

A Cross-sectional study of Maternal, Socioeconomic, and Clinical Determinants of Intrauterine Death

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KEYWORDS

Intrauterine death, maternal demography, Miscarriage,

ABSTRACT:

Objective: To identify the predominant causes of intrauterine death in the study population and assess the associations between age, socioeconomic status, and BMI

Methodology: This retrospective study analyzed 59 participants to assess maternal factors and causes of intrauterine deaths (IUIDs). Data on obstetric history, BMI, socioeconomic status, and fetal outcomes were collected using a structured proforma. Placental and cord evaluations, along with investigation reviews, were performed. Statistical analysis identified significant associations, with congenital anomalies and severe preeclampsia emerging as leading causes of IUID. Findings were compared with existing literature to highlight risk factors and improve antenatal care strategies.

Result: This study analyzed 59 participants (mean age 27.63 ± 1.47 years), predominantly from the APL category (74.6%) and with normal BMI (81.4%, mean 23.42 ± 1.31). Most (57.6%) had a degree, and 22% completed 10th grade. Severe preeclampsia (33.9%) and congenital anomalies (45.8%) were the leading causes of intrauterine death, followed by polyhydramnios, severe IUGR, abruption, and GDM. Socioeconomic status, BMI, and age did not show significant association with intrauterine death ($p > 0.3$). The findings highlight congenital anomalies and severe preeclampsia as major contributors, emphasizing the need for improved maternal health monitoring to reduce these outcomes.

Conclusion: This study identifies congenital anomalies and severe preeclampsia as the leading causes of intrauterine death. No significant links were found with age, socioeconomic status, or BMI, emphasizing the need to address maternal health to reduce intrauterine death rates.

Introduction

Fetal death is one of the most significant adverse pregnancy outcomes, posing profound emotional, psychological, and medical challenges to affected families. Despite its importance, definitions and classifications of fetal death vary significantly across countries and regions, often complicating accurate reporting and comparability. Miscarriage (spontaneous abortion) and stillbirth are two terms commonly used to describe fetal death, but they occur at different stages of pregnancy and carry distinct implications for reporting, evaluation, and management.^{1–3}

The World Health Organization (WHO) defines stillbirth as the death of a fetus after 28 weeks of gestation, weighing at least 1,000 g, or measuring 35 cm or more in crown-heel length. Using this definition, an estimated 2.65 million stillbirths occur annually worldwide, with approximately 1.2 million of these occurring during labor.^{4–6} However, definitions and thresholds for reporting stillbirths and miscarriages are not universally standardized. These discrepancies arise due to differences in parameters like gestational age, birth weight, or fetal length, complicating efforts to measure, compare, and address the burden of fetal death across populations.

The causes of fetal death are multifactorial and vary by gestational age, maternal health, socioeconomic status, and access to healthcare. Broadly, these causes may include maternal morbidities such as hypertension, diabetes, infections, or placental abnormalities; fetal factors like congenital anomalies or growth restriction; and external factors such as inadequate antenatal care.^{7–11} In many cases, however, the cause remains unexplained, with studies reporting that 25–60% of fetal deaths are classified as "unexplained," depending on the classification system used. The lack of standardization in evaluating and classifying these cases further underscores the need for more robust and universally accepted systems. Systems like the Relevant Condition at Death (ReCoDe), Tulip, Perinatal Society of Australia and New Zealand – Perinatal Death Classification (PSANZ-PDC), and Causes of Death and Associated Conditions (CODAC) have been developed to address this gap, offering frameworks that reduce unclassified cases and identify contributing factors.¹²

The associations between maternal characteristics (e.g., age, BMI, and socioeconomic status) and the causes of fetal death are of particular interest, as they offer opportunities for targeted interventions and improved outcomes. Maternal morbidities like hypertension, diabetes, and infections are well-documented contributors to intrauterine death, and their frequency and impact may vary across different population subgroups. Investigating these associations in depth can inform better healthcare policies, antenatal care practices, and risk management strategies.

Understanding the predominant causes of intrauterine death and their associations with maternal factors such as age, socioeconomic status, BMI, and morbidity is critical to improving maternal and fetal outcomes. By identifying these factors and their interplay, the study aims to provide valuable insights into preventable causes and develop strategies to reduce the burden of fetal death in similar populations.

