TREND AND FACTORS ASSOCIATED WITH STILLBIRTH AT HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM) FROM 2019 TO 2023

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UNIVERSITI SAINS MALAYSIA

2025

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by

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Research Project Report submitted in partial fulfilment of the

requirements for the degree of

MASTER OF PUBLIC HEALTH

JUNE 2025

ACKNOWLEDGEMENT

بِسْمِ اِلل الرَّحْمنِ الرَّحِيْمِ

In the name of Allah SWT, the Most Gracious and the Most Merciful and salutations be upon His messenger Muhammad, peace and blessings be upon him. Only with His blessing had I been granted the strength and perseverance to finish this research project. First and foremost, I would like to convey my heartfelt gratitude towards my supervisor, Associate Professor Dr Nor Azwany binti Yaacob from Department of Community Medicine, Universiti Sains Malaysia, whose knowledge, experience and guidance in providing invaluable feedback and incessant support, were instrumental in helping me complete this research project. I would also like to express my sincere appreciation for my co-researcher, Dr Wan Fadhlina Binti Wan Adnan from Department of Obstetrics and Gynecology, Universiti Sains Malaysia for her cooperation and readiness to accommodate the data collection process for this research project in her unit. I would also like to thank all the honourable lecturers, helpful support staff as well as my treasured fellow batchmates of Master of Public Health 2024/2025 for their constant encouragement, assistance and contribution, whether directly or indirectly, which helped ease and smooth the completion of this research project. Finally, I would like to honour the support and understanding from my mother, Juariah Binti Md Zin and my siblings from the beginning until the completion of this research project. I send unending prayers for my late father, Abu Hassan Bin Man who saw my potential and encouraged me to pursue medicine, without which, I would not be here today.

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LIST OF SYMBOLS

*	Asterisk
<	Less than
>	More than
≤	Less than or equal to
≥	Greater than or equal to
=	Equal to
%	Percentage
P	Proportion
α	Alpha (significance level)
B	Beta regression coefficient
m	Ratio of independent variable
n	Sample size
p	*p*-value
kg	Kilogram (unit of birth weight)
cm	Centimeter (unit of fetal length)
g	Gram (unit of fetal weight)

LIST OF ABBREVIATIONS

aOR	Adjusted Odds Ratio
ANC	Antenatal Care
AUC	Area Under Curve
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
CS	Cesarean Section
DF	Degrees of Freedom
DOSM	Department of Statistics Malaysia
ENAP	Every Newborn Action Plan
FGR	Fetal Growth Restriction
GBS	Group B Streptococcus
HPUSM	Hospital Pakar Universiti Sains Malaysia
IUGR	Intrauterine Growth Restriction
JEPeM	Jawatankuasa Etika Penyelidikan Manusia
LBW	Low Birth Weight
LMICs	Low- and Middle-Income Countries
MOH	Ministry of Health (Malaysia)
NICU	Neonatal Intensive Care Unit
NOR	National Obstetrics Registry

OR	Odds Ratio
PROM	Premature Rupture of Membranes
Ref.	Reference (in regression models)
ROC	Receiver Operating Characteristic
RR	Relative Risk
SBR	Stillbirth Rate
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
UK	United Kingdom
UKMMC	Universiti Kebangsaan Malaysia Medical Centre
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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TREN DAN FAKTOR YANG BERKAITAN DENGAN KELAHIRAN MATI DI HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM) DARI TAHUN 2019 HINGGA 2023

ABSTRAK

Latar Belakang: Kelahiran mati (*stillbirth*) kekal sebagai cabaran utama kesihatan awam, terutamanya di negara berpendapatan rendah dan sederhana. Walaupun Hospital Pakar Universiti Sains Malaysia (HPUSM) merupakan hospital rujukan tertiari, kejadian kelahiran mati masih berlaku, sekali gus menekankan keperluan untuk mengenal pasti faktor risiko yang boleh dicegah melalui siasatan yang terfokus.

Objektif: Kajian ini bertujuan untuk menerangkan tren kadar insiden kelahiran mati dan menentukan faktor-faktor yang berkaitan dengan kelahiran mati dalam kalangan kelahiran di HPUSM dari tahun 2019 hingga 2023.

Metodologi: Kajian kes-kawalan ini dijalankan melalui semakan rekod dari Jabatan Obstetrik dan Ginekologi, HPUSM, antara Oktober 2023 hingga Mei 2024. Data yang berkaitan telah dikumpulkan menggunakan proforma piawai dan dianalisis menggunakan perisian SPSS versi 29. Analisis statistik deskriptif, regresi logistik mudah dan regresi logistik berganda telah digunakan untuk menganalisis data.

Keputusan: Sebanyak 46,012 kelahiran telah dimasukkan untuk analisis tren, dengan kadar insiden kelahiran mati antara 5.06 hingga 7.24 setiap 1,000 kelahiran sepanjang tempoh lima tahun, menunjukkan tren yang berubah-ubah. Untuk analisis faktor berkaitan, sebanyak 196 kes kelahiran mati dan 268 kelahiran hidup yang dipilih secara rawak telah dianalisis. Analisis regresi logistik berganda menunjukkan bahawa umur ibu yang meningkat (aOR = 1.11; 95% CI: 1.05, 1.18; $p < 0.001$) dan abruptio

placenta (aOR = 12.89; 95% CI: 1.55, 107.12; p = 0.018) merupakan faktor risiko yang signifikan dengan peningkatan risiko kelahiran mati. Sebaliknya, anemia (aOR = 0.34; 95% CI: 0.13, 0.91; p = 0.033), berat lahir rendah (aOR = 0.28; 95% CI: 0.15, 0.55; p < 0.001), dan usia kehamilan yang lebih rendah (aOR = 0.66; 95% CI: 0.55, 0.79; p < 0.001) didapati berhubung dengan pengurangan kebarangkalian berlakunya kelahiran mati.

