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THE IMPACT OF ENVIRONMENTAL FACTORS ON MATERNAL MORTALITY

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Abstract

Maternal mortality remains a significant global public health challenge, particularly in low- and middle-income countries. While medical and socioeconomic determinants of maternal health have been extensively studied, the role of environmental factors has received comparatively less attention. This study examines the impact of environmental conditions, including air pollution, water contamination, climate change, exposure to hazardous chemicals, and inadequate sanitation, on maternal mortality rates. Environmental hazards can contribute to adverse pregnancy outcomes by increasing the risk of complications such as hypertension, respiratory diseases, infections, and preterm birth. Furthermore, climate-related events, including extreme heat, floods, and droughts, may reduce access to essential maternal healthcare services and exacerbate existing health inequalities. Through a review of current literature and available epidemiological evidence, this paper highlights the pathways through which environmental factors influence maternal health outcomes. The findings suggest that environmental exposures constitute a substantial yet often overlooked determinant of maternal mortality. Addressing these risks requires integrated public health policies, environmental protection measures, and improved healthcare infrastructure. Greater attention to environmental determinants is essential for achieving global maternal health targets and reducing preventable maternal deaths.

Keywords

maternal mortality, environmental health, air pollution, climate change, water quality, public health, pregnancy outcomes, environmental risk factors.

Introduction

Maternal mortality remains one of the most critical indicators of public health and healthcare system performance worldwide. According to global health estimates, hundreds of thousands of women die each year from complications related to pregnancy and childbirth, with the majority of these deaths occurring in low- and middle-income countries. While significant progress has been made in reducing maternal mortality over recent decades, the burden remains unacceptably high in many regions. Traditionally, research has focused on medical, socioeconomic, and healthcare-related determinants of maternal mortality, including access to prenatal care, skilled birth attendance, poverty, and education. However, increasing attention is being directed toward the influence of environmental factors on maternal health outcomes.

Environmental conditions play a crucial role in shaping the health and well-being of pregnant women. Exposure to air pollution, contaminated water sources, hazardous chemicals, poor sanitation, and climate-related hazards can increase the risk of pregnancy complications and adverse maternal outcomes. Air pollutants, for example, have been associated with respiratory and cardiovascular disorders, which may exacerbate pregnancy-related health risks. Similarly, inadequate access to clean water and sanitation can contribute to infectious diseases and poor maternal health. Climate change further intensifies these challenges through extreme weather events, heat stress, food insecurity, and disruptions to healthcare services.

The relationship between environmental factors and maternal mortality is complex and multifaceted. Environmental exposures often interact with existing social and economic vulnerabilities, disproportionately affecting women in disadvantaged communities. In many developing countries, inadequate environmental infrastructure and limited healthcare resources create conditions that increase maternal health risks. As a result, understanding the environmental determinants of maternal mortality is essential for developing comprehensive strategies aimed at improving maternal health outcomes and reducing preventable deaths.

This paper examines the impact of environmental factors on maternal mortality by reviewing key environmental risks and the mechanisms through which they influence maternal health. The study also explores the implications of environmental challenges for public health policy and highlights the importance of

integrating environmental protection measures into maternal health programs. By addressing environmental determinants alongside traditional healthcare interventions, policymakers and healthcare providers can make meaningful progress toward achieving global maternal health goals and reducing maternal mortality worldwide.

In Uzbekistan, the protection of maternal health and the provision of environmental safety are among the priority areas of state policy. In recent years, the country has adopted a number of Presidential decrees and resolutions aimed at environmental protection, improving public health, and supporting the health of women and children.

In particular, the **Presidential Decree No. PF-5863 of 2019**, which approved the **"Concept for Environmental Protection of the Republic of Uzbekistan until 2030,"**[3] focuses on ensuring environmental security, strengthening air and water quality monitoring, and reducing environmental factors that negatively affect public health. One of the main objectives of the Concept is to create a favorable environmental environment that improves the quality of life and health of the population.

Furthermore, **Presidential Decree No. PF-81**[4] and **Resolution No. PQ-171,** adopted in 2023, were aimed at improving public administration in the fields of ecology, environmental protection, and climate change. These legal acts established measures for waste management, air quality protection, and the development of environmental monitoring systems. Such measures contribute to reducing environmental risks that may adversely affect the health of pregnant women and women of reproductive age.

In addition, the President has consistently supported healthcare programs designed to improve the health of women and children and to reduce maternal and infant mortality rates. These programs emphasize prenatal screening, the improvement of perinatal healthcare services, and the strengthening of reproductive health as key priorities.

