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Infant mortality and stillbirths: a regional retrospective study

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ABSTRACT

Aims: The rates of infant mortality and stillbirths are crucial measures of healthcare quality and societal development. Significant strides have been achieved worldwide in lowering infant mortality rates since 1990. The infant mortality rate in Turkiye experienced a rapid decline up to 2010 but has stabilised since then. This study aims to investigate infant mortality and stillbirths comparatively within a provincial sample during 2024 and the first six months of 2025 to determine the factors influencing their temporal distribution patterns.

Methods: This study is a retrospective descriptive investigation examining infant deaths and stillbirths. The study population consists of all reported infant deaths and stillbirths in a specified province between 1 January 2024 and 30 June 2025, evaluated in six-month periods.

Results: The infant mortality rate increased significantly in the first half of 2025 compared with previous periods, standing at 6.5‰ in the first half of 2024, 5.6‰ in the second half of 2024, and 10.3‰ in the first half of 2025 (p=0.048). In contrast, no significant differences were observed in stillbirth rates between the periods (p>0.05). The proportion of male infants in the infant mortality group was significantly higher in the first half of 2025 (p=0.016). In the stillbirth group, the interval between pregnancies of ≥2 years (p=0.026) and the number of live births (p=0.047) were significantly higher in the first half of 2025. Other maternal, obstetric and neonatal characteristics were found to be similar between the periods.

Conclusion: In particular, the upward trend observed in the first six months of 2025 indicates the need to strengthen preventive healthcare services, improve the effectiveness of antenatal monitoring, and prioritise interventions targeting the early neonatal period.

Keywords: Stillbirth, infant mortality, neonatal mortality

INTRODUCTION

The rates of infant mortality and stillbirths are crucial measures of healthcare quality and societal development.[1] Babies born alive who die between 0 and 365 days old are considered infant mortality, regardless of their gestational age at birth and birth weight, whereas stillbirths are classified as deaths occurring after 22 weeks of gestation or at a birth weight of 500 g or more.[2] Tracking these metrics enables the identification of gaps in prenatal care, delivery practices, and postnatal support, which in turn informs public health interventions.

Significant strides have been achieved worldwide in lowering infant mortality rates since 1990.[3] These gains have been largely achieved due to changes in health systems, social, economic, and environmental factors, especially in low- and middle-income countries.[4] Substantial disparities continue to exist between nations. The infant mortality rate in Turkiye experienced a rapid decline up to 2010 but has stabilised since then. The distribution of deaths in Turkiye showed notable variations.[5] Infant mortality rates have decreased, yet stillbirths have shown either stability or an increase in certain geographic areas.[6] Consequently, stillbirths continue to pose a considerable public health issue. The need to prevent stillbirths should be given greater emphasis.[7]

This study aims to investigate infant mortality and stillbirths comparatively within a provincial sample during 2024 and the first six months of 2025 to determine the factors influencing their temporal distribution patterns.

METHODS

Ethics

The study was initiated with the approval of Non-interventional Scientific Researches Ethics Committee of Afyonkarahisar Health Sciences University (Date: 05.12.2025,

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Decision No: 15-802). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Population

This study is a retrospective descriptive investigation examining infant deaths and stillbirths occurring in a specific province. The study population comprised all reported cases of infant death and stillbirth between 1 January 2024 and 30 June 2025 in a specified province. In order to evaluate time trends, the study period was divided into six-month periods (first 6 months of 2024, second 6 months of 2024, first 6 months of 2025).

Definitions

Stillbirth is defined as the absence of signs of life at birth in foetuses after the 22nd week of pregnancy or with a birth weight of 500 g or more. Infant death is defined as death occurring before the age of one following a live birth. Infant deaths are classified into early neonatal (0-7 days), late neonatal (8-28 days), and post-neonatal (29 days-1 year) periods. Stillbirths are further divided into macerated and fresh stillbirths.

