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Trends and Causes of Maternal Mortality in Andijan Region, Uzbekistan

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Abstract Maternal mortality remains a critical indicator of healthcare quality and a major public health concern in Uzbekistan. Understanding its epidemiological and clinical determinants is essential for developing targeted preventive strategies. Methods: A retrospective descriptive study was conducted to analyze all registered maternal deaths (n = 89) in the Andijan region, Uzbekistan, from 2017 to 2024. Data were obtained from official medical and statistical records. The maternal mortality ratio (MMR) per 100,000 live births was calculated. Deaths were classified by direct and indirect causes, maternal age, parity, place of residence, and type of healthcare facility. Results: The MMR ranged from 11.3 to 14.9 per 100,000 live births, with a mean of 13.7. Direct obstetric causes accounted for 69.7% of deaths, primarily preeclampsia and obstetric hemorrhage (24% each). Indirect causes, including pneumonia and COVID-19 complications, represented 13%. Mortality was higher in rural than in urban areas (MMR 14.6 vs. 12.0). Women under 19 and over 35 years had significantly greater risk (RR 5.55 and 22.71, respectively) compared to the 20–29-year age group. Primiparous women comprised 40.4% of cases. Conclusion: Maternal mortality in the Andijan region remains a pressing public health issue, dominated by preventable direct causes. Targeted interventions should focus on rural populations, adolescents, older mothers, and primiparous women. Improving emergency obstetric care, surveillance, and access to skilled delivery services is essential for further reducing maternal mortality.

Keywords Maternal Mortality, Pregnancy Complications, Preeclampsia, Postpartum Hemorrhage, Risk Factors, Uzbekistan

1. Introduction

Maternal mortality (MM) is a key indicator of the state of the healthcare system and the social well-being of the population. According to the World Health Organization (WHO), approximately 810 women worldwide die daily from complications related to pregnancy or childbirth, with 60% of these MM cases being preventable [1]. The maternal mortality ratio (MMR), defined as the number of maternal deaths per 100,000 live births, is among the principal indicators for achieving the Millennium Development Goals (MDGs) and the United Nations Sustainable Development Goals (SDGs) [2,4]. A high level of MM constitutes a serious challenge that necessitates analysis and the development of strategies to improve the quality of medical care and social support for women during pregnancy.

In the Republic of Uzbekistan, comprehensive changes have been implemented in the healthcare sector since gaining independence, including extensive reforms across all medical fields, which have significantly contributed to improving the quality of healthcare services for the population. The protection of maternal and child health remains a priority policy area in the country. As a result of these reforms, over the past 25 years, the MMR in Uzbekistan has decreased more than threefold: from 65.5 per 100,000 live births in 1990 to 18.9 in 2015. Despite this progress, the rate of decline in MM slowed during the period 2000–2017, amounting to 36% [3]. At the 2015 United Nations Summit, a set of SDGs was adopted, including the goal of reducing MM by one-third by 2030 compared to 2015 levels. As a UN member, Uzbekistan endorsed these goals and adopted several key documents to support their implementation: the "National Goals and Objectives for Achieving the United Nations Sustainable Development Goals until 2030" in 2017; Resolution No. 841 "On Measures for the Implementation of National Goals and Objectives in the Field of Sustainable Development until 2030" in 2018; and Resolution No. 83 "On Additional Measures to Accelerate the Implementation of National Goals and Objectives in the Field of Sustainable Development until 2030" in 2022 [4-7].

Despite healthcare reforms and policy initiatives, there are few comprehensive regional analyses of MM in Uzbekistan.

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The Andijan region, with its large population and predominantly rural demographics, represents an important case for assessing maternal health outcomes and identifying persisting risk factors.

Study aim and research question.

This study aimed to conduct a retrospective analysis of MM in the Andijan region of Uzbekistan between 2017 and 2024, focusing on trends in the MMR, underlying causes of death, and associated demographic and obstetric risk factors. The primary research question was: what are the leading causes and determinants of MM in the region during this period?

Study type.

Given its retrospective and descriptive design, the study is exploratory in nature. It was intended to generate evidence on risk patterns and to inform targeted preventive strategies, rather than to test a predefined hypothesis.

