MINISTRY OF ECONOMY
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Spatial Analysis of Inequalities in Maternal and Child Mortalities in Pakistan

Presented by: Farzana Sher Muhammad
Affiliation: Faculty of Business and Economics, Universiti Malaya.

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Contents

Introduction

- The annual death of 287 million pregnant women and 5 million children (under the age of five years) has been a serious public health concern throughout the globe (UNICEF & World Health Organization, 2024; World Health Organization, 2023c).

- Maternal and child mortality (MCM) is not an outcome of treatment failure; rather, it arises from the complex interaction of underlying socioeconomic, housing, environmental, and cultural influences (National Institute of Population Studies (NIPS), 2020).

- According to the Burden of Disease(BOD) report from 1990 to 2019, MCM is among the five leading causes of death in Pakistan.

- Among the risk factors, maternal and neonatal disorders are the 3rd leading contributors.

- Pakistan stands 3rd out of the top 10 fragile countries with the highest MCM burden globally (World Health Organization, 2022b).

Introduction

- Among the SAARC countries, it has 3rd rank in high rates of MMR, and it has the highest IMR and U5MR, surpassing other low-income countries i.e., Afghanistan, India, and Nigeria.

- Maternal mortalities in rural areas of Pakistan are 26% greater than in urban areas (Hanif et al., 2021).

- There is a need for evidence on why some areas do better than others in MCMs in Pakistan.

- This research offers a novel perspective on spatial inequalities in maternal and child mortality by analyzing the interplay of various factors on MCMs.

- The research is significant for policymakers in developing more geographically targeted strategies to reduce mortality rates and achieve equitable health outcomes. This study also proposes to trace Pakistan's progress towards SDG-3 and SDG-10.

Objective

- To estimate the district mortality Index, locate the spatial clusters of mortalities, and determine the spatial impact of Socioeconomic, Environmental, health, and housing factors on DMI in Pakistan.

Research Gap

•Aggregation of mortalities: previous research mainly focused on the measurement of separate (maternal and child) mortalities such as maternal mortality, child mortality, infant mortality, neonatal and postnatal mortality this study combines all.

•Estimation of DMI: A new index that can be used for mortality assessment in various settings/countries.

•Updated and extensive data of MICS is used.

•Mosley and Chen's (1984) model is enhanced by inducting geographical aspects into determinants of MCMs.

•Previous literature has identified the determinants of MCM mortalities, mostly in non-spatial terminologies, this study fills the literature gap by exploring the spatial impact of different factors on health outcomes.

Data Source

- Household data sets of Multiple indicator cluster survey(s) (MICS) 2019-2020.
- The unit of analysis is 141 districts.

Description of various mortalities used in the construction of the District Mortality Index (DMI)

S. No.	Mortality name	Abbreviations	Description
1	Neonatal mortality rate	NMR	Probability of dying within the first month of life
2	Post neonatal mortality rate	PNMR	Difference between infant and neonatal mortality rates
3	Infant mortality rate	IMR	Probability of dying between birth and the first birthday
4	Child mortality rate	CMR	Probability of dying between the first and the fifth birthday
5	Died during pregnancy	DDP	Deaths of the women aged 15-49 years during pregnancy excluding accidents and acts of violence, per 100,000 live births
6	Died during childbirth	DDCB	Deaths of the women aged 15-49 years during childbirth excluding accidents and acts of violence, per 100,000 live births
7	Died within two months	DW2M	Death of the women aged 15-49 years within 2 months after pregnancy termination excluding accidents and acts of violence, per 100,000 live births

Methodology

Objective 1: To estimate the district mortality index (DMI)

Step 1: Standardization of indicators

Step 2: Accumulation of standardized variables in a single matrix

Objective 2: To identify the location of spatial clusters of mortalities in Pakistan.