Kesimpulan: Umur ibu yang meningkat, anemia, berat lahir rendah, kelahiran pramatang dan abruptio plasenta didapati mempunyai hubungan yang signifikan dengan kelahiran mati. Pengukuhan pemantauan antenatal dan pengurusan awal kehamilan berisiko tinggi adalah penting untuk mengurangkan kadar kelahiran mati dan meningkatkan kualiti penjagaan di HPUSM.

KATA KUNCI: kelahiran mati, faktor berkaitan, kajian kes-kawalan, tren insiden, risiko maternal

TREND AND FACTORS ASSOCIATED WITH STILLBIRTH AT HOSPITAL PAKAR UNIVERSITI SAINS MALAYSIA (HPUSM) FROM 2019 TO 2023

ABSTRACT

Background: Stillbirth remains a major public health challenge, especially in low- and middle-income countries. Despite being a tertiary referral center, stillbirths continue to occur at Hospital Universiti Sains Malaysia (HPUSM), underscoring the need to identify preventable risk factors through focused investigation.

Objective: This study aimed to describe the incidence rate trend of stillbirth and to determine the factors associated with stillbirth among deliveries at Hospital Universiti Sains Malaysia (HPUSM) from 2019 to 2023.

Methodology: This was a case-control study using record review from the Department of Obstetrics and Gynaecology, Hospital Universiti Sains Malaysia (HPUSM), conducted between October 2023 and May 2024. Relevant data were collected using a standardized proforma and analysed using SPSS software version 29. The data were analysed using descriptive statistics, simple logistic regression, and multiple logistic regression.

Results: A total of 46,012 deliveries were included for trend analysis, with the stillbirth incidence ranging from 5.06 to 7.24 per 1,000 births over the five-year period, showing a fluctuating trend. For the association analysis, 196 stillbirth and 268 randomly selected live birth were included. Multiple logistic regression analysis revealed that advanced maternal age (aOR = 1.11; 95% CI: 1.05, 1.18; $p < 0.001$) and abruptio placenta (aOR = 12.89; 95% CI: 1.55, 107.12; $p = 0.018$) were significantly associated with higher odds of stillbirth. Conversely, anemia (aOR = 0.34; 95% CI:

0.13, 0.91; p = 0.033), low birth weight (aOR = 0.28; 95% CI: 0.15, 0.55; p < 0.001), and lower gestational age (aOR = 0.66; 95% CI: 0.55, 0.79; p < 0.001) appeared as protective factors against stillbirth.

Conclusion: Advanced maternal age, anemia, low birth weight, preterm delivery, and abruptio placenta were significantly associated with stillbirth. Strengthening antenatal surveillance and timely management of high-risk pregnancies are essential to reduce stillbirths and improve the quality of care at HPUSM.

KEYWORD: stillbirth, associated factors, case-control study, incidence trend, maternal risk

CHAPTER 1
INTRODUCTION

1.1 Stillbirth

Stillbirth remains one of the most sensitive indicators of the quality of maternal and perinatal care. It is a deeply distressing event that impacts families and reflects critical gaps in health systems. Despite global efforts to reduce maternal and child mortality, stillbirth continues to be a neglected public health issue, especially in low- and middle-income countries. Definitions of stillbirth vary slightly between countries, which complicates global comparisons. The World Health Organization (WHO) defines stillbirth as the birth of a baby with no signs of life at or after 28 completed weeks of gestation, or with a birth weight of at least 1000 grams, or a body length of 35 cm when gestational age is unknown (WHO, 2024). This definition is primarily used for global reporting and monitoring to ensure consistency across countries (Lawn *et al*., 2009).

However, United Kingdom classified stillbirth as fetal death from 24 weeks of gestation or a birth weight of at least 500 grams (Da Silva *et al*., 2016; UK Parliament, 1992). In Malaysia, the Ministry of Health (MOH) uses a lower national threshold, defining stillbirth as fetal death at or beyond 22 weeks of gestation or with a birth weight of ≥500 grams (MOH, 2013). Stillbirths are further classified by gestational age into early (20–27 weeks), late (28–36 weeks), and term (≥37 weeks) categories (CDC, 2024). These varying thresholds pose challenges for data harmonization and policy planning, but standardization efforts like those by WHO are critical for accurately estimating and comparing the burden of stillbirth worldwide (CDC, 2024).

Globally, stillbirth remains a major challenge. According to World Health Organization (WHO, 2024), about 2 million babies are stillbirth each year, equating to

one every 16 seconds. notably, around 40% of these deaths occur during labour, pointing to gaps in timely and quality obstetric care (Saleem *et al*., 2018). Since 2000, it is estimated that over 53 million babies have been stillbirth, and if no substantial action is taken, another 16 million stillbirths could occur by 2030. Most of these deaths are concentrated in low- and middle-income countries, particularly in sub-Saharan Africa and South Asia, where health systems face greater limitations. In 2021 alone, half of all stillbirths occurred in six countries: India, Pakistan, Nigeria, Ethiopia, the Democratic Republic of Congo, and Bangladesh (United Nations Children's Fund (UNICEF), 2023).

