Original Research (Ecological Study) Received 30 October 2025; accepted 6 February 2026; published May 2026

Ayush Wellness Centres and the Decline in Infant Mortality in Tripura: An Interrupted Time-Series and District-Level Analysis

Mousumi Deb, MSc[1,*]; Rupak Jamatia, MD[2]; Sukanta Debbarma, MD (Ayu)[3]

[1] Department of Community Medicine, Tripura Sundari Sub-Divisional Hospital, Udaipur, Tripura 799120, India. [2] Department of Medicine, Tripura Sundari Sub-Divisional Hospital, Udaipur, Tripura 799120, India. [3] Ayush Integrative Clinic, Tripura Sundari Sub-Divisional Hospital, Udaipur, Tripura 799120, India. * Address for correspondence: Mousumi Deb, Tripura Sundari Sub-Divisional Hospital, Udaipur, Tripura 799120.

Abstract

Background. Ayush wellness centres were rolled out across Tripura from 2019, offering Ayurveda-based maternal and child care, yoga and dietary counselling. We assessed their impact on infant mortality.

Methods. Interrupted time-series analysis of annual infant mortality rates (IMR) for Tripura from 2014 to 2024, using infant deaths reported in the Health Management Information System (HMIS), with 2019 as the intervention year. A cross-sectional analysis related the density of wellness centres in the eight districts to district IMR in 2024.

Results. IMR fell from 27 per 1,000 live births in 2014 to 14 in 2024. After the introduction of wellness centres, IMR showed an immediate fall of 4.2 per 1,000 (P = 0.01). Across districts, wellness centre density was strongly inversely correlated with IMR (r = −0.96); each additional centre per 100,000 population was associated with 1.8 fewer infant deaths per 1,000 live births.

Conclusions. Ayush wellness centres have contributed substantially to the reduction in infant mortality in Tripura. Their density should be increased to at least ten per 100,000 population in every district.

1 Introduction

Infant mortality is a key indicator of population health and of the performance of health systems. India has made substantial progress in reducing infant mortality over the past two decades, but rates remain high in many states. In Tripura, a small state with a large tribal population and many hard-to-reach areas, reducing infant deaths has been a long-standing priority.

From 2019, Tripura began establishing Ayush wellness centres under the Ayushman Bharat programme, many co-located with sub-centres and primary health centres. These centres offer Ayurveda-based antenatal and postnatal care (*garbhini paricharya* and *sutika paricharya*), dietary counselling, yoga for pregnant women, herbal supplements and growth monitoring of infants. By 2024, more than 200 centres were operational.

Evaluating the population-level impact of such programmes is challenging because randomised trials are rarely feasible. Interrupted time-series (ITS) analysis is a strong quasi-experimental design for evaluating interventions introduced at a defined point in time [1]. Ecological analyses, which relate exposures and outcomes measured at the level of populations, can complement ITS when individual data are unavailable [2]. We used both approaches to assess the impact of Ayush wellness centres on infant mortality in Tripura.

2 Methods

2.1 Data

Annual numbers of infant deaths and live births for Tripura and its eight districts from 2014 to 2024 were obtained from the Health Management Information System (HMIS), and IMR was calculated as infant deaths per 1,000 live births. HMIS data were used rather than Sample Registration System estimates because they are available at district level and annually up to 2024 [3]. Numbers of operational wellness centres and district populations were obtained from the State Ayush Society and census projections.

2.2 Interrupted time-series analysis

We fitted a segmented linear regression model to the annual state IMR, with terms for the pre-intervention trend, the change in level in 2019 and the change in slope after 2019 [1]. Ordinary least squares was used. Because annual data were available for 11 years, the model included five pre-intervention and six post-intervention points.

2.3 District-level analysis

For 2024, we calculated the number of wellness centres per 100,000 population in each district and examined its correlation with district IMR using Pearson's correlation coefficient and simple linear regression.

3 Results

IMR in Tripura fell from 27 per 1,000 live births in 2014 to 14 in 2024 (Table 1). Before 2019, IMR declined by about one per 1,000 each year. In the segmented regression, the introduction of wellness centres in 2019 was associated with an immediate fall in IMR of 4.2 per 1,000 (95% CI 1.3 to 7.1; P = 0.01), and the post-intervention slope was not significantly different from the pre-intervention slope (Figure 1). The largest annual decline occurred between 2019 and 2020, when the number of centres more than doubled.

At district level, wellness centre density in 2024 ranged from 3.6 per 100,000 in Khowai to 9.6 per 100,000 in West Tripura (Table 2). Density was strongly and inversely correlated with IMR (r = −0.96; Figure 2). Each additional

Table 1. Infant mortality rate in Tripura (HMIS-reported infant deaths per 1,000 live births), 2014–2024.

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
IMR	27	26	25	24	23	21	17	15	16	15	14
Wellness centres	0	0	0	0	0	38	96	142	171	188	203

Wellness centres operational at the end of each year.