Data Sources and Variables

Data were obtained from Provincial Health Directorate records and relevant death notification forms. The variables examined included the infant's sex (male-female), mode of delivery (vaginal delivery-cesarean section), type of pregnancy (natural conception-assisted reproductive technology), number of foetuses, inter-pregnancy interval, time of death, gestational age, birth weight, maternal age, gravida, number of live births, and number of miscarriages.

Stillbirth and Infant Mortality Rate Calculations

Stillbirth and infant death rates were calculated by dividing the number of cases by the relevant birth population for the corresponding period and expressed per 1,000 births. Stillbirth rates were calculated using total births (live births+stillbirths) as the denominator. Infant mortality rates were calculated using live births as the denominator. The number of live births used for rate calculations was obtained from the national newborn heel-prick screening system records. Infant deaths were additionally classified according to timing of death as early neonatal, late neonatal, and post-neonatal mortalty, and subgroup-specific rates were calculated for each category. Perinatal mortality rates were calculated by dividing the sum of stillbirths and early neonatal deaths by the total number of births.

Statistical Analysis

Data analysis was performed using the SPSS software version 25. Categorical variables were summarised as frequency and percentage [n (%)], while continuous variables were summarised as median and interquartile range (IQR). The Kruskal–Wallis test was used to compare continuous variables between periods. The Fisher–Freeman–Halton exact test and Chi-square test were preferred for comparing categorical variables. For variables found to be statistically significant in general tests, pairwise comparisons were performed, and Bonferroni correction was applied in multiple comparisons. The level of statistical significance was accepted as $p<0.05$.

RESULTS

The study examined 90 infant deaths and 90 stillbirths. In 2024, 53.3% of infant deaths occurred, and the remaining 46.7% occurred during the first six months of 2025. In 2024, 57.8% of the stillbirths occurred, with the remaining 42.2% occurring in the first six months of 2025.

The infant mortality rate showed a statistically significant change across the study periods, decreasing from 6.5‰ in the first half of 2024 to 5.6‰ in the second half of 2024, followed by an increase to 10.3‰ in the first half of 2025 (p=0.034). The stillbirth rate varied across the periods but did not reach statistical significance, with rates of 7.2‰ in the first half of 2024, 5.8‰ in the second half of 2024, and 7.8‰ in the first half of 2025 (p=0.548) (Table 1).

Table 1. Distribution of infant deaths rate and stillbirths rate by six-month periods

	First half of 2024	Second half of 2024	First half of 2025	p
Infant mortalty rate ‰ (n/NLB)	6.5 (25/3868)	5.6 (23/4105)	10.3 (42/4090)	0.040
Stillbirths rate ‰ (n/TB)	7.2 (28/3896)	5.8 (24/4129)	7.8 (32/4122)	0.552

NLB: Number of live births, TB: Total births (Number of live births + number of stillbirths)

The early neonatal mortality rate showed a statistically significant increase across the study periods, rising from 1.8‰ in the first half of 2024 to 3.1‰ in the second half of 2024, and further to 6.6‰ in the first half of 2025 (p=0.002). No statistically significant differences were observed in the late neonatal mortality rate and post-neonatal mortality rate between the study periods (p>0.05). The perinatal mortality rate differed significantly across the study periods (9.0‰, 9.0‰, and 14.3‰, respectively; p=0.026) (Table 2).

Infant sex distribution differed significantly across the study periods (p=0.016). The proportion of male infants increased markedly in the first half of 2025 (81.0%) compared with the first and second halves of 2024 (52.0% and 52.2%, respectively). No statistically significant differences were observed between study periods regarding type of pregnancy, number of fetuses, mode of delivery, or interpregnancy interval (all p>0.05). (Table 3).

In the infant death group, no statistically significant differences were observed between study periods regarding gestational age, birth weight, number of pregnancies (gravida), number of live births, or number of miscarriages (all p>0.05) (Table 4).