1. **Global Moran's I**
2. **Local indicators of spatial association (LISA)**

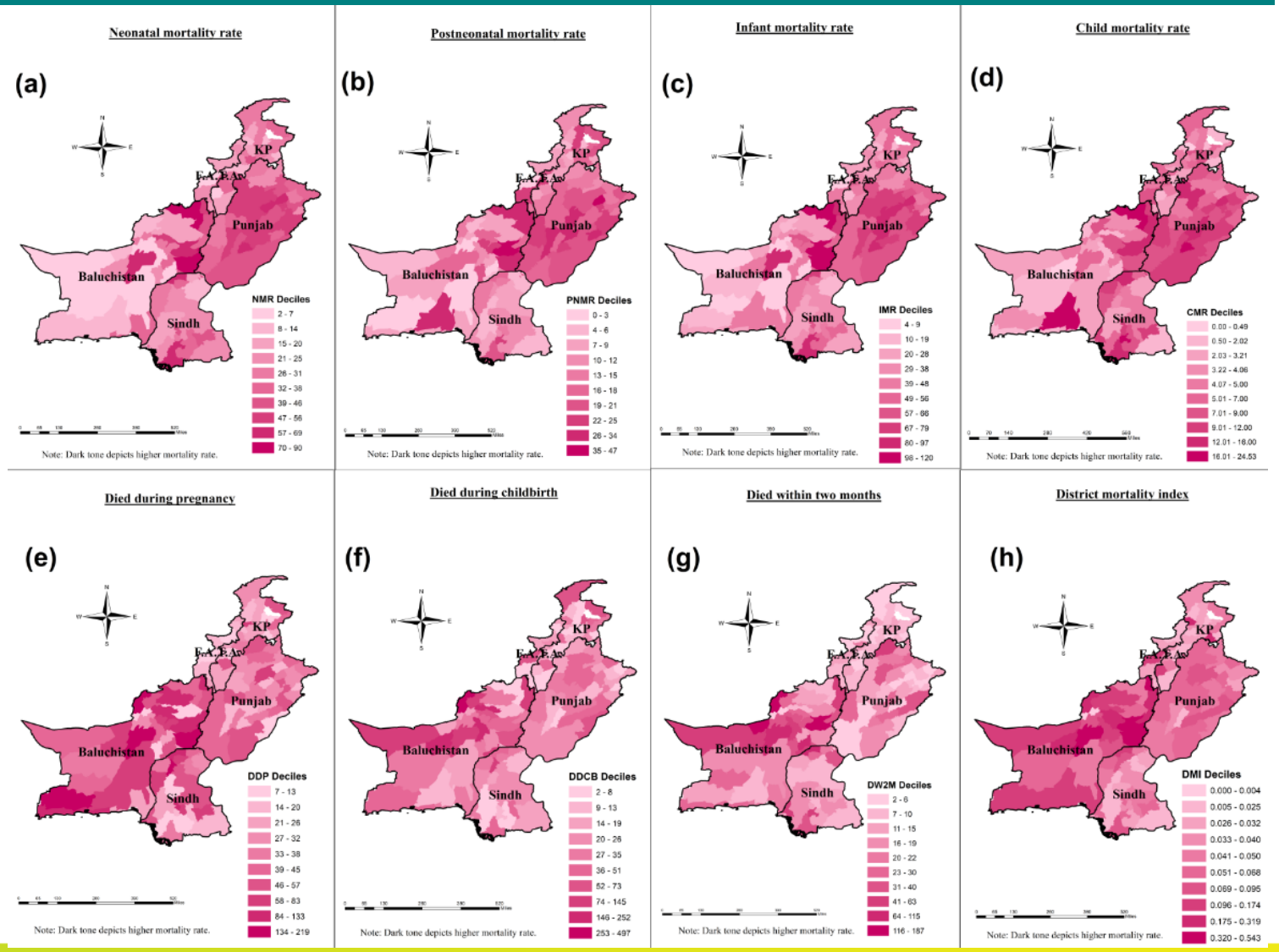
Objective 3: To assess the Spatial impact of Socioeconomic, Environmental, health, and housing factors on MCMs in Pakistan.

