

EFFECT OF RISING TEMPERATURE ON MATERNAL HEALTH OUTCOMES IN LAHORE METROPOLITAN

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ABSTRACT

Rising global temperatures pose increasing public health risks, particularly for vulnerable populations such as pregnant women. This study examined the effect of rising temperature on maternal health outcomes in Lahore Metropolitan, Pakistan. A quantitative cross-sectional design was employed, with data collected from 385 pregnant women using a structured interview schedule. Descriptive statistics, chi-square analysis, and linear regression were applied to assess the relationship between temperature exposure and maternal health conditions. The findings reveal that rising temperature significantly predicts adverse maternal health outcomes ($\beta = 0.462$, $p < 0.001$), explaining 21.3% of the variance in maternal health status. Women experiencing higher temperature impact reported greater health complications compared to those with lower exposure. The results highlight the intersection of climate vulnerability and maternal health risk in urban settings. The study underscores the need for climate-sensitive maternal healthcare policies and adaptive urban infrastructure to mitigate heat-related health effects among pregnant women.

Keywords: Rising temperature, maternal health, climate change, heat exposure, urban vulnerability.

INTRODUCTION

One of the most obvious and immediate effects of the climate change has turned out to be increasing global temperatures. During the last decades, cities have become subject to heatwaves, extended warm seasons and rising average temperature. The Intergovernmental Panel on Climate Change (IPCC, 2021) states that global surface temperatures are on the increase, and the consequences of this matter have a significant impact on human health. Exposure to heat has now been cited as a significant risk factor to the environment especially in the highly populated urban areas.

The pregnant women are regarded as a biologically vulnerable population when it comes to an increase in temperature. When a woman is

pregnant, her body experiences dramatic changes which include a larger volume of blood, high level of metabolism and a misalignment of thermoregulation. The changes render pregnant women susceptible to dehydration and thermal stress. The possible impact of high temperatures on the body is fatigue, unstable blood pressure, dehydration, and complication of the pregnancy (Chersich et al., 2020). There are associations between extreme heat exposure and adverse maternal and neonatal outcomes such as preterm birth and low birth weight that have been reported in international studies (Lakhoo et al., 2025).

Urban living increases the exposure to heat even more due to the fact that cities exhibit the urban heat island effect. The increase in ambient

temperature levels in the metropolis is caused by concrete surfaces, lack of green space, traffic emissions, and crowded housing construction. In such cities as Lahore, fast urbanization and environmental deterioration have led to a rise in the level of temperature during the summer seasons. An increase in the exposure to temperature in these environments can have a direct impact on the maternal health conditions. Extreme weather conditions can also affect access to maternal healthcare services besides the impact they have on physical health. Being less mobile, the overcrowding of healthcare facilities, and the rise of financial pressures caused by energy and water prices may all be observed during hot spikes. Pregnant mothers can put off or restrict traveling in hot weather. These interruptions have the potential of indirectly exacerbating the health of the mothers. Climate-related heat exposure is acknowledged by the World Health Organization (WHO, 2021) as an increasingly pressing public health problem and a specific problem in low- and middle-income nations that have minimal adaptive infrastructure.

In spite of the fact that international literature has investigated the connection that exists between heat exposure and maternal outcomes, there is only scarce empirical data in city Pakistan. A majority of local research is aimed at general environmental health as opposed to temperature-specific maternal effects. Furthermore, limited research studies exist to determine the impact of increased temperature on health-related problems of pregnant women and access to maternal healthcare services in one analytical model.

The critical context on which the issues are investigated is presented by Metropolitan Lahore. In recent years, the city has had rising temperatures during summer, heat warnings, and stress on the environment. Vulnerability could also be increased by socioeconomic differences within neighborhoods. Increased heat exposure-Pregnant women, in low-income neighborhoods, can be exposed to more heat because of poor housing ventilation, low cooling systems, and lack of access to healthcare services.

In the current research, the researcher seeks to investigate how increasing temperature influences the health of mothers in the metropolitan Lahore.

In particular, the research question is whether an increase in temperature has a great impact on health problems of women during pregnancy. This research offers a specific study of heat effects maternal vulnerability in the context of urban Pakistani through the specific lens of temperature exposure.

Methodology

The research design in this study was quantitative cross-sectional research design in order to investigate the impact of increased temperature on the health outcomes of the mothers in Lahore Metropolitan. This was deemed suitable and appropriate because the study would cross-sectional where exposure to increasing temperature and maternal health issues would be measured at one point in time and hence statistical evaluation of the relationship between climate stressors and pregnancy outcomes would be done. The quantitative method was chosen because it was to produce quantifiable evidence and determine statistically significant correlations between temperature exposure and maternal health indicators.