2. Materials and Methods

This study is a retrospective descriptive analysis based on statistical records and medical documentation provided by local health authorities. All data were anonymized to maintain confidentiality.

The total number of live births in the Andijan region during the study period (2017–2024) was collected and used as the denominator to calculate the maternal mortality ratio (MMR), ensuring the accuracy and reliability of the findings.

Research methods included: descriptive statistics and epidemiological analysis to assess trends in MMR, correlation analysis to examine associations between MM and various risk factors, data processing using Microsoft Excel. Microsoft Excel was utilized for data processing and statistical analysis due to its accessibility and capability for handling epidemiological datasets. However, to enhance the robustness of the results, additional statistical tests to assess the significance of observed trends and associations were conducted using appropriate software tools.

Limitations of this study include potential inaccuracies or incompleteness in medical records, which may affect the comprehensiveness of the data.

Ethical Considerations. This study is a retrospective analysis based on anonymised registry data provided by the Andijan Regional Health Authorities. No direct contact with participants occurred, and no identifying information was collected. In accordance with national regulations in Uzbekistan, retrospective analyses of anonymised secondary data do not require formal approval by a research ethics committee or individual informed consent.

3. Results

During the study period, 89 maternal deaths were registered in the region. The MMR oscillated between 11.3 and 14.9 per 100,000 live births. The lowest value was recorded in 2017 (12.6), the highest in 2019 (14.9). The average ratio over the analyzed years was 13.73 ± 1.15. Despite observed fluctuations, no definitive upward or downward trend was identified; instead, the data reflect seasonal or random variations. The notable decline in 2024 may indicate positive developments in maternal healthcare or the effectiveness of preventive interventions (figure 1).

Regarding place of residence, 11 (12.3%) of the deceased women were urban residents, while 78 (87.6%) resided in rural districts, with respective MMR of 12.0 and 14.6. Therefore, residence in rural areas demonstrates a statistically significant association with an increased risk of MM, with a relative risk estimated at approximately 1.2–1.3. Analysis by districts and cities revealed the highest MMR in Karasu city, and the Ulugnor, Bustan, Asaka, and Khojaabad districts.

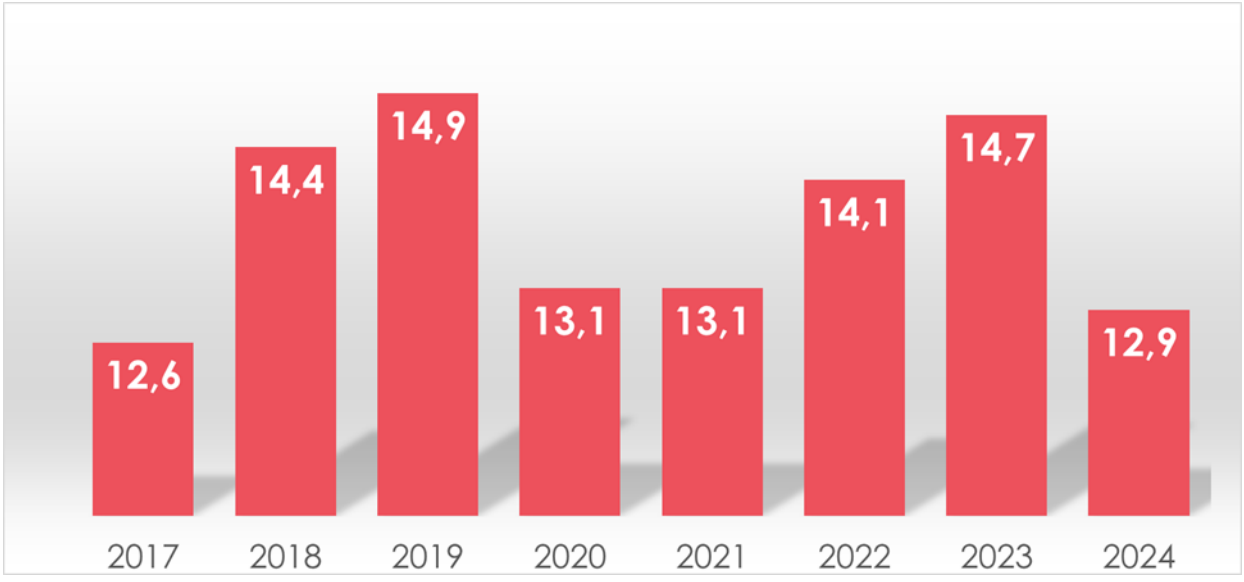

Figure 1. Trends in the maternal mortality ratio (MMR) per 100,000 live births in the Andijan region, Uzbekistan, 2017–2024. *Data were obtained from the official records of the Andijan Regional Health Authorities. MMR = maternal mortality ratio (number of maternal deaths per 100,000 live births)*