Material and Methods

Study Design:

A retrospective observational study was designed to analyze the causes of intrauterine fetal death (IUFD) and their associations with maternal and clinical characteristics.

Study Setting:

The study was conducted at a tertiary care center in Kerala, utilizing hospital records for data collection.

Sampling Method:

Convenience sampling was used to select cases of IUFD from hospital records over a defined period.

Sample Size:

The study included 59 participants. The sample size was determined based on data availability and relevance to the study objectives.

Inclusion Criteria:

- Pregnant women aged 18 years or older.
- Confirmed cases of IUFD, documented in hospital records.
- Availability of complete clinical, diagnostic, and obstetric history in the records.

Exclusion Criteria:

- Incomplete or missing clinical data in hospital records.
- Cases with unclear or undocumented causes of IUFD.

Data Collection:

Data were extracted from hospital records using a structured proforma. The following information was collected:

- **Maternal Characteristics:** Age, Body Mass Index (BMI), and socioeconomic status (Above or Below Poverty Line).
- **Obstetric History:** Gravidity, parity, and previous pregnancy outcomes.
- **Clinical Factors:** Antenatal care visits, and gestational age at IUFD.
- **Fetal Outcomes:** Birth weight, presence of congenital anomalies, and documented cause of IUFD.
- **Placental and Cord Evaluations:** Findings from pathological reports, including placental infarctions, infections, or cord complications.

Data Management:

Data were anonymized to maintain patient confidentiality and entered into a secure database for analysis.

Statistical Analysis:

Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. Chi-square tests were performed to assess the association between maternal factors (e.g., BMI, socioeconomic status) and the causes of IUFD. Statistical significance was set at $p < 0.05$.

Ethical Considerations:

The Institutional Ethics Committee approved the study. As the study involved retrospective data analysis, patient consent was not required, in accordance with ethical guidelines for retrospective studies.

This methodology ensures a systematic and ethical approach to understanding the causes of IUFD and their associations with maternal factors, to improve prevention strategies and clinical outcomes.

Result

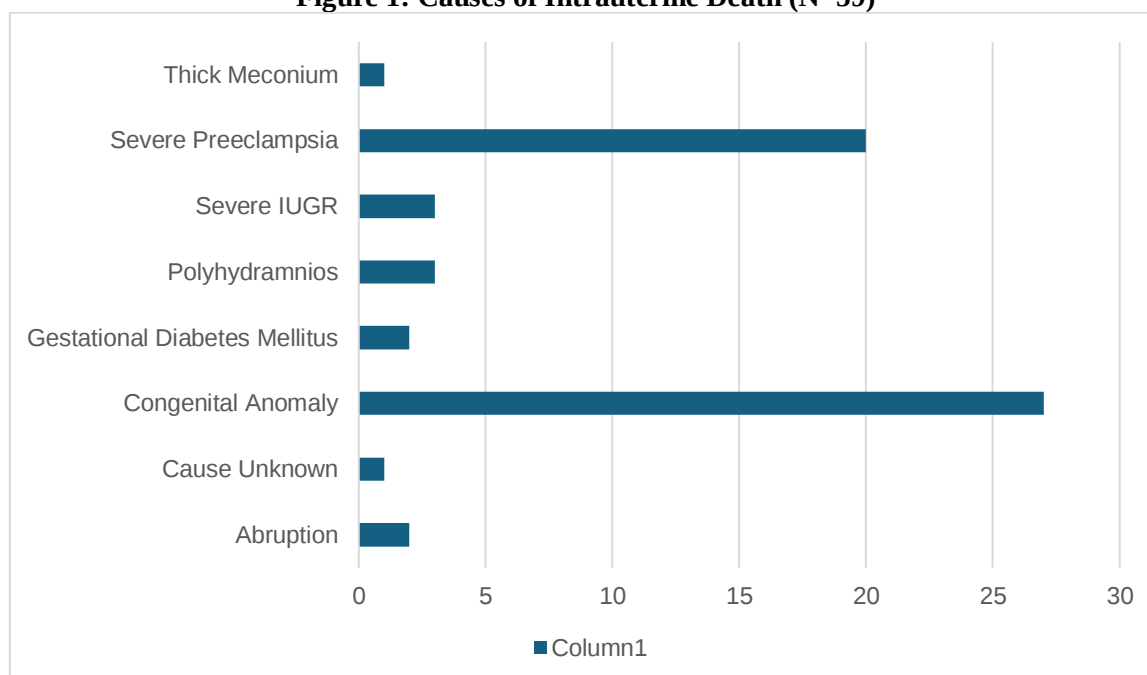
The study included 59 participants with a mean age of 27.63 years ($SD \pm 1.47$). Most participants belonged to the Above Poverty Line (APL) category (74.6%), and the majority had a normal BMI (81.4%) with a mean BMI of 23.42 ($SD \pm 1.31$). Regarding education, 57.6% of participants held a degree, while 22% had only completed 10th grade.(Table 1)