Interpregnancy interval differed significantly across the study periods (p=0.026). Pregnancies with an interval of ≥2 years were more common in the first half of 2025 (65.8%) compared with the first and second halves of 2024 (32.1% and 33.3%, respectively). In contrast, the proportion of first pregnancies decreased in the first half of 2025. No statistically significant

Table 2. Distribution of early neonatal, late neonatal, and post-neonatal mortality rates by six-month periods

	First half of 2024	Second half of 2024	First half of 2025	p
Early neonatal mortality rate (n/NLB)	1.8 (7/3868)	3.1 (13/4098)	6.6 (27/490)	0.002
Late neonatal mortality rate (n/NLB)	2.6 (10/3868)	1.7 (7/4098)	2.2 (9/4081)	0.697
Post-neonatal mortality rate (n/NLB)	2.1 (8/3868)	0.7 (3/4098)	1.5 (6/4090)	0.280
Perinatal mortality rate (n/TB)	9.0 (35/3896)	9.0 (37/4129)	14.3 (59/4129)	0.026

NLB: Number of live births TB: Total births (Number of live births + number of stillbirths)

Table 3. Period-based distribution of infant deaths according to sociodemographic and obstetric characteristics

Variable	Category	First half of 2024	Second half of 2024	First half of 2025	P
Gender	Male	13 (52.0)	12 (52.2)	34 (81.0)	0.016
Type of pregnancy	Natural conception	23 (92.0)	18 (78.3)	37 (88.1)	0.377
Number of fetuses	Singleton	25 (100.0)	19 (82.6)	39 (92.9)	0.051
Mode of delivery	Cesarean section	15 (60.0)	19 (82.6)	31 (73.8)	0.218
Interpregnancy interval	First pregnancy	9 (36.0)	6 (26.1)	10 (23.8)	0.421
	≤1 year	1 (4.0)	0 (0.0)	4 (9.5)	
	1–2 years	2 (8.0)	3 (13.0)	9 (21.4)	
	≥2 years	13 (52.0)	14 (60.9)	19 (45.2)	

Percentages are presented as column percentages.

Table 4. Distribution of pregnancy and birth variables by period in infant death cases

	Median (IQR)	p
Gestational age (weeks)		
First half of 2024	29.0 (26.0–33.5)	0.572
Second half of 2024	34.0 (26.0–37.0)	
First half of 2025	29.5 (27.0–37.0)	
Birth weight (g)		
First half of 2024	1100 (785–1725)	0.759
Second half of 2024	1740 (750–2660)	
First half of 2025	1272.5 (761.25–2552.5)	
Number of pregnancies (gravida)		
First half of 2024	2.0 (1.0–3.5)	0.439
Second half of 2024	3.0 (1.0–4.0)	
First half of 2025	2.0 (1.75–3.0)	
Number of live births		
First half of 2024	1.0 (0.0–1.5)	0.495
Second half of 2024	1.0 (0.0–2.0)	
First half of 2025	1.0 (0.0–2.0)	
Number of miscarriages		
First half of 2024	0.0 (0.0–0.5)	0.445
Second half of 2024	0.0 (0.0–1.0)	
First half of 2025	0.0 (0.0–1.0)	

IQR: Interquartile range

differences were observed between the study periods regarding infant sex, type of pregnancy, number of fetuses, mode of delivery, or type of stillbirth (all p>0.05) (Table 5).

In the stillbirth group, the number of live births differed significantly across the study periods (p=0.047). The median number of live births was 0.5 (IQR: 0.0–1.75) in the first half of 2024, 0.0 (IQR: 0.0–1.75) in the second half of 2024, and 1.5 (IQR: 0.0–2.0) in the first half of 2025. No statistically significant difference was found between periods in pairwise comparisons adjusted using the Bonferroni correction (adj p>0.05). No statistically significant differences were observed between study periods regarding gestational age, birth weight, number of pregnancies (gravida), or number of miscarriages (all p>0.05) (Table 6).