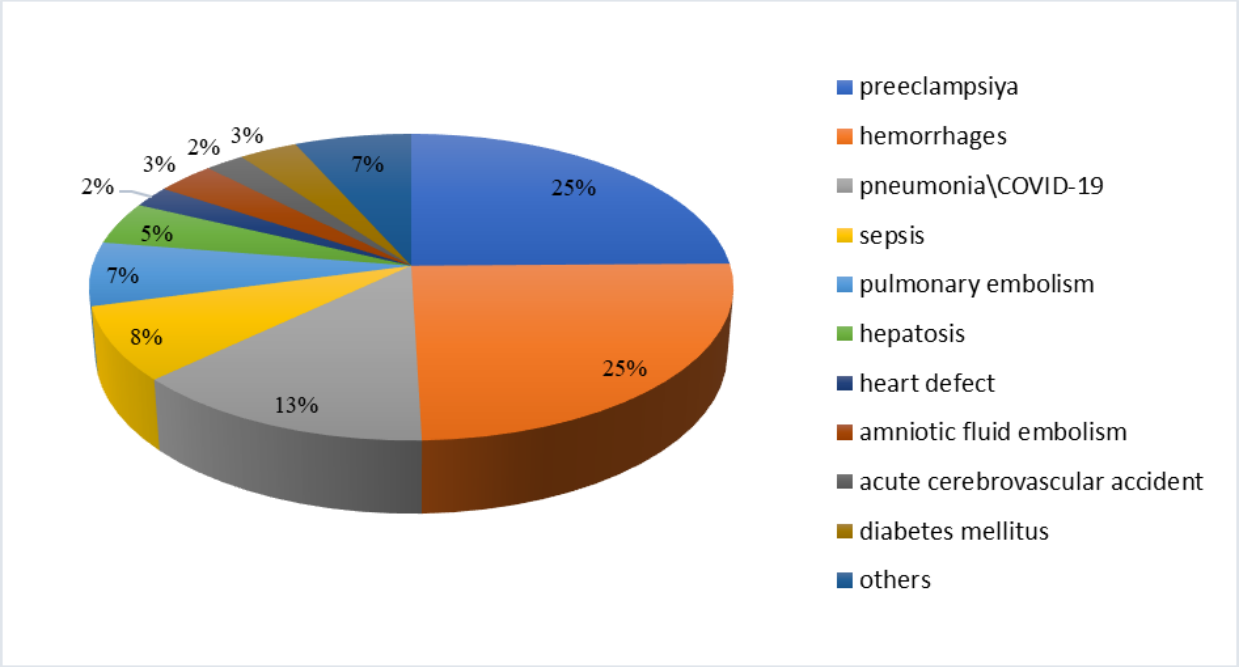

Figure 2. Distribution of maternal deaths by direct obstetric causes, Andijan region, 2017–2024. *Causes include postpartum haemorrhage, hypertensive disorders, sepsis, and other obstetric complications*