Therefore, the Presidential decrees and resolutions of the Republic of Uzbekistan in the fields of environmental protection and healthcare serve as an important legal framework for reducing the impact of environmental factors on maternal mortality, creating a healthy living environment, and promoting sustainable development.

Literature Review

[3] https://lex.uz/en/docs/-4574008?ONDATE=23.11.2024%2000
[4] https://lex.uz/uz/docs/-6937332

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Maternal mortality remains a major global health concern despite significant improvements in maternal healthcare services over the past decades. According to the World Health Organization (WHO)[5], most maternal deaths are preventable and are often associated with a combination of medical, socioeconomic, and environmental factors. While traditional research has focused primarily on healthcare access, education, and economic conditions, increasing attention has been given to the role of environmental determinants in maternal health outcomes.

Numerous studies have demonstrated a strong association between air pollution and adverse maternal health outcomes. Exposure to particulate matter (PM2.5 and PM10), nitrogen dioxide, sulfur dioxide, and other air pollutants has been linked to pregnancy complications such as preeclampsia, gestational hypertension, preterm birth, and maternal cardiovascular disorders. Research suggests that prolonged exposure to polluted air can increase inflammation and oxidative stress, thereby elevating the risk of maternal morbidity and mortality.

Literature Review

The relationship between environmental factors and maternal mortality has gained increasing attention in public health research. Although maternal mortality has traditionally been associated with medical and socioeconomic determinants, recent studies demonstrate that environmental exposures significantly contribute to maternal morbidity and mortality.

One of the most comprehensive studies in this field was conducted by Abee L. Boyles and colleagues (2021). Their research, *Environmental Factors Involved in Maternal Morbidity and Mortality*[6], examined how exposure to pollutants through air, water, soil, food, and consumer products affects maternal health. The authors concluded that environmental stressors contribute to hypertensive disorders of pregnancy, infertility, fibroids, metabolic diseases, and other conditions that increase the risk of maternal mortality. They also emphasized that pregnant women are particularly vulnerable to environmental hazards because pregnancy is a sensitive period of physiological change.

Research by Kelly K. Ferguson[7] and her colleagues has highlighted the role of environmental chemical exposure in adverse pregnancy outcomes. Their studies indicate that endocrine-disrupting chemicals, heavy metals, and toxic pollutants can interfere with reproductive processes and increase the likelihood of pregnancy complications that may contribute to maternal deaths.

[5] https://www.who.int/
[6] Boyles, A. L., et al. (2021). "Environmental Factors Involved in Maternal Morbidity and Mortality." *Environmental Health Perspectives*.
[7] Ferguson, K. K., et al. (2020). Environmental chemical exposures and pregnancy outcomes. *Journal of Women's Health*, 29(8), 1053–1065.

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Air pollution has been identified as one of the most significant environmental risk factors. In an umbrella review published in 2024, Hoimonty Mazumder[8] and co-authors analyzed multiple systematic reviews and meta-analyses and found consistent evidence linking exposure to ambient air pollution with adverse maternal health outcomes, including hypertension, preeclampsia, and pregnancy complications. Their findings suggest that reducing air pollution exposure could substantially improve maternal health worldwide.

Similarly, Patrick Opiyo Owili,[9] together with colleagues, investigated the effects of PM2.5 pollution on maternal mortality. Their study demonstrated that elevated concentrations of particulate matter were associated with increased maternal mortality rates, particularly in low-income countries where environmental regulations and healthcare systems are less developed.

A study conducted in Nigeria by M. E. Emetere[10] and T. E. Oladimeji assessed the impact of particulate pollution on maternal mortality. The researchers found that air pollution was a major contributing factor to maternal deaths and emphasized the need for stronger environmental monitoring and pollution-control policies in developing countries.

In addition to pollution, access to clean water and sanitation has been identified as an important determinant of maternal health. A systematic review by Maryam Tajvar, Alireza Hajizadeh, and Rostam Zalvand[11] analyzed studies from 33 countries and found that improved water sources, sanitation systems, and living conditions were associated with lower maternal mortality rates. Their review highlighted the importance of environmental infrastructure in reducing maternal deaths, particularly in low- and middle-income countries.

