that supports long-term reductions in child mortality and improved societal well-being.

Strengthening healthcare spending efficiency and service accessibility

While GHE is crucial, its impact on U5MR depends on how resources are allocated and utilized. Countries like Thailand and Costa Rica have improved healthcare efficiency by prioritizing spending on primary healthcare and preventive services rather than focusing on hospital-based care [53]. Sri Lanka can enhance the impact of GHE by expanding community health worker programs, mobile clinics, and health equity assessments to ensure funds reach the most at-risk populations. Additionally, strengthening healthcare infrastructure through the integration of advanced technology and information systems (IS) is crucial in optimizing healthcare delivery, improving resource management, and supporting real-time decision-making [54]. Investing in technology infrastructure, such as digital health platforms and telemedicine, can further expand access to quality healthcare services, particularly in remote areas, contributing to sustained reductions in child mortality [55].

Expanding immunization programs with digital health solutions

High immunization coverage, particularly for vaccines like DTP1, is essential for reducing U5MR. Sri Lanka's immunization programs have been largely successful, but sustaining and improving vaccination rates requires leveraging technology-driven solutions to overcome logistical barriers [46]. Countries like Rwanda and India have successfully implemented mobile health (mHealth) platforms such as RapidSMS, Co-WIN, and U-WIN, which enable real-time vaccine tracking and community engagement to maintain high coverage rates [56, 57]. Sri Lanka can adopt SMS-based reminders, digital

immunization records, and mobile health applications to enhance vaccination program efficiency, reduce missed appointments, and counter vaccine hesitancy. Additionally, addressing challenges such as logistical barriers and public skepticism through continuous monitoring, community engagement, and public education campaigns will be essential in ensuring equitable vaccine access for all children, regardless of socio-economic status or geographic location [17]. The integration of these technological solutions can further strengthen Sri Lanka's public health system, ensuring resilience and sustained progress in immunization coverage.

Addressing malnutrition through integrated nutrition and agricultural policies

Malnutrition remains a significant contributor to child mortality in Sri Lanka, emphasizing the need for comprehensive nutrition programs that address both immediate and long-term nutritional challenges [5, 19]. These programs should incorporate food supplementation, education on infant and young child feeding practices, and food security initiatives, particularly in regions with high malnutrition rates [1]. Evidence from Bangladesh and Ethiopia suggests that integrating nutrition-sensitive agriculture with maternal and child health programs significantly improves child health outcomes [58–60]. Sri Lanka can adopt similar strategies by implementing bio-fortification of staple foods, school feeding programs, and agricultural diversification to enhance food security. Additionally, community-based growth monitoring and targeted nutrition interventions have proven effective in reducing malnutrition rates and should be prioritized. To complement these efforts, policymakers should promote technological innovations in agricultural practices, food distribution systems, and knowledge management, optimizing food supply chains and enhancing nutritional education. This integrated approach not only reduces malnutrition's association with child mortality but also fosters a sustainable socio-economic ecosystem that prioritizes equitable health outcomes.

Prioritizing immediate and long-term policy interventions

Policymakers should prioritize interventions based on immediacy and long-term impact to optimize resource allocation. Immediate priorities should focus on expanding primary healthcare accessibility, implementing real-time digital health solutions, and improving nutrition programs to address urgent child health challenges. Meanwhile, long-term priorities should emphasize strengthening health system governance, improving public healthcare efficiency, and ensuring sustainable economic policies that reduce income inequality and food insecurity. A balanced approach integrating both short-term and structural solutions will ensure sustained

progress in reducing under-five mortality and improving overall child health outcomes.

Fostering cross-sectoral collaboration for sustainable child health outcomes

Sri Lanka's progress in reducing child mortality can be further strengthened through enhanced cross-sectoral collaboration between health, education, social welfare, and agriculture sectors [61]. The Philippines' *Kalusugan Pangkalahatan* strategy and Thailand's Universal Health Coverage program illustrate how multi-sectoral policies can contribute to long-term U5MR reductions by aligning health initiatives with economic and social development goals [62, 63]. Establishing a national child health task force in Sri Lanka to integrate economic, healthcare, and technological policies would be a critical step forward. Regular monitoring and evaluation of these policies will ensure their effectiveness and allow for necessary adjustments to address evolving child health challenges. This broad-based approach will contribute to a sustainable socio-economic ecosystem, ensuring long-term reductions in child mortality and improving overall societal well-being.