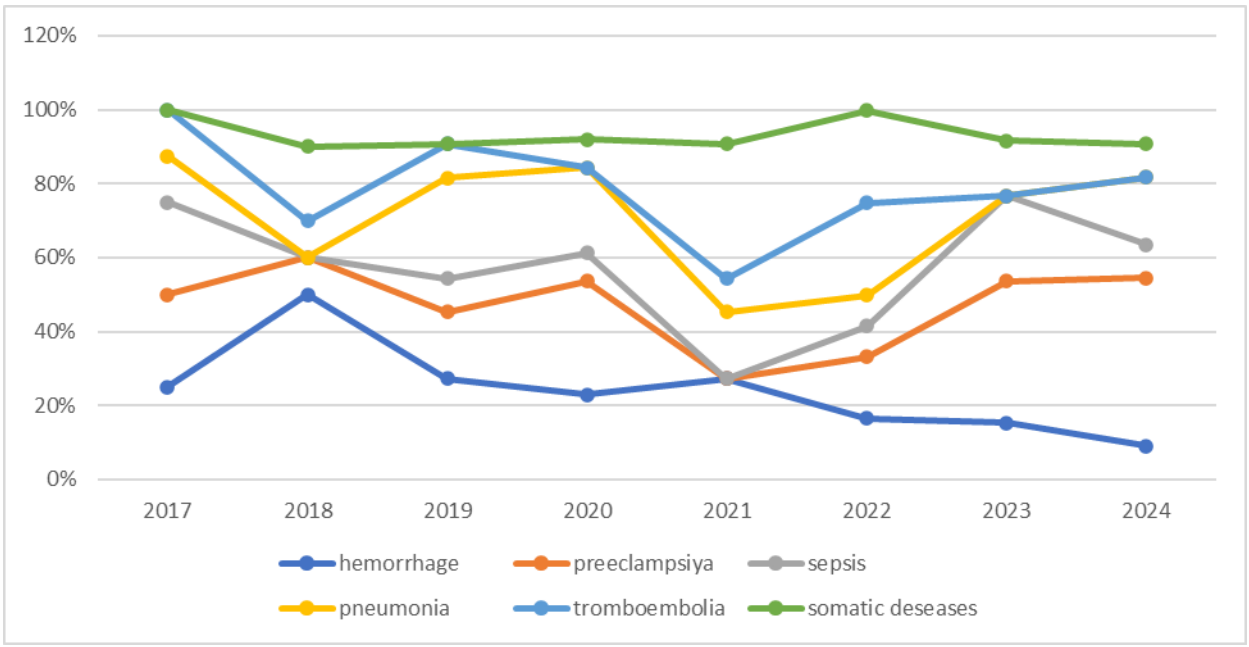

Figure 3. Dynamics of maternal mortality causes in the Andijan region, 2017–2024. *Trends are shown for major direct and indirect causes of maternal death, including haemorrhage, preeclampsia, sepsis, pneumonia, thromboembolism, and somatic diseases. Source: Andijan Regional Health Authorities*

Causes of Maternal Mortality. Figure 2 illustrates the structure of MM causes during 2017–2024. Preeclampsia and obstetric hemorrhage are the leading causes of MM, accounting for 24% each. Unlike previous years, pneumonia and COVID-19 complications among pregnant women rose to third place, accounting for 13.0% of deaths. Septic complications followed at 10.0%, pulmonary embolism at 8.0%, hepatosis at 5.0%, and amniotic fluid embolism at 3.0%. Other less frequent causes included leukemia, early toxicosis, liver cirrhosis, and suicide resulting from postpartum psychosis.

Figure 3 depicts annual distributions of the main causes. Hemorrhages and preeclampsia remained leading factors throughout the period, with considerable variability. In 2017, hemorrhages and preeclampsia represented approximately equal shares (38% and 37,5%, respectively), while in 2023 and 2024, the share of preeclampsia increased sharply to 50% and 45.4%. The incidence of sepsis varied from 0 to 25%, reflecting fluctuating impacts of infectious complications. Pneumonia showed elevated rates in 2019 and 2020 (27.2%

and 23%), declining thereafter. Pulmonary embolism showed notable variability, peaking at 25% in 2022 but absent in some years. Since 2021, comorbid somatic diseases have become more prominent, reaching 27–30% in 2023–2024, indicating growing influence of chronic conditions on maternal mortality (figure 3).

Direct obstetric causes accounted for 69.7% of maternal deaths, with indirect causes comprising 30.3%. Direct causes include haemorrhage, preeclampsia, sepsis, and thromboembolism; indirect causes include pneumonia and other somatic diseases. The predominance of direct causes suggests significant potential for further reduction of MM through targeted management and prevention, as most direct causes are controllable and preventable (figure 4).