The study was done in Lahore, the initial largest metropolis of Punjab, Pakistan. Lahore is a fast-growing urban environment with dense population, traffic jams, air pollution and urban heat island. The city has been facing frequent heat waves and extended days of extreme temperatures in the last few years, which is why it is a topical area to study the maternal health vulnerabilities to climate changes. Urban heat effects, a combination of socio-economic unbalance, and city infrastructural imbalances including electricity load shedding and water scarcity also adds to the stresses of the pregnant women to heat.

The study target population was pregnant women from second trimester and living in the selected urban regions of Lahore Metropolitan. Multi-stage sampling was used to make sure that representation was made across socio-economic backgrounds. In the first stage, Lahore was divided into five geographical zones. In the second stage, public and private sector healthcare facilities within these zones were taken as universe. In the final stage, eligible respondents were selected using random sampling. The sample size was

calculated using Cochran's formula for large populations with a 95% confidence level and 5% margin of error. Based on this calculation, a minimum sample of 384 respondents was required.

Data were collected using a structured interview schedule developed in accordance with the objectives of the study. Face validity of the instrument was ensured through expert review by specialists in sociology. Reliability analysis was conducted using Cronbach's Alpha to assess internal consistency of the composite constructs. A reliability coefficient of 0.70 or above was considered acceptable for inclusion in further analysis. Composite indices for temperature exposure and maternal health outcomes were generated by calculating mean scores of relevant items.

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS), version 26. Descriptive statistics, including frequencies, percentages were used to summarize socio-economic attributes and key variables. Bivariate analysis was conducted using the Chi-

square test to examine the association between categorized levels of temperature exposure and maternal health outcomes and Linear regression analysis was conducted to examine the effect of rising temperature on maternal health outcomes.

Results

Socioeconomic Characteristics

A total of 385 respondents were included in the study. The majority of participants were aged 25–30 years (42.1%), followed by 18–24 years (29.9%), indicating that most respondents were within the active reproductive age group. More than half of the respondents (54.3%) utilized private hospitals, while 27.0% relied on government facilities. Monthly household income was concentrated between 51,000–70,000 PKR (33.8%), though a notable segment earned below 50,000 PKR. Overall, the descriptive findings indicate considerable socio-economic and environmental vulnerability, which may increase susceptibility to heat-related maternal health risks in urban Lahore.

Table 1
 Socio-Economic Characteristics of Respondents

Sr. no	Description	Category	Frequency (f)	Percentage (%)
1.	Age composition (years)	18–24	115	29.9
		25–30	162	42.1
		31–35	75	19.5
		36–40	25	6.5
		40+	8	2.1
		Total	385	100.0
2.	Healthcare facility used	Government hospital	104	27.0
		Private hospital	209	54.3
		Clinic	72	18.7
		Total	385	100.0
3.	Education level	No formal education	46	11.9
		Primary pass	78	20.3
		Matriculation	129	33.5
		Intermediate	88	22.9
		Bachelor's or higher	44	11.4
		Total	385	100.0

Sr. no	Description	Category	Frequency (f)	Percentage (%)
		Total	385	100.0
4.	Occupation of Head of Household	Government Employ	58	15.1
		Private Employ	69	17.9
		Laborer	107	27.8
		Daily wages	94	24.4
		Unemployed	57	14.8
		Total	385	100.0
5.	Monthly household income (PKR)	Less than 30,000	42	10.9
		30,000-50,000	92	23.9
		51,000-70,000	130	33.8
		71,000-90,000	82	21.3
		More than 90,000	39	10.1
		Total	385	100.0

Bivariate Analysis

To examine the relationship between rising temperature and maternal health outcomes, both Chi-square analysis and linear regression were conducted. The Chi-square test was applied to assess the association between categorized levels of rising temperature exposure and maternal health issues. The results indicated whether a statistically significant association existed between the two variables. A p-value less than 0.05 was considered statistically significant. If the obtained p-value was ≤ 0.05 , the null hypothesis (H0) was rejected, indicating that rising temperature is significantly associated with maternal health issues.

To further examine the predictive effect of rising temperature on maternal health outcomes, linear regression analysis was performed. Rising temperature exposure was entered as the independent variable, while maternal health issues were treated as the dependent variable. The regression model assessed the strength and direction of the relationship. A statistically significant beta coefficient ($p \leq 0.05$) indicated that rising temperature significantly predicts maternal health complications.