While global stillbirth rates have declined modestly in recent years, the average annual rate of reduction between 2000 and 2019 was only 2.3%, far slower than the progress seen in reducing neonatal and under-five mortality. This statistic is based on the WHO's definition of stillbirth, which refers to a baby born with no signs of life at or after 28 weeks of gestation (Hug *et al*., 2021). This slow pace reflects the persistent disparities in care, especially during labour and delivery. The COVID-19 pandemic has likely worsened the situation by disrupting antenatal services, delaying referrals, and increasing the burden on already stretched healthcare systems (Mohan *et al*., 2023)

Recent global analyses indicate a 25.5 percent overall decline in stillbirth rates over the past five years. However, significant disparities in stillbirth rates persist between and within low- and middle-income countries, with many showing minimal or no reduction in stillbirth rates (Saleem *et al*., 2018). To address this issue, the Every Newborn Action Plan (ENAP) launched by WHO and UNICEF calls for countries to reduce stillbirth rates to below 12 per 1000 births by 2030 (WHO and UNICEF, 2015). While some high-income countries have already surpassed this goal with stillbirth

rates as low as 2 per 1000 births while progress has been much slower in developing countries (Sujata *et al*., 2021).

In Malaysia, significant improvements have been made. The national stillbirth rate dropped from approximately 28 per 1000 births in the 1950s to below 5 per 1000 in recent years (Norain *et al*., 2023) However, this progress has not been linear. After reaching 4.3 per 1000 births in the early 2010s, the rate temporarily increased to 5.5 per 1000 in 2018 before declining again to 4.8 per 1000 in 2023. Data from the National Obstetrics Registry (NOR) confirm these fluctuations, which are often influenced by clinical practice, health service coverage, and the quality of care provided during pregnancy and childbirth (MOH, 2021).

At the state level, trends vary. In Kelantan, the stillbirth rate was 5.5 per 1000 in 2014 and declined gradually to 4.6 per 1000 in 2023 (Department of Statistic Malaysia (DOSM), 2023). Although the overall rate remains within acceptable international thresholds, the relatively stagnant trend signals the need for more targeted efforts especially in identifying and addressing preventable causes of stillbirth, such as maternal comorbidities, delayed labour management, and limited access to emergency obstetric services.

At HPUSM, one of the referral and teaching hospital in Kelantan, the stillbirth rate reflects the complexity of maternal cases managed and the institution's role in handling high-risk pregnancies. Monitoring stillbirth trends at HPUSM provides a useful insight on the effectiveness of antenatal and intrapartum care. Furthermore, identifying the key contributing factors within the local context is crucial to guide intervention and policy.

In short, stillbirth remains an important maternal health concern globally, nationally, and locally. While much progress has been made, the need for continued

revise research and tailored program is clear. By analyzing the trends and associated factors of stillbirth at HPUSM between 2019 and 2023, this study aims to contribute meaningful insights that can inform clinical practice in HPUSM and health system improvements in Kelantan in general.

1.2 Problem statement and rationale of the study

Stillbirth remains a global public health concern, affecting not only maternal health statistics but also the emotional and psychological well-being of families and communities. Despite being preventable, stillbirths continue to occur in both high- and low-resource settings, often due to delays or gaps in maternal care. The World Health Organization (WHO, 2024) estimates that nearly 2 million stillbirths occur annually, and nearly 40% of these happened during labour, often due to intrapartum complications that are treatable or avoidable with timely and quality care. These numbers point to a missed opportunity in strengthening health systems, especially in areas of antenatal and intrapartum surveillance.

In many cases, stillbirth is linked to preventable factors such as hypertensive disorders, diabetes, infections, placental problems, and prolonged pregnancies. Such conditions that, if managed early, could reduce fetal loss (Goldenberg *et al*., 2009; Saleem *et al*., 2018). A study from Italy found that a significant proportion of women who experienced stillbirth, particularly those with underlying maternal comorbidities often had inadequate or delayed antenatal care. In the study, 10.7% of antepartum stillbirths (56 out of 524 cases) were linked to inadequate care, where elements of substandard clinical management or access barriers rendered the deaths potentially preventable (Po' *et al*., 2021). This highlights the importance of proactive monitoring and accessible, high-quality maternal health services.

Stillbirth is also recognized as a sensitive indicator of maternal healthcare quality. In well-functioning health systems, regular check-ups, risk assessments, and timely interventions reduce complications and improve outcomes. Research by Rosnah (2008), highlighted lower stillbirth rates are often a reflection of good obstetric practices, while persistently high rates may signal deficiencies in access, service delivery, or emergency response. In Malaysia, stillbirths account for nearly two-thirds of all perinatal deaths, even though the country has achieved the ENAP target of fewer than 12 stillbirths per 1,000 births (Norain *et al*., 2023).

Yet, despite these achievements, the pace of stillbirth reduction in Malaysia has slowed. Recent data show that the national stillbirth rate, although relatively low at around 4.8 per 1,000 births, has not significantly improved over the past few years. In states like Kelantan, which face logistical and health resource challenges, the decline has been even more modest (DOSM, 2023; MOH, 2021). This raises concerns about gaps in antenatal follow-up, late referral of high-risk pregnancies, and inconsistent documentation or reporting systems, particularly in rural and semi-urban settings (MOH, 2021; Ravichandran *et al*., 2021).

Another barrier to progress is the limited post-mortem investigation of stillbirths. Cultural sensitivity, religious norms, and a lack of infrastructure have contributed to the underutilization of perinatal autopsies in Malaysia. Consequently, one-third of stillbirths remain unexplained, preventing clinicians and researchers from fully understand their causes and patterns (Goldenberg *et al*., 2009; Rosnah, 2008). Moreover, many stillbirths are simply recorded as part of perinatal mortality without distinguishing them from early neonatal deaths, further limiting the clarity of national and regional statistics.

Addressing these challenges requires a comprehensive understanding of both the epidemiological trends and the underlying factors associated with stillbirth. While several maternal, obstetric, and intrapartum risk factors are well-established, their relevance may vary by setting, healthcare access, and population profile. For instance, in developing countries, most stillbirths occur in the antepartum period, often due to undetected or unmanaged maternal conditions, whereas in high-resource settings, improved monitoring and planned interventions have shifted the burden to earlier gestational losses or fetal anomalies (Goldenberg *et al*., 2009; Mohan *et al*., 2023).