Geographically weighted Regression (GWR) Model

$$DMI_i = \beta_0(u_i, v_i) + \beta_1(u_i, v_i)\, MOED_i + \beta_2(u_i, v_i) WIQ_i + \beta_3(u_i, v_i) SANF_i + \beta_4(u_i, v_i) HDW_i$$

$$+\beta_5(u_i, v_i) ANC_i + \beta_6(u_i, v_i) SBA_i + \beta_7(u_i, v_i) WQ_i + \beta_8(u_i, v_i) MDEX_i + \mu_0$$

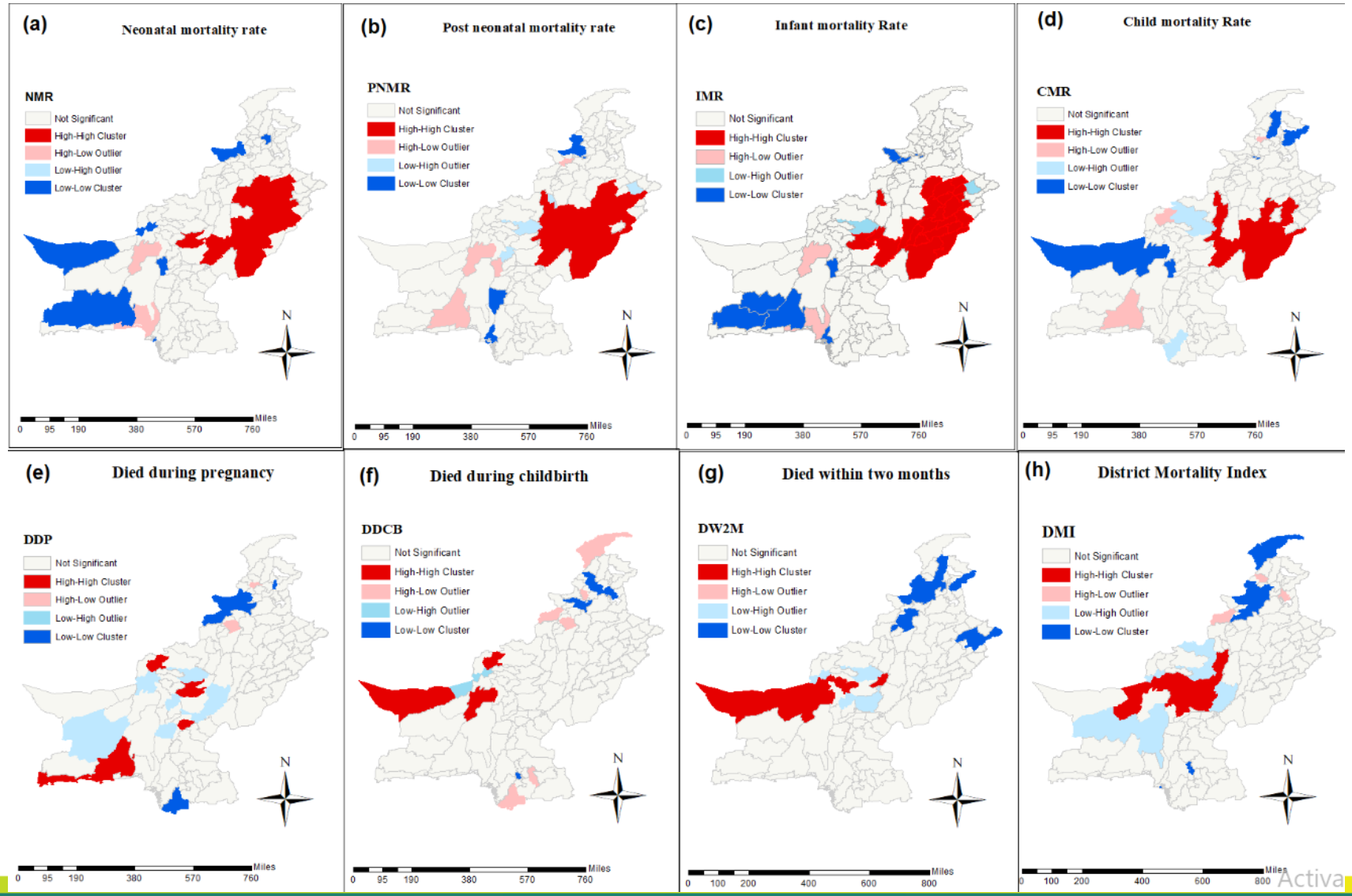
Results: spatial variation of DMI and MCMs in Pakistan