Table: Baseline and Maternal Characteristics (N=59)

Characteristics	N (%)
Age (Mean $\pm$ SD)	27.63 $\pm$ 1.473
Socioeconomic Status	
APL	44 (74.6)
BPL	15 (25.4)
BMI Category	
Normal Weight	48 (81.4)
Overweight	11 (18.6)
Education	
10th Grade Pass	13 (22.0)
Degree	34 (57.6)
Higher Secondary	7 (11.9)
Professional Degree	5 (8.5)

Among the causes of intrauterine death, congenital anomalies were the most prevalent, accounting for 45.8% of cases, followed by severe preeclampsia (33.9%). Other notable causes included polyhydramnios and severe intrauterine growth restriction (IUGR), each contributing 5.1% of cases, while abruption and gestational diabetes mellitus were less common at 3.4% each. Unknown causes and thick meconium accounted for 1.7% of cases each.(Figure 1)

Figure 1: Causes of Intrauterine Death (N=59)



Age Category and Cause of Intrauterine Death revealed that congenital anomalies (59.3% in ≥ 28 and 40.7% in < 28) and severe preeclampsia (45.0% in ≥ 28 and 55.0% in < 28) were the predominant causes. Other causes such as abruptio, unknown causes, and thick meconium had minimal representation. Despite these distributions, Fisher's Exact Test ($p=0.585$) indicated no statistically significant association between age category and the cause of intrauterine death.(Table 2)

Table 2: Age Category and Cause of Intrauterine Death

Cause of Intrauterine Death	28 and Above (n, %)	Below 28 (n, %)	Total (n, %)	Fisher's Exact Test	p-Value
Abruptio	1 (50.0%)	1 (50.0%)	2 (100.0%)	6.129	0.585
Cause Unknown	1 (100.0%)	0 (0.0%)	1 (100.0%)		
Congenital Anomaly	16 (59.3%)	11 (40.7%)	27 (100.0%)		
Gestational Diabetes Mellitus	1 (50.0%)	1 (50.0%)	2 (100.0%)		
Polyhydramnios	3 (100.0%)	0 (0.0%)	3 (100.0%)		
Severe IUGR	1 (33.3%)	2 (66.7%)	3 (100.0%)		
Severe Preeclampsia	9 (45.0%)	11 (55.0%)	20 (100.0%)		
Thick Meconium	0 (0.0%)	1 (100.0%)	1 (100.0%)		
Total	32 (54.2%)	27 (45.8%)	59 (100.0%)		

Socioeconomic Status (Socio) and Cause of Intrauterine Death, a majority of cases were observed in the APL category (74.6%), with BPL accounting for 25.4%. Congenital anomalies (70.4% in APL) and severe preeclampsia (85.0% in APL) were the most frequent causes. Minor contributions were observed for causes like thick meconium and severe IUGR. Fisher's Exact Test ($p=0.322$) suggested no significant relationship between socioeconomic status and the cause of intrauterine death.(Table 3)

Table 3: Socioeconomic Status (Socio) and Cause of Intrauterine Death

Cause of Intrauterine Death	APL (n, %)	BPL (n, %)	Total (n, %)	Fisher's Exact Test	p-Value
Abruption	1 (50.0%)	1 (50.0%)	2 (100.0%)	7.338	0.322
Cause Unknown	1 (100.0%)	0 (0.0%)	1 (100.0%)		
Congenital Anomaly	19 (70.4%)	8 (29.6%)	27 (100.0%)		
Gestational Diabetes Mellitus	1 (50.0%)	1 (50.0%)	2 (100.0%)		
Polyhydramnios	2 (66.7%)	1 (33.3%)	3 (100.0%)		
Severe IUGR	3 (100.0%)	0 (0.0%)	3 (100.0%)		
Severe Preeclampsia	17 (85.0%)	3 (15.0%)	20 (100.0%)		
Thick Meconium	0 (0.0%)	1 (100.0%)	1 (100.0%)		
Total	44 (74.6%)	15 (25.4%)	59 (100.0%)		