Limitations and future directions

This study provides valuable insights into U5MR in Sri Lanka but has several limitations. Reliance on secondary data may introduce measurement and reporting biases, and the focus on select variables (PGDP, immunization coverage, government healthcare expenditure and malnutrition) excludes key determinants such as maternal education, healthcare quality, household practices, and regional disparities, leading to potential omitted variable bias. Additionally, the generalizability of findings may be limited, as economic and healthcare structures differ across contexts.

Methodologically, this study employs MLR with time-series data, which identifies associations but does not establish causation. While trends over time are analyzed, causal inference requires alternative methods, such as instrumental variables, lagged predictors, or structural equation modeling. We also recognize the potential for reverse causality, where improved child health outcomes may contribute to economic growth. Furthermore, the model does not account for lagged effects, which may be relevant for variables such as healthcare expenditure. These limitations, along with the presence of unobserved confounders, restrict the study's ability to draw causal conclusions.

To enhance understanding, future research should adopt mixed methods approaches, integrating quantitative analysis with qualitative insights from healthcare providers, policymakers, and communities. Such methods can clarify barriers to healthcare access and

immunization uptake. Additionally, longitudinal studies tracking mortality trends over time would help assess policy effectiveness. Future studies could also consider employing instrumental variable (IV) regression, difference-in-differences (DiD) models, or other quasi-experimental techniques to better isolate causal effects. The role of healthcare quality and digital health infrastructure also warrants further investigation, particularly in service delivery efficiency and mortality outcomes. Comparative studies across similar developing nations could identify best practices in leveraging economic growth, policy reforms, and healthcare improvements to reduce U5MR. Addressing these limitations through broader variable inclusion, alternative causal inference techniques, and deeper policy analysis will improve future research and its relevance for evidence-based policymaking.

Conclusion

This study provides a comprehensive analysis of the key determinants of under-five mortality in Sri Lanka, revealing the crucial roles of economic growth, healthcare infrastructure, immunization coverage, and nutritional status. The findings highlight that sustained economic development and strong healthcare systems are essential for reducing child mortality, while specific interventions addressing malnutrition and maintaining high immunization rates are equally vital. Despite significant progress, challenges such as regional malnutrition and inadequate healthcare services remain, emphasizing the need for continued efforts. The policy implications derived from this research offer a strategic roadmap for policymakers to promote inclusive economic growth, enhance healthcare spending, sustain immunization programs, address nutritional deficiencies, and foster cross-sectoral collaboration. By implementing these strategies, Sri Lanka can build on its successes to further decrease under-five mortality rates and improve overall child health outcomes. In conclusion, this study not only deepens the understanding of the factors affecting child mortality in Sri Lanka but also provides clear direction for policies that could make a meaningful difference in ensuring healthier futures for the nation's children.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s41043-025-00862-x>.

Supplementary Material 1
Supplementary Material 2
Supplementary Material 3
Supplementary Material 4
Supplementary Material 5
Supplementary Material 6

Supplementary Material 7

Supplementary Material 8

Supplementary Material 9

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Author contributions

V.R.: Data curation, formal analysis, investigation, project administration, resources, supervision, writing- original draft preparation, writing - revised draft, reviewing, and editing. R.J.: Conceptualisation, data curation, formal analysis, project administration, resources, software, supervision, writing and editing, conceptualisation.

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Data availability

The datasets used during the current study are available from the corresponding author upon reasonable request.

Declarations

Statements and declarations

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Ethical approval

This study was approved by the Sri Lanka Institute of Information Technology, Sri Lanka (PVC/RI/EC/2024/04).

Consent to participate

Not applicable.

Conflict of interest

The authors declare no competing interests.

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