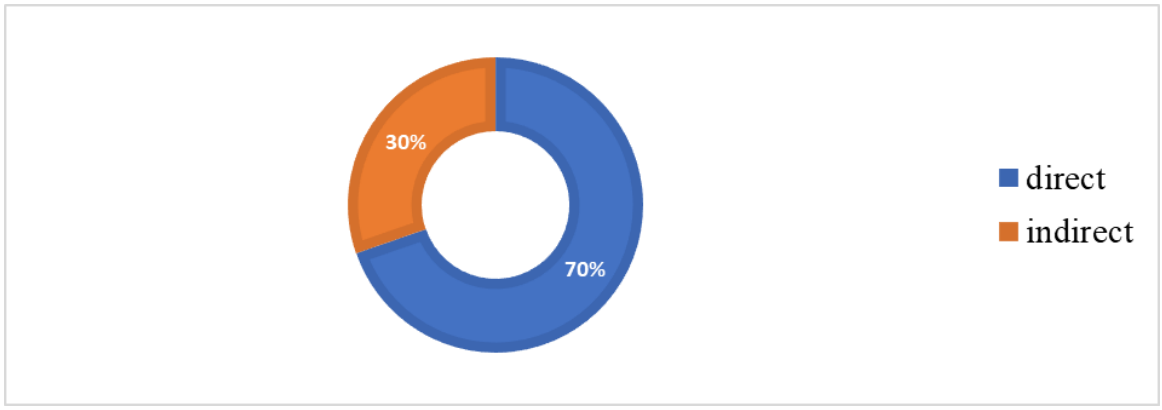

Figure 4. Structure of direct and indirect causes of maternal mortality in the Andijan region, 2017–2024. *Source: Andijan Regional Health Authorities*