In this context, HPUSM plays an important role, as a tertiary referral centre in Kelantan, managing a significant number of high-risk pregnancies and complex obstetric cases. It also acts as a sentinel site for monitoring maternal health outcomes in the state of Kelantan. Therefore, evaluating stillbirth trends and their contributing factors at HPUSM from 2019 to 2023 provides an opportunity to assess the quality of care, detect gaps in maternal service delivery, and guide evidence-based improvements.

The findings from this study provide important insights into the trends and factors associated of stillbirth at HPUSM, which can guide clinical practice, inform maternal health guidelines, and support policy initiatives, thereby contributing to national efforts to reduce stillbirths and improve pregnancy outcomes in Malaysia.

1.3 Research questions

1. What is the trend of stillbirth rate at HPUSM from 2019 to 2023?
2. What are factors associated with stillbirths at HPUSM?

1.4 Research objectives

1.4.1 General objective

To study the epidemiology of stillbirths at HPUSM from 2019 to 2023.

1.4.2 Specific objectives

1. To describe the trend of stillbirth incidence rate at HPUSM from 2019 to 2023.
2. To determine the association factors of stillbirths at HPUSM.

1.5 Research hypothesis

There is a significant association between sociodemographic, maternal factors, and fetal factors and stillbirth at HPUSM.

CHAPTER 2
LITERATURE REVIEW

A comprehensive literature search was conducted using multiple online databases including PubMed, ScienceDirect, Scopus, and Google Scholar. Various search strategies were employed, including the use of Boolean operators ("AND," "OR," "NOT") to refine and expand the scope of the results. The search terms used included: stillbirth, intrauterine fetal death, fetal demise, risk factors, maternal factors, clinical factors, and pregnancy outcome. Preference was given to articles published within the last 10 years, with particular emphasis on studies conducted in Malaysia, Southeast Asia, and other low- and middle-income countries (LMICs).

2.1 Stillbirth

At the HPUSM, the United Kingdom's definition is used, which considers stillbirth as fetal death occurring at or after 24 weeks of gestation or birth weight of at least 500 grams (Da Silva *et al*., 2016; UK Parliament, 1992). This aligns with clinical practices in many high-resource settings where viability thresholds are lower than the WHO's international reporting criteria. The application of the UK definition allows for earlier identification and management of high-risk pregnancies while enabling local data to capture a broader spectrum of fetal losses. In Kelantan, however, the definition applied is fetal death occurring at or after 22 weeks of gestation or with a birth weight of 500 grams or more, which allows for even earlier identification and reporting of stillbirths.

Stillbirths are often classified into two types based on the appearance of the fetus at delivery. A macerated stillbirth is defined as the delivery of a fetus showing signs of skin breakdown, indicating that death occurred during the antepartum period,

typically more than 12 hours before delivery. In contrast, a fresh stillbirth is defined as the delivery of a fetus with intact skin and no signs of maceration, suggesting that death likely occurred intrapartum, shortly before or during labour. This classification can provide important clinical clues regarding the timing and potentially preventable causes of fetal demise (UNICEF, 2023). Globally, the burden of stillbirth remains substantial, with the World Health Organization (WHO, 2024) estimating approximately 2 million stillbirths annually, with nearly 40% occurring during labour.

2.2 Trend stillbirth rate

The stillbirth rate (SBR) is defined as the number of stillbirths per 1,000 total births and is widely accepted as a sensitive indicator of maternal healthcare quality, especially in the domains of antenatal surveillance, intrapartum monitoring, and emergency obstetric care (Rosnah, 2008; Srushti *et al*., 2013).

Over the past two decades, global efforts to reduce stillbirths have led to gradual progress. According to the United Nations Inter-agency Group for Child Mortality Estimation (IGME, 2024), the global stillbirth rate (SBR) declined from 14.1 per 1,000 total births in 2019 to 13.9 per 1,000 in 2021, reflecting ongoing improvements in maternal healthcare delivery and access to skilled birth attendants (UNICEF, 2023). However, this decline has been modest and has shown signs of slowing, particularly in low- and middle-income countries where preventable stillbirths remain high.

In Malaysia, the national stillbirth rate has also shown a downward trend. Based on statistics from the Department of Statistics Malaysia (DOSM, 2023) and recent literature by Norain *et al*., (2023), the rate decreased from 5.98 per 1,000 total births in 2015 to approximately 4.8 per 1,000 in 2023. While this trend reflects

continued improvements in maternal and perinatal care, including antenatal risk screening, emergency obstetric services, and institutional deliveries, the rate of reduction has plateaued in recent years. This indicates a need to refocus efforts on modifiable and context-specific risk factors.

Higher stillbirth rates are often reported in tertiary and university hospitals, such as teaching institutions, which typically serve as referral centres for complicated and high-risk pregnancies. For example, a study at UKM Medical Centre (UKMMC) reported a stillbirth rate of 6.3 per 1,000 births in 2019, while HPUSM recorded a stillbirth rate of 8.47 per 1,000 in 2017 (Haslina *et al*., 2013; Randhawa, 2022). This phenomenon is not unexpected, as tertiary institutions manage a greater proportion of pregnancies complicated by maternal comorbidities, fetal anomalies, or obstetric emergencies that may increase the likelihood of fetal demise.

2.3 Sociodemographic associated with stillbirth

2.3.1 Maternal age

Advanced maternal age (AMA) is widely recognised as a key risk factor for stillbirth. A multicountry study by Saleem *et al*. (2018) in low- and middle-income countries found that women under 20 years had a relative risk (RR) of 1.11 (95% CI: 1.00, 1.23), while those aged over 35 years had an even higher risk (RR = 1.63; 95% CI: 1.40, 1.89) compared to the reference group (20–30 years). Similarly, a systematic review by Huang *et al*. (2008) revealed that AMA is associated with relative risks ranging from 1.20 to 4.53, with increased risks observed after age 35 and especially over 40 years.