Results: Global Moran's I of DMI and MCMs in Pakistan

Variable	Moran's I	E(I)	SD(I)	Z-scores	P-values
Neonatal mortality rate	0.316	-0.0071	0.00261	6.325	0.000
Post-neonatal mortality rate	0.301	-0.0071	0.00259	6.056	0.000
Infant mortality rate	0.352	-0.0071	0.00261	7.026	0.000
Child mortality rate	0.226	-0.0071	0.00260	4.580	0.000
Died during pregnancy	0.120	-0.0071	0.00249	2.564	0.010
Died during childbirth	0.073	-0.0071	0.00179	1.894	0.058
Died within two months	0.1887	-0.0071	0.00227	4.109	0.000
District mortality index	0.303	-0.0071	0.00243	6.291	0.000

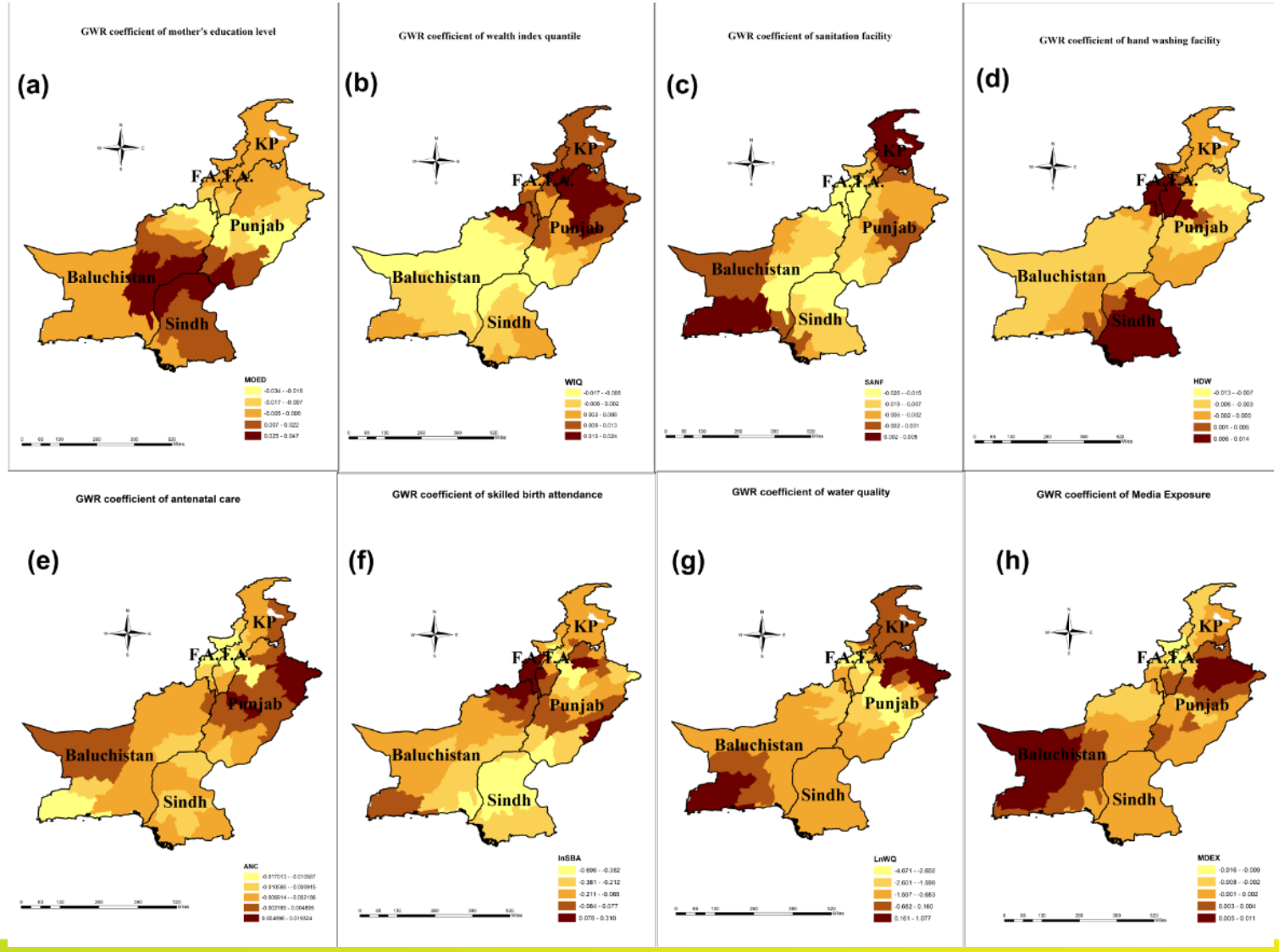
Results: Local Moran's I of DMI and MCMs in Pakistan