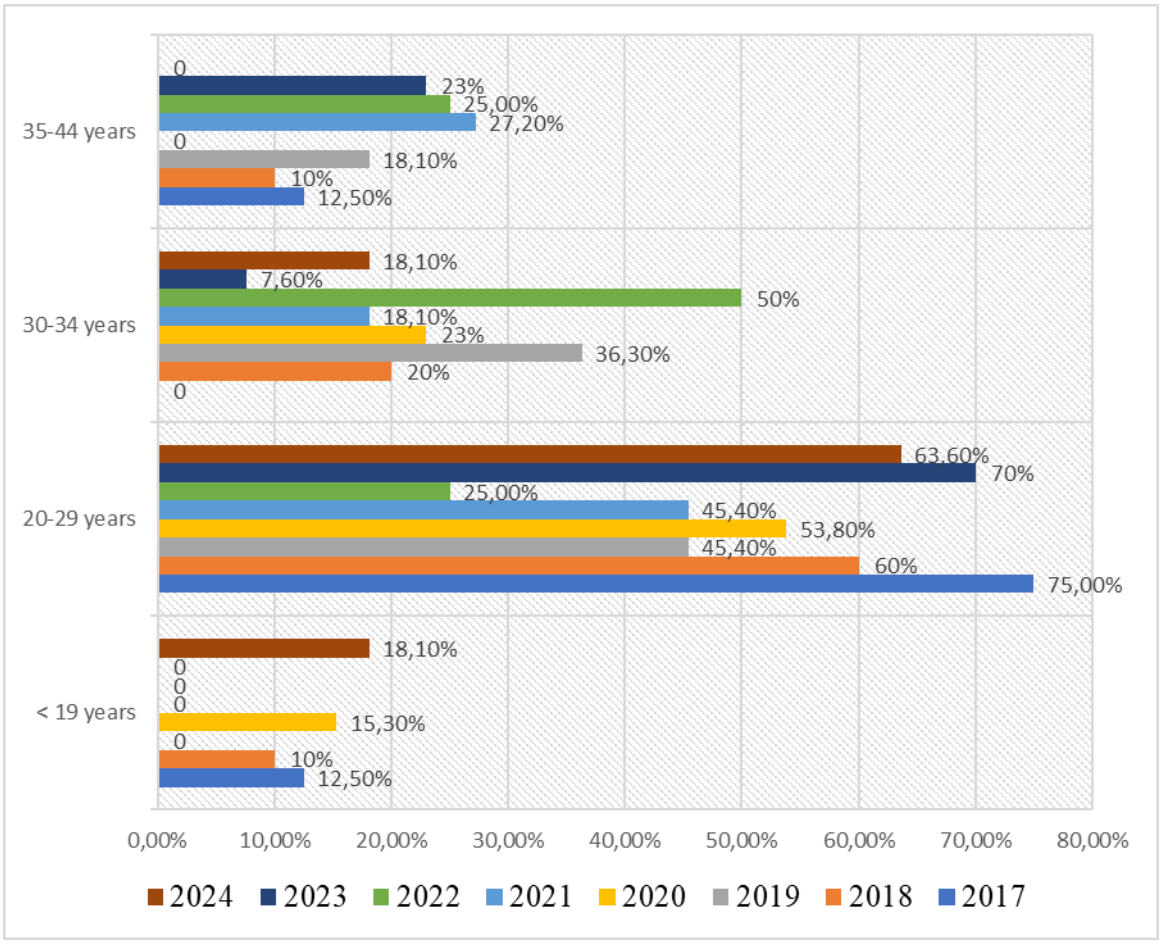

Figure 5. Maternal mortality by age group in the Andijan region, 2017–2024. *Data presented as percentages of total maternal deaths*

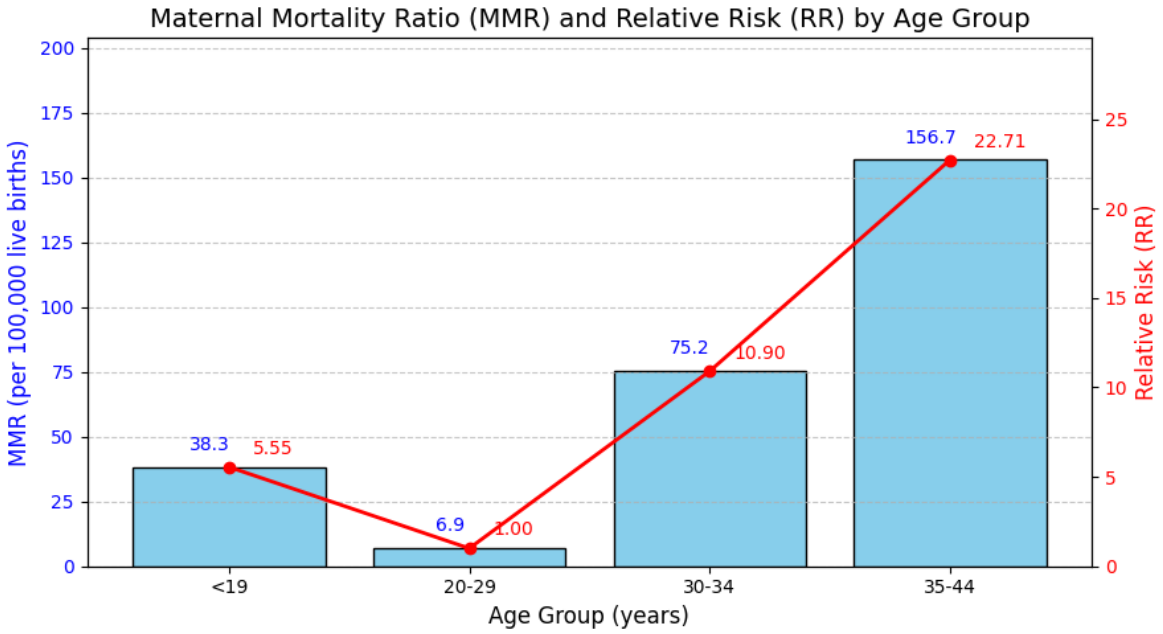

Figure 6. MM ratio and relative risk (RR) by age groups. Data normalized per 100 000 live births; RR calculated relative to 25–29 age group