In Malaysia, data from the National Obstetrics Registry National Obstetrics Registry (NOR), (2021) supports this trend. Women aged 35 to 39 years had a stillbirth

rate of 8.61 per 1,000 total deliveries, and those aged above 44 years experienced a rate of 11.82 per 1,000, among the highest recorded. Teenage mothers under 15 years also showed elevated stillbirth rates (SBR: 11.36 per 1000 births) (Rosnah, 2008). The biological plausibility of this association is well established, with AMA linked to increased risk of placental insufficiency, hypertensive disorders, and chromosomal abnormalities (Carolan and Frankowska, 2011; Khalil *et al*., 2013).

2.3.2 Socioeconomic status and race

Socioeconomic disparities play a crucial role in determining stillbirth risk. A Malaysian study by Norain *et al*. (2023) found that mothers with household incomes of RM3001 and above were significantly less likely to experience stillbirth (aOR = 0.79; 95% CI: 0.69, 0.89). In contrast, 83% of stillbirth cases were reported among women from low-income groups, highlighting financial and access-related inequalities (Saleem *et al*., 2018; Srushti *et al*., 2013).

Race has also been shown to influence stillbirth rates, often reflecting underlying disparities in healthcare access, literacy, and cultural practices. According to the National Obstetrics Registry (Ravichandran *et al*., 2021), the highest stillbirth rates were observed among Indigenous groups (SBR: 17.54 per 1000 births), followed by Indian (SBR: 7.13 per 1000 births) and Malay populations (SBR: 5.97 per 1000 births). These differences in stillbirth rates among race groups may be influenced by factors such as rural residence, socioeconomic status, and limited access to timely and adequate antenatal care, all of which have been shown to contribute to disparities in pregnancy outcomes (Boo *et al*., 2024; Ravichandran *et al*., 2021; Saleem *et al*., 2018).

2.3.3 Marital status

Tesema *et al*. (2021), large-scale study across 12 East African countries found that women who were single or unmarried had nearly three times the odds of experiencing stillbirth compared to married women (aOR = 2.99, 95% CI: 2.04, 4.39). This is likely due to reduced emotional, financial, and logistical support during pregnancy, which can limit timely healthcare access and increase vulnerability to complications. In contrast, the case-control study by Fikre *et al*. (2021) in Ethiopia noted that 95.3% of stillbirth cases and 98.1% of controls were married. However, this high proportion of married women in both groups reflects the broader sociocultural context of the study population, where marriage is the predominant norm which is similar in Malaysia. Therefore, while Fikre's study did not demonstrate a significant difference based on marital status, it highlights the importance of considering local demographic patterns when interpreting stillbirth risk factors.

This pattern was echoed in the Malaysian context by Norain *et al*. (2023), who analyzed data from the national Under-Five Mortality Surveillance system. The study found that unmarried mothers had over 15 times higher odds of receiving insufficient antenatal care (ANC) (aOR = 15.15, 95% CI: 10.41, 22.05) and over 6 times higher odds of delivering at unsuitable locations (aOR = 6.47, 95% CI: 4.42, 9.45) compared to married women. These findings reflect both structural health service gaps and underlying social stigma, where unmarried pregnancies are often viewed negatively, potentially discouraging women from seeking timely antenatal care, thus contributing to avoidable stillbirth and neonatal deaths.

2.4 Maternal factors associated with stillbirth

2.4.1 Antenatal booking status

A booked pregnancy is defined as one in which the mother initiates antenatal care within the first trimester, typically before 12 weeks of gestation. This allows for early risk screening, health education, and timely management of complications. Conversely, an unbooked pregnancy refers to one where antenatal care is either initiated after the first trimester or not at all, increasing the risk of adverse outcomes (Jiee *et al*., 2018; P. Lim *et al*., 2023). In line with this, the Ministry of Health Malaysia recommends the first ANC visit to occur within 12 weeks of gestation (MOH, 2023)

Consistent evidence across both local and international studies emphasizes that the absence or delay in antenatal care is a significant risk factor for stillbirth. A study in Italy by Salerno *et al*., (2023) reported that late antenatal booking increased the risk of stillbirth by 56% (OR = 1.56; 95% CI: 1.10, 2.22). In Malaysia, unbooked pregnancies have similarly been linked to poor fetal outcomes, often due to missed opportunities for early detection of complications, insufficient fetal growth monitoring, and delayed clinical intervention (Boo *et al*., 1991; Rosnah, 2008).

Ravichandran *et al*., (2021) highlighted that women lacking antenatal follow-up were less likely to receive essential services such as iron supplementation and blood pressure screening, and were often referred late for high-risk pregnancy care. A more recent study by Kanwal *et al*., (2025) found a significantly higher stillbirth rate among unbooked women, who frequently presented with undiagnosed conditions like hypertensive disorders and obstructed labour.

These findings are further supported by a retrospective cohort study in Malaysia, which showed that women with no antenatal care had substantially poorer

fetal outcomes than those who had at least one ANC visit (Lim *et al*., 2024). Lack of follow-up was associated with delays in intrapartum care and increased preventable stillbirths due to complications such as placental abruption and intrauterine growth restriction (IUGR). Similarly, Butt *et al*., (2018) reported that unbooked status was strongly associated with adverse maternal and neonatal outcomes, including a higher incidence of stillbirth.