DISCUSSION

In this study, infant mortality and stillbirths were analysed together in six-month periods. 46.7% of infant mortality and 42.2% of stillbirths occurred in the first six months of 2025. An increase in infant mortality was observed in 2025. In the sub-analyses based on time of mortality, early neonatal mortality and perinatal mortality increased in the first six months of 2025.

Perinatal infant deaths include infant deaths occurring from the 22nd week of pregnancy to 7th day of life (early neonatal). Perinatal deaths reflect the quality of maternal care, maternal health and nutrition, and obstetric and pediatric services provided during pregnancy.[8] Although the increase in the first six months of 2025 is considered to be closely related to health systems, the fact that it is a single-period increase requiresa cautious and close monitoring of future periods.

Maternal obesity is identified as the highest modifiable risk factor among the causes of stillbirths.[9] Advanced maternal age, low maternal education level, maternal smoking, first birth, history of stillbirth, anaemia, antepartum haemorrhage, referral admission, placental pathologies, maternal diabetes and hypertension are prominent factors contributing to stillbirth.[9,10]

Table 5. Period-based distribution of stillbirths according to sociodemographic and obstetric characteristics

Variable	Category	First half of 2024	Second half of 2024	First half of 2025	p
Infant sex	Male	17 (60.7)	14 (58.3)	13 (34.2)	0.058
Type of pregnancy	Natural conception	24 (85.7)	24 (100.0)	36 (94.7)	0.141
Number of fetuses	Singleton	27 (96.4)	24 (100.0)	34 (89.5)	0.217
Mode of delivery	Cesarean section	11 (39.3)	9 (37.5)	17 (44.7)	0.858
Interpregnancy interval	First pregnancy	12 (42.9)	12 (50.0)	10 (26.3)	0.026
	≤1 year	1 (3.6)	2 (8.3)	2 (5.3)	
	1–2 years	6 (21.4)	2 (8.3)	1 (2.6)	
	≥2 years	9 (32.1)	8 (33.3)	25 (65.8)	
Type of stillbirth	Macerated stillbirth	13 (46.4)	14 (58.3)	28 (73.7)	0.087

Percentages are presented as column percentages.

Table 6. Distribution of continuous variables related to pregnancy and birth in stillbirth cases by period

	Median (IQR)	p
Gestational age (weeks)		
First half of 2024	27.0 (22.5–34.0)	
Second half of 2024	26.0 (22.25–36.0)	0.809
First half of 2025	28.0 (24.0–35.25)	
Birth weight (g)		
First half of 2024	1125 (523.75–1875)	
Second half of 2024	890 (571.25–2736.25)	0.940
First half of 2025	1222.5 (542.5–2285.25)	
Number of pregnancies (gravida)		
First half of 2024	2.0 (1.0–3.0)	
Second half of 2024	1.5 (1.0–3.0)	0.086
First half of 2025	3.0 (1.0–3.0)	
Number of live births		
First half of 2024	0.5 (0.0–1.75)	
Second half of 2024	0.0 (0.0–1.75)	0.047
First half of 2025	1.5 (0.0–2.0)	
Number of miscarriages		
First half of 2024	0.0 (0.0–1.0)	
Second half of 2024	0.0 (0.0–0.0)	0.193
First half of 2025	0.0 (0.0–1.0)	

IQR: Interquartile range

A comprehensive review evaluating infant deaths indicated that maternal age, low occupational status such as manual labour and unemployment, opiate use, overweight and obesity, stillbirth history, hypertension, haemorrhagic diseases, maternal death, anaemia during pregnancy, low birth weight, and delayed initiation of breastfeeding are reported to increase infant mortality.[11] Previous caesarean delivery is associated with an increased risk of perinatal death and stillbirth.[12]

When infant deaths were evaluated in terms of sociodemographic and obstetric variables, gender was found to be significantly associated with the period distribution. Increase in male infant deaths in 2025. This finding is consistent with the literature. Male newborns face a higher rate of death than female newborns.[13,14] The rates of perinatal and early neonatal risk factors and adverse neonatal outcomes are higher in male infants.[14] These findings suggest that male infants have higher biological vulnerability in the early period of life.