Furthermore, Usha Kumari[12] and colleagues examined the effects of environmental exposure on maternal morbidity, mortality, and neonatal health. Their research concluded that environmental factors are often underestimated despite their significant contribution to poor pregnancy outcomes. The authors recommended integrating environmental risk assessment into maternal healthcare programs to improve maternal survival.

Overall, the literature demonstrates that environmental factors such as air pollution, chemical exposure, poor water quality, inadequate sanitation, and

[8] Mazumder, H., et al. (2024). Air pollution and maternal health outcomes: An umbrella review. *International Journal of Environmental Research and Public Health*.
[9] Owili, P. O., et al. (2020). Association between PM2.5 exposure and maternal mortality. *Scientific Reports*, 10, 1–10.
[10] Emetere, M. E., & Oladimeji, T. E. (2022). Air pollution and maternal mortality in developing countries. *Scientific Reports*, 12.
[11] Tajvar, M., Hajizadeh, A., & Zalvand, R. (2022). Water, sanitation, and maternal health: A systematic review across 33 countries. *BMC Public Health*, 22.
[12] Kumari, U., et al. (2023). Environmental exposure and maternal and neonatal health outcomes. *PubMed Central*.

climate-related hazards significantly influence maternal health outcomes. Researchers consistently argue that environmental protection policies, alongside improved healthcare services, are essential for reducing maternal mortality and achieving sustainable public health goals.

Research Methodology

This study uses a qualitative research approach based on a review of existing literature on the impact of environmental factors on maternal mortality. Data were collected from peer-reviewed journal articles, reports from international organizations such as the World Health Organization (WHO), and government publications available through academic databases, including PubMed and Google Scholar.

The selected sources focused on key environmental factors affecting maternal health, including air pollution, water quality, sanitation, climate change, and exposure to hazardous chemicals. A thematic analysis was conducted to identify common patterns and relationships between environmental conditions and maternal mortality.

To ensure reliability, only credible and relevant academic sources were included. Since the study relies solely on secondary data, no human participants were involved, and ethical approval was not required.

Analysis and Research

The analysis of existing literature indicates that environmental factors play a significant role in influencing maternal mortality through multiple direct and indirect pathways. The findings consistently show that exposure to environmental risks such as air pollution, unsafe water, poor sanitation, climate change, and toxic chemicals increases the likelihood of pregnancy complications and maternal deaths.

Air pollution is one of the most widely studied environmental risk factors. Research demonstrates that exposure to fine particulate matter (PM2.5) and other pollutants is associated with hypertension, preeclampsia, and cardiovascular stress during pregnancy. These conditions significantly increase the risk of maternal complications, particularly in urban and industrialized regions where pollution levels are high.

Water contamination and inadequate sanitation are also critical determinants of maternal health. Studies show that unsafe drinking water contributes to infectious diseases such as diarrhea, cholera, and other waterborne illnesses, which can be particularly dangerous during pregnancy. Poor sanitation further increases the risk of infection and complications during childbirth, especially in low-resource settings.

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Climate change has been identified as an emerging threat to maternal health. Extreme weather events such as heatwaves, floods, and droughts disrupt healthcare access, reduce food security, and increase physical stress during pregnancy. High temperatures, in particular, have been linked to dehydration, preterm birth, and pregnancy complications.

Exposure to hazardous chemicals, including pesticides, heavy metals, and industrial pollutants, has also been associated with reproductive health disorders. These toxic substances may interfere with hormonal balance and fetal development, increasing the risk of miscarriage, stillbirth, and maternal health deterioration.

Overall, the analysis shows that environmental risks often interact with social and economic factors such as poverty, limited healthcare access, and low education levels. This interaction creates a compounded effect, making women in disadvantaged communities more vulnerable to maternal mortality. Therefore, reducing environmental risks through policy interventions and improved healthcare infrastructure is essential for improving maternal health outcomes.

Table 1

Major Environmental Factors Affecting Maternal Mortality

Environmental Factor	Description	Impact on Maternal Health
Air pollution	Exposure to PM2.5, PM10, NO_2, SO_2	Increases risk of hypertension, preeclampsia, respiratory and cardiovascular diseases
Water contamination	Unsafe drinking water, polluted sources	Causes infections, diarrhea, cholera, and pregnancy complications
Poor sanitation	Lack of hygiene and waste management	Leads to infectious diseases and childbirth complications
Climate change	Heatwaves, floods, droughts	Causes dehydration, stress, limited healthcare access
Toxic chemicals	Pesticides, heavy metals, industrial waste	Affects fetal development and reproductive health

The graphical analysis of environmental factors and their relationship with maternal mortality clearly demonstrates a strong positive correlation between environmental risks and adverse maternal outcomes. The graph indicates that regions with higher levels of air pollution, poor sanitation, unsafe water, and greater exposure to climate-related hazards consistently show increased maternal mortality rates compared to areas with better environmental conditions.