2.4.2 Parity

Parity has also been implicated as a significant factor influencing stillbirth. Grand multiparity (defined as having five or more previous births) is associated with increased risks of obstetric complications such as uterine atony, placenta previa, and delayed access to care, which can increase stillbirth risk (Muniro *et al*., 2019). A meta-analysis conducted in low- and middle-income countries (LMICs) by Saleem *et al*., (2018) reported that higher parity is linked to an elevated stillbirth risk compared to parity of one or two. Similarly, a population-based study in Zimbabwe by Feresu *et al*., (2005) reported that women with parity two and above had a hazard ratio of 1.20 (95% CI: 1.01, 1.42) for combined stillbirth and early neonatal death compared to women with lower parity. Although the association is not always linear, the risks are often compounded by maternal age, comorbidities, and reduced utilization of facility-based deliveries.

2.4.3 Maternal comorbidities

In a study from French Guiana, maternal comorbidities (chronic hypertension) were associated with an eightfold increased risk of stillbirth (95% CI: 3.64, 17.61) (Mathieu *et al*., 2023). Similarly, Malaysian data from the Under-Five Mortality Surveillance Report (2015–2017) reported that maternal hypertension and diabetes

were among the most frequent preventable causes of stillbirth (aOR = 1.88; 95% CI: 1.66, 2.12) (Norain *et al*., 2023). In Indonesia, Yusrika *et al*. (2024) found that women with underlying conditions had a significantly higher risk of stillbirth (aOR = 24.41; 95% CI: 5.93, 100.43), particularly when antenatal care was delayed or absent.

2.4.4 Anemia in pregnancy

Anemia during pregnancy has been consistently identified as a significant risk factor for stillbirth. A study by Kasa *et al*., (2023) reported that anemic mothers were 2.62 times more likely to experience stillbirth than non-anemic mothers (95% CI: 1.93, 3.31), emphasizing anemia's impact on fetal outcomes. Similarly, Boo *et al*., (2024) highlighted that severe anemia in the third trimester significantly increases the risk of stillbirth, with an adjusted relative risk (aRR) of 3.37 (95% CI: 1.97, 6.11).

2.4.5 Obesity

Obesity is known to increase the likelihood of adverse pregnancy outcomes through its association with complications such as preeclampsia, gestational diabetes, and placental dysfunction. A study conducted in Japan reported that obese women had 2.6 times higher odds of experiencing stillbirth compared to women with normal BMI (aOR = 2.60; 95% CI: 1.59, 4.24) (Shinohara *et al*., 2023). Similarly, a large population-based study in Sweden involving 64,632 women found that overweight women had double the risk of stillbirth (RR = 2.06; 95% CI: 1.91, 4.21), and obese women had nearly four times the risk (RR = 3.97; 95% CI: 1.60, 9.70) compared to those with normal weight (Akselsson *et al*., 2023).

2.4.6 History of Group B Streptococcus (GBS) colonized

In a study conducted in Eastern Ethiopia, the odds of stillbirth among GBS-colonized mothers were significantly higher compared to non-colonized mothers, with

an aOR of 8.93 (95% CI: 5.47, 14.56) (Yadeta *et al*., 2018). Similarly, a study by Sama *et al*., (2021) reported a strong correlation between stillbirth and GBS colonization, showing an odds ratio (OR) of 7.75 (95% CI: 2.61, 21.71). The findings indicate that maternal GBS colonization significantly elevates the risk of intrauterine fetal death.

2.4.7 Abruptio placenta

The American College of Obstetricians and Gynecologists (ACOG), (2020) has identified a wide range of intrapartum complications that contribute to stillbirth. These include, placental abruption, umbilical cord accidents, uterine rupture, obstructed labour, infections such as syphilis or chorioamnionitis and genetic and chromosomal anomalies. Many of these are preventable with timely diagnosis and intervention, reinforcing the importance of skilled attendance at birth and continuous fetal surveillance.

2.4.8 History of abortion

Women with a history of spontaneous abortion are at increased risk of adverse outcomes in subsequent pregnancies. Recurrent spontaneous abortion (RSA) has been significantly linked to complications such as preterm delivery, fetal growth restriction, and low birth weight (Vijayalakshmi *et al*., 2023; Yang *et al*., 2017). A recent study by (Vijayalakshmi *et al*., 2023) found that among women with a history of miscarriage, 3% experienced stillbirth, alongside other adverse events including preterm delivery (29%) and fetal distress (15%).

Moreover, a meta-analysis by Jia *et al*., (2024) highlighted that women with RSA face significantly higher risks of pregnancy complications, including preeclampsia (OR: 2.06; 95% CI: 1.49, 2.86), placental abruption (OR: 1.67, 95% CI: 1.36, 2.06), and perinatal death (OR: 2.24, CI: 1.39, 3.60). These findings suggest that

previous abortion is not only a marker of poor obstetric history but also a predictor of heightened vulnerability in future pregnancies.

Women with a history of poor obstetric outcomes, particularly previous stillbirths, are at significantly higher risk of recurrence in subsequent pregnancies. Poor obstetric history such as previous stillbirths or abortions has been associated with increased recurrence risk. Several studies have found that women with a prior stillbirth have two to three times higher risk of recurrence in subsequent pregnancies (Boo *et al*., 2024; Flenady *et al*., 2011), indicating the importance of enhanced monitoring and tailored antenatal care for such women.

2.4.9 History of previous cesarean section (CS)

A meta-analysis by O'Neill *et al*., (2013) demonstrated that women who had undergone a prior caesarean delivery had a 23% increased risk of stillbirth compared to those who delivered vaginally, with an OR of 1.23 (95%CI: 1.08, 1.40). This risk is believed to stem from uterine scarring and the potential for complications such as uterine rupture, placental abnormalities, or impaired implantation in future pregnancies. Supporting this finding, a study conducted across four district hospitals in Pemba Island, Tanzania, reported that a previous CS significantly increased the risk of stillbirth (OR = 2.63; 95% CI: 1.05, 6.59) (Skytte *et al*., 2023).