Table 2

Association between rising temperature and maternal health outcomes

Rising Temperature Impact	Good Health n (%)	Moderate Health n (%)	Poor Maternal Health n (%)	Total
Low Temperature Impact	75 (56.8%)	28 (21.2%)	29 (22.0%)	132
Moderate Impact	25 (31.6%)	26 (32.9%)	28 (35.4%)	79
High Impact	24 (13.8%)	49 (28.2%)	101 (58.0%)	174
Total	124 (32.2%)	103 (26.8%)	158 (41.0%)	385

Pearson chi square = .00

The results indicate a clear pattern between rising temperature impact and maternal health status. Among respondents experiencing high temperature impact, 58.0% reported poor

maternal health, compared to only 22.0% among those experiencing low temperature impact. Conversely, good health was highest (56.8%) among women reporting low temperature impact

and lowest (13.8%) among those exposed to high impact. These findings suggest that increased

temperature exposure is associated with worsening maternal health outcomes.

Table 3

Linear Regression Analysis of Rising Temperature on Maternal Health Outcomes

Predictor	B	Std. Error	Beta	t	p-value
Constant	1.007	0.097	–	10.391	.000
Rising Temperature	0.472	0.046	0.462	10.185	.000

Model Fit Statistics

R = 0.462

R² = 0.213

Adjusted R² = 0.211

F(1, 383) = 103.726

p < 0.001

Linear regression analysis revealed that rising temperature significantly predicts maternal health outcomes ($\beta = 0.462$, $p < 0.001$). The model was statistically significant, $F(1, 383) = 103.726$, $p < 0.001$, explaining 21.3% of the variance in maternal health outcomes ($R^2 = 0.213$). The positive beta coefficient indicates that higher temperature exposure is associated with worsening maternal health conditions. Since $p < 0.001$, the null hypothesis (H_0) is rejected. Rising temperature has a statistically significant effect on maternal health outcomes.

Discussion

The findings of this study indicate that rising temperature significantly predicts adverse maternal health outcomes in Lahore Metropolitan. The regression results demonstrate that increased heat exposure is associated with worsening maternal health conditions, confirming that climate-related stressors have measurable health implications during pregnancy. These findings are consistent with a growing body of global research demonstrating that elevated ambient temperatures increase the risk of dehydration, hypertensive disorders, preterm birth, and other pregnancy-related complications (Bekkar et al., 2020; Chersich et al., 2020).

Exposure to heat during pregnancy places physiological stress (increased cardiovascular workload, decreased uteroplacental blood flow, thermoregulatory stress) that can potentially lead

to poor maternal outcomes (Zhang et al., 2022). Results of research in low- and middle-income nations also indicate that the health burden of extreme heat is increased among women experiencing poor socio-economic status and having little access to cooling, safe housing, and drinking water (Rylander et al., 2023). This structural vulnerability framework is consistent with the descriptive results of the current research that seek to indicate poor housing conditions and water scarcity.

The urban heat island effect is especially vulnerable to urban environments, in which built environments increase ambient temperatures, e.g., Lahore. Past studies have demonstrated that women who live in the heavily populated and infrastructurally inflicted regions are more exposed to the environmental heat and have lower adaptive abilities (Kuehn and McCormick, 2020). Here, environmental disparity is parallel to maternal health susceptibility, thus justifying the need to incorporate climate adaptation in reproductive health planning.

The statistically significant and positive value of the beta coefficient in this research indicates that increase in temperature is related, and also predictive of worsening of maternal health outcomes. Like quantitative data, recent epidemiological studies have reported similar quantitative data showing that there are significant relationships between heat waves and maternal morbidity (Wang et al., 2021). All these findings

underline the fact that climate change is a developing determinant of maternal health, especially in the fast urbanizing areas.

On the whole, the current research presents localized empirical data on the relationships between climate change and maternal health on the global level. It accentuates the necessity of climate-sensitive maternal healthcare policies, enhanced urban infrastructures, and specific heat adaptation interventions in order to safeguard at-risk pregnant women.

Conclusion

This paper finds that temperature increase affects the health outcome of mothers in Lahore Metropolitan in a significant way. These findings prove that the more the expectant mothers are exposed to heat, the more they tend to get their health conditions deteriorated, so the more vulnerable expectant women get in urban settings. The regression analysis results verify that the increase in temperature is not just an environmental issue but a quantifiable social health threat of maternal health. The socio-economic profile of respondents also signals the possibility that the factors that create an unfavorable environment in the form of poor housing, difficulty in accessing potable water, and economic instability could exacerbate the negative implications of extreme heat. Women who are living under environmentally and economically disadvantaged conditions seem to be more exposed to pregnancy related complications during high temperature seasons.

On the whole, the study highlighted the critical necessity of inclusion of climate-sensitive strategies in the planning of maternal healthcare and urban policy. Enhancing heat adaptation measures, infrastructure, and equitable access to basic facilities are key measures in shielding the maternal health amidst increasing temperatures.

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