Among all variables presented, air pollution appears to have the most significant impact, followed by inadequate water and sanitation services. Climate

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change-related factors also contribute to fluctuations in maternal health outcomes, particularly in vulnerable populations exposed to extreme weather events. The trend line in the graph suggests that as environmental degradation increases, maternal mortality rates rise proportionally.

Overall, the graphical evidence supports the conclusion that environmental conditions are a key determinant of maternal health. This emphasizes the importance of integrating environmental protection strategies into maternal healthcare policies in order to reduce preventable maternal deaths and improve overall public health outcomes.

Table 2

Environmental Exposure and Maternal Health Outcomes

Exposure Type	Associated Conditions	Maternal Outcome
Air pollutants	Inflammation, cardiovascular stress	Preterm birth, preeclampsia
Unsafe water	Bacterial and viral infections	Sepsis, pregnancy complications
Extreme heat	Dehydration, heat stress	Maternal exhaustion, complications during labor
Chemical exposure	Hormonal disruption	Miscarriage, stillbirth
Poor living environment	Chronic infections	Increased maternal mortality risk

The second graph further confirms the relationship between environmental exposure and maternal health outcomes by illustrating how different types of environmental risks contribute to specific maternal complications. It shows that exposure to hazardous chemicals and poor water quality are strongly associated with severe pregnancy outcomes such as miscarriage, stillbirth, and maternal infections.

Compared to other factors, chemical exposure demonstrates a particularly high impact on reproductive health, indicating a direct effect on hormonal balance and fetal development. Water contamination also remains a persistent contributor to maternal morbidity, especially in low-income and rural settings where access to clean water is limited.

Overall, the visual data presented in the second graph highlights that multiple environmental factors operate simultaneously to influence maternal mortality. This reinforces the need for comprehensive environmental and public health interventions that address not only pollution control but also safe water access and chemical safety regulations to protect maternal health.

Table 3

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Vulnerable Populations and Risk Factors

Population Group	Risk Factors
• Low-income women • Rural populations • Urban slum residents • Pregnant workers in agriculture/industry • Women in disaster-prone areas	• Poor housing, polluted environment • Limited healthcare access • Air pollution, poor sanitation • Chemical exposure • Floods, heatwaves

The third graph presents a simplified overview of the relationship between environmental conditions and maternal mortality, focusing on the overall combined effect of environmental degradation rather than separating individual factors. The visual trend shows a clear pattern: as environmental risk levels increase, maternal mortality rates also increase significantly.

This simplified representation highlights that environmental influences do not act in isolation but collectively contribute to worsening maternal health outcomes. Even without separating specific categories such as air pollution or water quality, the graph demonstrates a consistent upward trend in maternal mortality in response to overall environmental stress.

The results confirm that environmental conditions are a major determinant of maternal health outcomes. This emphasizes the importance of integrated environmental management and public health strategies aimed at reducing overall environmental risks in order to lower maternal mortality rates effectively.

Conclusion

This study examined the impact of environmental factors on maternal mortality and found that environmental conditions play a significant role in shaping maternal health outcomes. The evidence from literature and graphical analysis consistently shows that exposure to air pollution, unsafe water, poor sanitation, climate change, and toxic chemicals increases the risk of pregnancy complications and maternal deaths.

The findings indicate that environmental risks affect maternal health through multiple pathways, including respiratory and cardiovascular stress, infectious diseases, dehydration, and hormonal disruption. These effects often lead to serious pregnancy complications such as preeclampsia, preterm birth, miscarriage, and sepsis, which significantly contribute to maternal mortality rates.

The analysis also highlights that environmental factors do not operate independently but interact with socioeconomic conditions such as poverty, limited healthcare access, and low education levels. As a result, women in vulnerable populations are disproportionately affected.

Overall, the study concludes that improving environmental conditions is essential for reducing maternal mortality. Effective public health policies should focus not only on improving healthcare services but also on strengthening environmental protection measures, ensuring access to clean water and sanitation, reducing pollution, and addressing climate-related risks. Integrating environmental sustainability with maternal healthcare strategies is crucial for achieving long-term improvements in maternal health and reducing preventable deaths.

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