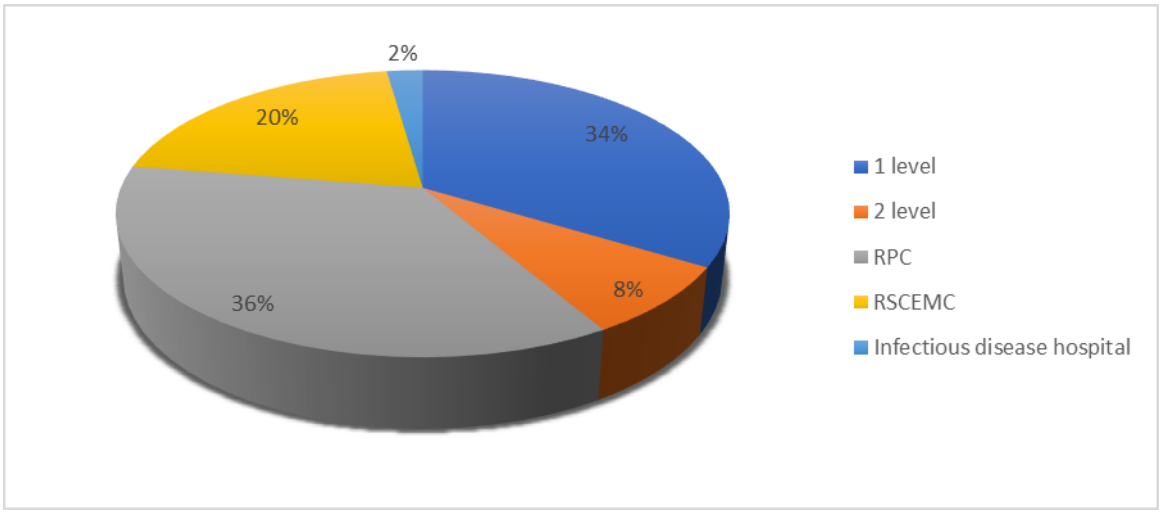

Figure 7. Location of maternal mortality cases in the Andijan region, 2017–2024. *Distribution of maternal deaths by type of medical organization, expressed as percentages of total cases. Statistically significant differences were observed across groups (χ^2 test, $p < 0.05$). Source: Andijan Regional Health Authorities*

Age-Related Risk Factors. MM was most common among women aged 20–29, reflecting both higher fertility and potential care gaps even among lower-risk groups. Women over 35 and adolescents (<19) had significantly higher relative risks of MM, with respective MMRs of 156.7 and 38.3 per 100,000 live births, compared to 6.9 in the 20–29 age group (figure 5).

The intensive MM rate per 100,000 live births for each age group, considering all births in the respective categories, is shown in Figure 6. The highest MMR was observed in women aged 35–44 years (156.7 per 100, 000 live births), nearly 23 times greater than the baseline group of 20–29 years (6.9 per 100, 000). The relative risk (RR) of MM also increased significantly with age, reaching 22.71 for women over 35 and 5.55 for those under 19. These findings indicate high risk in both younger and older maternal age groups, underscoring the need for targeted preventive measures for these populations (figure 6).

Parity. The data from 2017 to 2024 indicate that MM is most frequent among women in their first pregnancy, constituting 40.4% (36 cases) of total deaths. Women with two pregnancies represent 28.0% (25 cases), while those with three or four and more pregnancies each account for 15.7% (14 cases). Notably, the proportion of deaths among primigravida peaked in 2018 and 2020, exceeding 50%. In contrast, mortality among women with four or more pregnancies showed a peak in 2019 and 2022, with 27.2% and 33.3% respectively. These patterns suggest parity as an important risk factor with varying impact over time. The consistent presence of maternal deaths across all parity

groups underscores the importance of tailored healthcare strategies targeting both first-time and multiparous mothers (tab. 1).

Table 1. Maternal mortality by parity (order of pregnancy), Andijan region, 2017-2024. *Data presented as percentages of total maternal deaths*

Years	Number of pregnancy							
	1		2		3		≥ 4	
	abs	%	Abs	%	abs	%	Abs	%
2017	3	37.5	3	37.5	2	25.0	-	-
2018	5	50.0	3	30.0	2	20.0	-	-
2019	3	27.2	3	27.2	2	18.1	3	27.2
2020	7	53.8	-	-	3	23.0	3	23.0
2021	5	45.4	3	27.2	1	9.09	2	18.1
2022	2	16.6	5	41.6	1	8.3	4	33.3
2023	7	53.8	5	38.4	-	-	1	10.0
2024	4	36.3	3	27.2	3	27.2	1	9.09
Total	36	40.4*	25	28,0	14	15,7	14	15.7

Correlation between pregnancy order and the number of MM:
$r = –0.488$, $p = 0.0026$ → inverse relationship.
ANOVA ($p < 0.05$) confirms significant differences.