Results: Global (OLS) and Local (GWR) Regression results

Ordinary Least Square results (Global Regression results)								
Variable	β score	S.E	t-stats	RSS			60.301	
Intercept	0.004	2.158	0.002	Total number of parameters			9	
MOED	-0.001	0.001	0.034	ML-based global sigma values			0.653	
WIQ	0.010	0.003	2.951***	Unbiased global sigma estimates			0.675	
LnWQ	-0.190	0.522	-0.364	CV			0.778	
SANF	-0.006	0.003	-1.781***	-2 log-likelihood			280.373	
ANC	-0.013	0.004	-3.245***	AICc			302.066	
LnSBA	-0.219	0.197	-1.109	BIC			329.861	
HDW	-0.003	0.001	-3.705***	Classic AIC			300.373	
MDEX	-0.002	0.002	-1.010	R^2			0.336	
Geographically Weighted Regression results (Local regression results)								
Variable	Mean	SD	Median	RSS			33.135	
Intercept	3.024	4.777	3.093	Bandwidth size			58	
MOED	-0.002	0.015	-0.001	ML-based global sigma values			0.484	
WIQ	0.003	0.009	0.006	Unbiased global sigma estimates			0.600	
LnWQ	-1.025	0.970	-1.077	CV			1.137	
SANF	-0.007	0.007	-0.004	-2 log-likelihood			195.949	
ANC	-0.003	0.006	-0.005	AICc			314.035	
LnSBA	-0.181	0.186	-0.154	BIC/MDL			400.438	
HDW	-0.001	0.005	-0.002	Classic AIC			278.591	
MDEX	-0.001	0.004	0.001	R^2			0.63	
				ANOVA				
				Source	SS	DF	MS	F
				Global Residuals	60.30	132		
				GWR improvement	27.16	40.11	0.67	
				GWR residual	33.13	91.88	0.36	1.87

Results: GWR coefficients of the study indicators on DMI scores



Conclusion

•Despite being the most developed province regarding healthcare facilities and literacy, Punjab has the highest child mortality rates.

•Maternal mortality and overall DMI scores were highest in Baluchistan as compared to other provinces, showing heterogeneity in health outcomes across the districts of Pakistan (Arif et al., 2022).

•The spatial analysis revealed that spatially clustered districts found in Punjab and eastern Baluchistan exhibited higher under-5 mortality and Maternal mortality rates with H-H clusters respectively.

•There are huge disparities in socioeconomic, environmental, health, and housing factors that are driving spatial inequalities in MCMs among districts in Pakistan.

•This spatial variation is also reflected in the DMI scores, highlighting the need for targeted interventions to address these inequalities and improve health outcomes across all districts.

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Thank you