2.4.10 Premature rupture of membrane (PROM)

PROM exposes the fetus to ascending infections and can lead to complications such as intrauterine infection, umbilical cord prolapses, and preterm labour. All of this will increase the risk of fetal demise if not promptly managed.

A case-control study from India conducted at the Veer Surendra Sai Institute of Medical Sciences and Research (VIMSAR) reported a strong association between

PROM and stillbirth. The study found that women with PROM had 2.49 times higher odds of stillbirth compared to those without PROM (OR = 2.49; 95% CI: 1.31, 3.91; p = 0.03) (O. Patel *et al*., 2023).

Similarly, a study in the Greater Accra Region of Ghana emphasized the association between PROM and intrapartum stillbirth. The analysis showed that the odds of intrapartum stillbirth were approximately 3.36 times higher among women who experienced PROM compared to those who did not (aOR = 3.36; 95% CI: 1.20, 9.40; p < 0.05) (Vanotoo *et al*., 2023). The findings highlight that PROM is not only a risk for infection and preterm birth but also a key contributor to intrapartum fetal mortality, especially in resource-limited settings where immediate obstetric care may be delayed.

2.5 Fetal factors associated with stillbirth

2.5.1 Gestational age

A systematic review by Mukherjee *et al*., (2024) examining stillbirth determinants in Sub-Saharan Africa reported that preterm births (before 37 weeks gestation) are strongly linked to stillbirth (median aOR 3.54, IQR 2.02–4.81), underscoring the heightened vulnerability of preterm infants.

Similarly, Lawn *et al*., (2016) emphasized that gestational age less than 37 weeks is consistently associated with increased stillbirth risk. This association is often mediated by complications such as fetal growth restriction (FGR) and preterm labour, which compromise fetal health and increase the likelihood of adverse outcomes.

Further evidence from Christou *et al*., (2023), in a Cambodian hospital-based study, found that both extreme prematurity (aOR= 3.29; 95%CI: 2.37, 4.55) and moderate prematurity (aOR= 2.45; 95% CI: 1.74, 3.46) significantly increased the

odds of stillbirth when compared to full-term births. Additionally, small-for-gestational-age (SGA) infants were found to have higher odds of stillbirth (aOR= 2.32; 95% CI: 1.71, 3.14). These findings highlight the need for early detection and clinical management of preterm and growth-restricted fetuses to prevent stillbirth.

2.5.2 Birth weight

Birth weight is another critical intrapartum determinant. Infants weighing less than 2,500 grams are particularly vulnerable to adverse outcomes. Between 2018 and 2020, the stillbirth rate (SBR) among low birth weight (LBW) infants in Malaysia was reported as 25 per 1,000 births, compared to 4.4 for infants with birth weights above 2,500 grams (Ravichandran *et al*., 2021). This association was further supported by a study at UKM Medical Centre (UKMMC), which found that 83.9% of stillbirths between 2004 and 2010 involved infants weighing under 2,500 grams (Haslina *et al*., 2013).

Prematurity is also strongly correlated with stillbirth. A study by Neogi *et al*. (2018) in India found that preterm deliveries were 4.5 times more likely to result in stillbirth compared to full-term births (aOR= 4.5; 95% CI: 3.20, 6.50). Locally, data from UKMMC reported that 30.2% of stillbirths occurred before 27 weeks of gestational age, underscoring the risks associated with extreme prematurity (Haslina *et al*., 2013). The UKMMC report linked this finding to a higher prevalence of intrauterine growth restriction (IUGR) and preterm birth among LBW infants, which both recognized contributors to stillbirth.

2.5.3 Fetus sex

Fetal sex has been increasingly recognized as a biological determinant of pregnancy outcomes, including the risk of stillbirth. Multiple large-scale studies and

meta-analyses have consistently shown that male fetuses are at a higher risk of stillbirth compared to female fetuses.

A systematic review and meta-analysis by Mondal *et al*., (2014) involving over 30 million births reported that male fetuses had a 10% elevated risk of stillbirth compared to females (pooled relative risk: 1.10; 95% CI: 1.07, 1.13). Similarly, a retrospective cohort study in Scotland by Smith, (2000) found that male fetuses had a 19% increased risk of stillbirth (RR = 1.19; 95% CI: 1.10, 1.29).

Further supporting this trend, a study in Australia by Engel *et al*., (2008) found that 59% of stillbirths occurred in male fetuses, and that male stillbirths tended to occur at a later gestational age (median 30.5 weeks) compared to female stillbirths (median 25 weeks). This suggests that male fetuses may be more susceptible to late gestation complications, potentially due to differences in placental development, hormonal responses, or immune interactions.

2.5.4 Number of fetuses

Report from 6th National Obstetrics Registry (NOR) showed stillbirth rates were significantly higher in multiple pregnancies compared to singleton pregnancies between 2018 and 2020 (SBR: 39 per 1,000 births), highlighted the increased risk associated with multiple births(Ravichandran *et al*., 2021). A similar stillbirth rate among multiple pregnancy was observed in England and Wales from 1993 to 2004 (SBR: 17 per 1,000 births) (Pharoah, 2006).

2.5.5 Preterm labour

Preterm labour, defined as the onset of labour before 37 completed weeks of gestation, has been consistently identified as a significant contributor to stillbirth risk. Mengitsu (2022) reported that mothers who experienced preterm labour were 2.1 times

more likely to have stillbirths compared to those who delivered at term (aOR = 2.10, 95% CI: 1.10–4.01) (Mengistu *et al*., 2022). The association underscores the critical impact of gestational age on fetal viability and perinatal survival.