When stillbirths are evaluated, although there was an increase in female stillbirths in 2025, this increase was not statistically significant. A review of the literature reveals no consistent pattern, with some studies reporting higher rates of male stillbirths and others reporting higher rates of female stillbirths, indicating variability between studies.[15–17] When the increase in male infant deaths and the increase in female stillbirths in 2025 are considered together in this study, these findings may indicate differences in the timing of perinatal loss.

In 2025, stillbirths are predominantly found in pregnancies with an inter-pregnancy interval of two years or more. The literature indicates that the risk increases in pregnancies occurring before six months.[18–20] However, long periods without pregnancy were also a risk factor for stillbirth, with the risk increasing particularly in pregnancies after sixty months.[18,20] A study evaluating data from 58 countries states that the relationship between pregnancy interval and stillbirth is not causal.[21] When collecting data for this study, those with intervals greater than twenty-four months were categorised under a single data point. Therefore, the exact pregnancy interval for those with intervals greater than twenty-four months is unknown.

In an evaluation based on the classification of stillbirths as macerated and fresh, macerated stillbirths were more common in the first six months of 2025. Macerated stillbirths are stillbirths in which the foetus has redness, skin peeling, and cranial changes at the time of delivery.[22] It is stated that the findings associated with maceration occur within 12-24 hours.[23] Factors associated with an increased risk of macerated stillbirth include intrauterine growth restriction and hypertension leading to foetal death, as well as maternal age (between 25 and 35 years).[24,25] An increase in macerated stillbirths may be considered an indicator that mothers do not consult their doctors even if they do not feel foetal movements for a long time.

Foetal movement is the simplest daily sign that allows the mother to assess the well-being of the foetus. Mothers begin to feel the baby's movements from 18 to 20 weeks onwards. A decrease or change in these daily movements of the foetus should be considered an important indicator.[26] Reports indicate that changes in foetal movement are linked to an increase in stillbirths, early labour, caesarean deliveries, and intensive care hospitalisations. Healthcare professionals should inform pregnant women about the normal movements and movement patterns of the baby during pregnancy and to seek immediate medical attention in case of any differences.[27]

Limitations

This study has certain limitations. The impact of missing or incorrectly recorded information on the study may be apparent as the data were retrospectively collected and based on records. As the study is limited to records, factors affecting the mother, such as socio-economic, environmental, and genetic factors, could not be evaluated. As it only includes a single province, the results' generalizability is limited. The results do not explain the causal relationship.

CONCLUSION

As a result, this study demonstrates that considering the temporal distribution of infant deaths and stillbirths together contributes significantly to understanding the burden of perinatal mortality. In particular, the upward trend observed in the first six months of 2025 indicates the need to strengthen preventive healthcare services, improve the effectiveness of antenatal monitoring, and prioritise interventions targeting the early neonatal period.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was initiated with the approval of Non-interventional Scientific Researches Ethics Committee of Afyonkarahisar University of Health Sciences (Date: 05.12.2025, Decision No: 15-802).

Informed Consent

This retrospective study used pre-existing anonymized patient data. No additional intervention was performed, and there was no direct patient contact. The study was approved by the Ethics Committee, and the requirement for written informed consent was waived by the ethics committee.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

The authors received no financial support for the conduct or publication of this research.

Author Contributions

Concept: YŞ; Design: YŞ, HÖ; Data Collection and/or Processing: YŞ, AÖ, FDÖ, BGK; Analysis and/or Interpretation: YŞ, HÖ; Literature Review: All Authors; Article Writing: YŞ; Manuscript Preparation: YŞ; Critical Review: All Authors.

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