BMI Category and Cause of Intrauterine Death, the majority of cases occurred in the normal weight category (81.4%), with overweight cases constituting 18.6%. Congenital anomalies (81.5%) and severe preeclampsia (80.0%) were the most common causes within the normal weight group, while abruption and severe preeclampsia contributed the most in the overweight group. Fisher's Exact Test ($p=0.459$) showed no significant association between BMI category and cause of intrauterine death. (Table 4)

Table 4: BMI Category and Cause of Intrauterine Death

Cause of Intrauterine Death	Normal (n, %)	Weight Overweight (n, %)	Total (n, %)	Fisher's Exact Test	p-Value
Abruption	1 (50.0%)	1 (50.0%)	2 (100.0%)	6.299	0.459
Cause Unknown	0 (0.0%)	1 (100.0%)	1 (100.0%)		
Congenital Anomaly	22 (81.5%)	5 (18.5%)	27 (100.0%)		
Gestational Diabetes Mellitus	2 (100.0%)	0 (0.0%)	2 (100.0%)		
Polyhydramnios	3 (100.0%)	0 (0.0%)	3 (100.0%)		
Severe IUGR	3 (100.0%)	0 (0.0%)	3 (100.0%)		
Severe Preeclampsia	16 (80.0%)	4 (20.0%)	20 (100.0%)		
Thick Meconium	1 (100.0%)	0 (0.0%)	1 (100.0%)		
Total	48 (81.4%)	11 (18.6%)	59 (100.0%)		

Discussion

The present study highlights key findings regarding the contributors to intrauterine fetal death (IUFD), focusing on congenital anomalies and severe preeclampsia. Comparisons with existing studies provide a deeper understanding of the prevalence, risk factors, and potential prevention strategies.

Incidence and Demographics

In this study, IUFD was primarily associated with congenital anomalies and severe preeclampsia, with no statistically significant association with socioeconomic status, age, or BMI. This aligns with findings from Sharma et al. (2016) (13), who reported a high incidence of IUFD (36 per 1000 live births) in a population predominantly characterized by low socioeconomic status, rural residency, and unbooked pregnancies. The lack of association with BMI in the present study contrasts with Ohana et

al. (2019) (15), who identified advanced maternal age and hypertensive disorders as risk factors, emphasizing the role of maternal health in IUFD prevention.

Role of Congenital Anomalies

Congenital anomalies were a leading cause of IUFD in this study, consistent with observations by Ohana et al. (2019) (15) and Zhang et al. (2019) (16). Zhang et al. identified exposure to environmental hazards, particularly during the first trimester, as a significant contributor to congenital anomalies and IUFD. Similarly, Sharma et al. (2016) (13) reported congenital malformations in 8.8% of IUFD cases, while Ohana et al. (2019) (15) noted a two-fold increase in IUFD risk associated with congenital anomalies. These findings underscore the importance of early antenatal screening and minimizing environmental exposures to reduce congenital anomalies.

Socioeconomic and Antenatal Care Factors

Despite the predominance of participants in the Above Poverty Line (APL) category, socioeconomic status did not show a significant association with IUFD in this study. This contrasts with findings from Sharma et al. (2016) (13) and Boo et al. (2024) (14), where low socioeconomic status and inadequate antenatal care were major contributors. Boo et al. reported that receiving fewer than four antenatal check-ups significantly increased the risk of stillbirth (aRR 1.75, 95% CI: 1.25–2.47). Similarly, Sharma et al. found that unbooked and unsupervised pregnancies were associated with higher IUFD incidence. These differences may reflect varying healthcare access and utilization patterns across populations.

Environmental and Behavioral Risk Factors

While the present study did not assess environmental or behavioral factors, Zhang et al. (2019) (16) highlighted their significance. Exposure to radiation, chemicals, and pesticides increased the risk of congenital anomalies and IUFD, while passive smoking by the husband elevated the risk of fetal death (adjusted OR 1.4). These findings emphasize the importance of addressing environmental and behavioral risk factors in antenatal care programs.