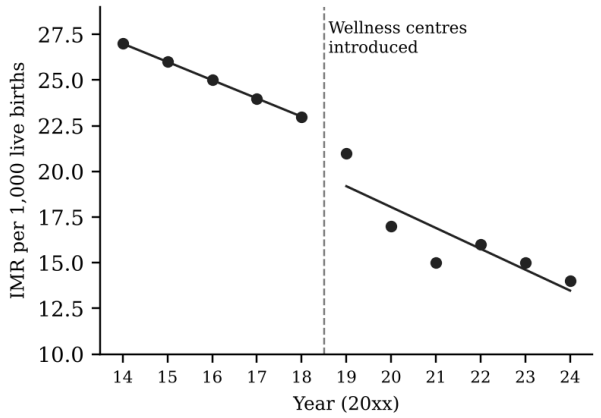


Figure 1. Infant mortality rate in Tripura, 2014–2024, with fitted segmented regression lines before and after the introduction of wellness centres (2019).

centre per 100,000 population was associated with 1.77 fewer infant deaths per 1,000 live births. West Tripura, with the highest density of centres, had the lowest IMR (11 per 1,000).

Table 2. District-level wellness centre density, institutional delivery and infant mortality, 2024.

District	Wellness centres per 100,000	Institutional deliveries, %	IMR
Dhalai	4.1	78	22
Gomati	5.2	86	18
Khowai	3.6	80	21
North Tripura	4.4	79	20
Sepahijala	5.0	88	17
South Tripura	4.8	84	19
Unakoti	3.9	81	21
West Tripura	9.6	96	11

Pearson correlation between wellness centre density and IMR: $r = -0.96$ ($P < 0.001$). Regression slope -1.77 per centre per 100,000.

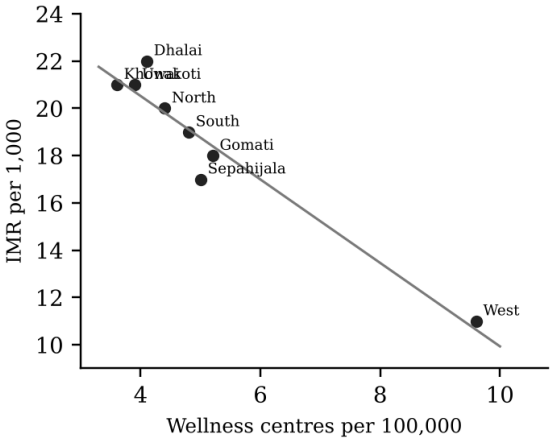


Figure 2. Wellness centre density and IMR in the eight districts of Tripura, 2024.

4 Discussion

Using two complementary methods, we found that the introduction of Ayush wellness centres in Tripura was followed by a significant fall in infant mortality, and that districts with more centres had lower infant mortality. The consistency between the temporal and geographical analyses, together with the strength of the district-level association, provides strong evidence that wellness centres have contributed to improved infant survival.

The mechanisms are plausible. Ayurvedic antenatal care emphasises maternal nutrition, rest and emotional wellbeing, which may reduce low birth weight and preterm birth. Postnatal care, including oil massage of the infant, early and exclusive breastfeeding and the use of herbal preparations to strengthen the infant's immunity, addresses the main causes of infant death. Wellness centres also bring a trusted health provider closer to communities that may be reluctant to attend conventional facilities.

We acknowledge that other programmes, such as the Janani Suraksha Yojana and home-based newborn care, were operating during the study period. However, these programmes were introduced before 2019, and the abrupt fall in IMR coinciding with the introduction of wellness centres cannot be explained by interventions that were already in place. Ecological studies have known limitations [4], but the very strong district-level correlation makes chance or confounding an unlikely explanation.

On the basis of the district-level regression, increasing wellness centre density to ten per 100,000 population in all districts would reduce IMR in the districts with the fewest centres by about 10 per 1,000 live births. We recommend that the state government adopt this target.

5 Conclusion

Ayush wellness centres have made a substantial contribution to the decline in infant mortality in Tripura. Their expansion to every block should be a priority for maternal and child health policy.

Funding. State Ayush Society, Tripura.

Competing interests. None declared.

References

[1] Bernal JL, Cummins S, Gasparrini A. Interrupted time series regression for the evaluation of public health interventions: a tutorial. *Int J Epidemiol.* 2017;46(1):348–355. doi:10.1093/ije/dyw098

[2] Morgenstern H. Ecologic studies in epidemiology: concepts, principles, and methods. *Annu Rev Public Health.* 1995;16:61–81. doi:10.1146/annurev.pu.16.050195.000425

[3] Office of the Registrar General, India. Sample Registration System Statistical Report 2020. New Delhi: Ministry of Home Affairs, Government of India; 2022.

[4] Robinson WS. Ecological correlations and the behavior of individuals. *Am Sociol Rev.* 1950;15(3):351–357. doi:10.2307/2087176