Location of MM cases. The analysis of MM distribution across different types of medical facilities demonstrated that the highest proportion of cases occurred in regional perinatal centers (36%) and first-level district medical organizations (34%). A considerable share of deaths was also registered in the Republican Scientific Center for Emergency Medical Care and its affiliated branches (20%). In contrast, a substantially lower proportion was observed in second-level city medical organizations (8%), while the lowest incidence was recorded in infectious disease hospitals (2%) (figure 7). The elevated proportion of cases in regional perinatal centers may be attributed to the referral and concentration of the most severe clinical conditions requiring highly specialized care. Meanwhile, the significant share of deaths at the first-level district organizations likely reflects delays in seeking medical assistance, limited capacity for early diagnosis, and resource constraints at the local level. MM cases identified in the Republican Scientific Center for Emergency Medical Care were predominantly associated with transfers of patients from obstetric hospitals in critical condition due to severe extragenital pathology, necessitating urgent specialized intervention. The minimal proportion of cases in infectious disease hospitals can be explained by their restricted role in providing obstetric and gynecological care.

4. Discussion

Summary of main findings

This study provides the first comprehensive retrospective analysis of MM in the Andijan region from 2017 to 2024. The MMR remained relatively stable during this period, fluctuating between 11.3 and 14.9 per 100,000 live births, with no clear downward trend. Direct obstetric causes, particularly preeclampsia and obstetric hemorrhage, predominated, while infectious diseases, including pneumonia and COVID-19 complications, also contributed substantially to maternal deaths. Mortality was significantly higher among rural residents, adolescents, women over 35 years, and primiparous mothers.

Preventive strategies should prioritize:

1. Early identification and management of hypertensive disorders.
2. Strengthening blood transfusion and hemorrhage control systems.
3. Expanding continuous professional training for obstetric staff.
4. Implementing digital surveillance and telemedicine tools to monitor high-risk pregnancies.

Interpretation and comparison with other studies

The predominance of preventable obstetric causes aligns with findings from other middle-income countries, where hemorrhage and hypertensive disorders remain leading contributors to maternal deaths. These causes are largely avoidable with timely diagnosis, effective referral, and adequate emergency obstetric care. The emergence of infectious causes, particularly during the COVID-19 pandemic, underscores the vulnerability of maternal health services to emerging public health threats. Our results on elevated risk among younger (<19 years) and older (>35 years) mothers are consistent with international evidence demonstrating age-related vulnerability. Similarly, the high proportion of deaths among primiparous women highlights the need for intensified monitoring during first pregnancies.

Public health implications

The higher MMR observed in rural areas reflects persistent inequalities in access to quality healthcare. Strengthening healthcare infrastructure, improving referral systems, and training obstetric personnel in rural districts should be prioritized. Preventive interventions targeting preeclampsia and obstetric hemorrhage, as well as integrated surveillance for infectious diseases, are essential for further reducing MM. Tailored community-based programs addressing adolescents, older mothers, and primiparous women are also warranted.

Strengths and limitations

As noted earlier, this study analysed all maternal deaths in the Andijan region over an eight-year period, ensuring complete population coverage and reliable epidemiological data. However, the retrospective design and reliance on medical records limited control over data quality, and missing clinical details restricted analysis of confounding factors.

Future research

Further prospective studies incorporating individual-level clinical data are needed to explore the underlying determinants of MM. Research should also assess the effectiveness of targeted interventions in reducing preventable obstetric deaths and in addressing inequalities between rural and urban populations.

5. Conclusions

MM in the Andijan region remains a persistent public health challenge. Preventable direct obstetric causes, particularly preeclampsia and obstetric haemorrhage, accounted for the majority of deaths, with higher risks observed among rural residents, adolescents, women over 35 years, and primiparous mothers.

Targeted interventions focusing on early detection and management of hypertensive disorders and haemorrhage, strengthening healthcare capacity in rural districts, and integrating infectious disease surveillance into maternal health services are essential. Tailored community-based programmes for high-risk groups should be prioritised to achieve further reductions in maternal mortality and to guide regional health policy.

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