Strengths and Limitations

This study provides valuable insights into the causes of IUFD, with a focus on congenital anomalies and severe preeclampsia. However, the sample size is relatively small, limiting the generalizability of findings. Additionally, while this study explored several risk factors, the role of environmental exposures and behavioral factors was not assessed.

Conclusion

This study highlights congenital anomalies and severe preeclampsia as the leading causes of intrauterine death in the study population. While no significant relationships were observed between age, socioeconomic status, and BMI with the cause of intrauterine death, these findings underscore the importance of early antenatal screening and minimizing environmental exposures. Further investigation into the underlying mechanisms contributing to congenital anomalies and severe preeclampsia is warranted.

References:

1. The American College of Obstetricians and Gynecologists. ACOG practice bulletin No. 104: Antibiotic prophylaxis for gynecologic procedures. *Obstet Gynecol.* 2009;113(5):1180–9.
2. Graafmans WC, Richardus JH, Macfarlane A, Rebagliato M, Blondel B, Pauline Verloove-Vanhorick S, et al. Comparability of published perinatal mortality rates in Western Europe: The quantitative impact of differences in gestational age and birthweight criteria. *Br J ObstetGynaecol.* 2001;108(12):1237–45.
3. Howell EM, Blondel B. International infant mortality rates: Bias from reporting differences. *Am J Public Health.* 1994;84(5):850–2.
4. WHO. Neonatal and perinatal mortality: Country region and Global estimates. World Health Organisation. 2006.
5. Lawn JE, Yakoob M, Haws RA, Soomro T, Darmstadt GL, Bhutta ZA. 3.2 million stillbirths: Epidemiology and overview of the evidence review. Vol. 9, *BMC Pregnancy and Childbirth.* 2009.

6. Lawn JE, Gravett MG, Nunes TM, Rubens CE, Stanton C. Global report on preterm birth and stillbirth (1 of 7): definitions, description of the burden and opportunities to improve data. *BMC Pregnancy Childbirth*. 2010;10(S1).
7. Aminu M, Unkels R, Mdegela M, Utz B, Adaji S, van den Broek N. Causes of and factors associated with stillbirth in low- and middle-income countries: a systematic literature review. *BJOG*. 2014;121:141–53.
8. Balchin I, Whittaker JC, Patel R, Lamont RF, Steer PJ. Racial variation in the association between gestational age and perinatal mortality: Prospective study. *Br Med J*. 2007;334(7598):833–5.
9. Bell R, Glinianaia S V., Rankin J, Wright C, Pearce MS, Parker L. Changing patterns of perinatal death, 1982-2000: A retrospective cohort study. *Arch Dis Child Fetal Neonatal Ed*. 2004;89(6).
10. Gardosi J, Madurasinghe V, Williams M, Malik A, Francis A. Maternal and fetal risk factors for stillbirth: Population based study. *BMJ*. 2013;346(7893).
11. Vergani P, Cozzolino S, Pozzi E, Cuttin MS, Greco M, Ornaghi S, et al. Identifying the causes of stillbirth: a comparison of four classification systems. *Am J Obstet Gynecol*. 2008;199(3):319.e1-319.e4.
12. Cnattingius S, Haglund B, Kramer MS. Differences in late fetal death rates in association with determinants of small for gestational age fetuses: Population based cohort study. *Br Med J*. 1998;316(7143):1483–7.
13. Sharma S, Sidhu H, Kaur S. Analytical study of intrauterine fetal death cases and associated maternal conditions. *Int J Appl Basic Med Res*. 2016 Jan-Mar;6(1):11-3. doi: 10.4103/2229-516X.173986. PMID: 26958515; PMCID: PMC4765266.
14. Boo YY, Bora AK, Chhabra S, Choudhury SS, Deka G, Kakoty S, Kumar P, Mahanta P, Minz B, Rani A, Rao S. Maternal and fetal factors associated with stillbirth in singleton pregnancies in 13 hospitals across six states in India: a prospective cohort study. *International Journal of Gynecology& Obstetrics*. 2024 May;165(2):462-73.
15. Ohana O, Holcberg G, Sergienko R, Sheiner E. Risk factors for intrauterine fetal death (1988–2009). *The Journal of Maternal-Fetal& Neonatal Medicine*. 2011 Sep 1;24(9):1079-83.
16. Zhang J, Cai WW. Risk factors associated with antepartum fetal death. *Early human development*. 1992 Mar 1;28(3):193-200.