Additionally, a history of stillbirth was identified as a significant predictor of preterm birth, suggesting a cyclical relationship between previous adverse outcomes and subsequent pregnancies. The adjusted odds ratio for this association was 2.7 (95% CI: 1.1, 7.3), indicating that women with prior stillbirths face heightened risks for preterm delivery and its associated complications in future pregnancies (Adugna, 2022).

2.5.6 Intrauterine growth restriction (IUGR)

Intrauterine Growth Restriction (IUGR), also known as Fetal Growth Restriction (FGR), is a pathological condition where the fetus fails to achieve its genetically predetermined growth potential, commonly due to placental insufficiency (Song *et al*., 2022). Unlike constitutionally small but healthy fetuses, IUGR indicates an underlying abnormality, most often placental dysfunction that compromises fetal oxygen and nutrient supply, thereby increasing the risk of adverse perinatal outcomes.

IUGR is a common obstetric complication, affecting approximately 10% of pregnancies, and is implicated in up to 50% of stillbirths, emphasizing the strong association between growth restriction and fetal demise (Usman *et al*., 2022). A study by Volkov and Kastor, (2023) highlighted that more than half of all stillbirths are associated with FGR, with early-onset FGR accounting for nearly 60% of these cases. The study further demonstrated that FGR increases the risk of stillbirth by 3 times compared to pregnancies without FGR (aOR= 3.2; 95% CI: 1.01, 10.30).

2.5.7 Post-term birth

A population-based study from Iran by Khalili *et al*., (2020) reported that post-term birth was strongly associated with stillbirth, with an aOR of 3.31 (95% CI: 2.66, 4.13). This suggests that post-term fetuses were more than three times as likely to experience stillbirth compared to those born at term. Similarly, findings from the EN-INDEPTH study by Di Stefano *et al*., (2021), which evaluated stillbirths across five Health and Demographic Surveillance System sites in sub-Saharan Africa and Asia, also confirmed the association. The study revealed that both preterm and post-term births were linked to higher odds of stillbirth. Specifically, post-term births had an aOR of 1.51 (95% CI: 1.05, 2.19), further supporting the need for close monitoring beyond 40 weeks of gestation.

2.5.8 Fetal presentation

Fetal presentation, particularly non-cephalic positions such as breech or transverse lie, has been consistently associated with an elevated risk of stillbirth. A systematic review focusing on stillbirth determinants in sub-Saharan Africa reported that non-cephalic fetal presentation had an aOR of 5.64 (95% CI: 4.42, 7.19), suggesting more than a fivefold increased risk of stillbirth compared to cephalic presentation (Mukherjee *et al*., 2024). Besides that, Skytte *et al*., (2023) conducted a study in Pemba Island, Tanzania, where malpresentations, specifically breech or cephalic malposition were associated with a dramatically increased risk of stillbirth, reflected by an OR of 17.67 (95% CI: 7.50, 41.64).

2.6 Provider factors associated with stillbirth

Quality healthcare services, particularly ANC, play a critical role in the prevention of stillbirth. High-quality ANC enables the timely identification and

management of maternal and fetal complications, thus reducing the risk of adverse outcomes. A study conducted in South Ethiopia demonstrated that good-quality ANC was associated with an 81% reduction in the odds of antepartum stillbirth, emphasizing the importance of comprehensive, continuous, and responsive maternal care services (Berhe *et al*., 2023).

2.7 Conceptual framework

Factors that may contribute to the risk of stillbirth can generally be grouped into sociodemographic, maternal factors, fetal factors and provider factors (Figure 2.1). Due to limitations in the availability and completeness of secondary data, this study focused only on selected sociodemographic, maternal, and fetal factors variables that have been previously highlighted in the literature as potential contributors to stillbirth. The primary outcome assessed in this study was the occurrence of stillbirth among deliveries recorded at HPUSM between 2019 and 2023.

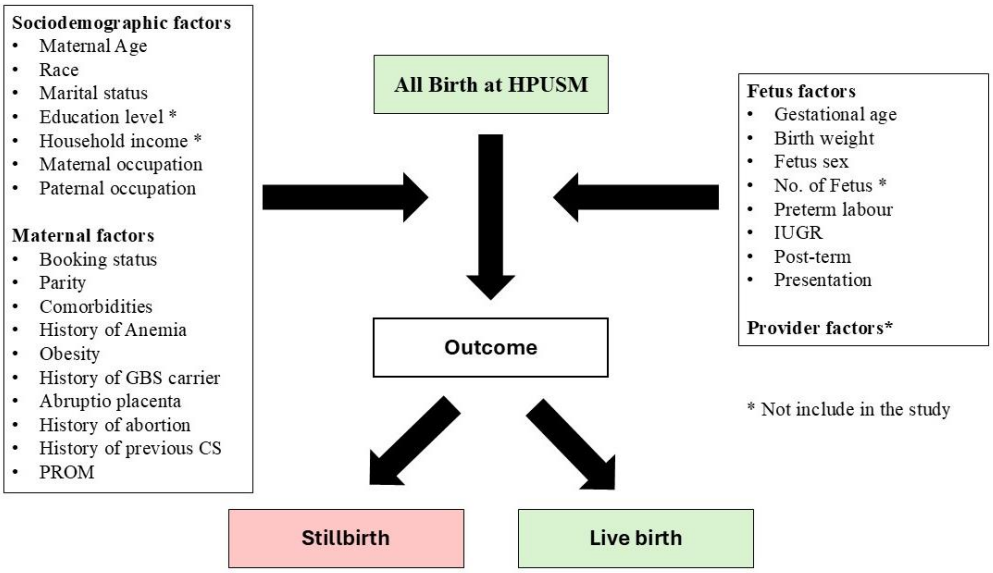

Figure 2.1 Conceptual Framework of Factors Associated with Stillbirth at HPUSM (2019–2023)