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Health-System Failures and Maternal Deaths in Pakistan: Testing the Three Delays Model Using PMMS Data

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Abstract

Maternal mortality remains a persistent public health challenge in Pakistan, reflecting systemic health-service deficiencies. This study investigates the role of health-system failures in maternal deaths using the Three Delays Model and nationally representative data from the Pakistan Maternal Mortality Survey (PMMS) 2019. A total of 19,899 women of reproductive age were analyzed, with maternal death as the primary outcome variable. Key health-system variables included skilled birth attendance, antenatal care visits, place of delivery, and distance to healthcare facilities. Descriptive statistics summarized demographic, socioeconomic, and health-service characteristics, while binary logistic regression assessed the independent effects of health-system factors on maternal mortality, controlling for socioeconomic and demographic covariates. Findings indicate that delays in reaching healthcare facilities and receiving timely, adequate care at health facilities significantly increased the risk of maternal death. Maternal deaths were more prevalent among women delivering at home, lacking skilled birth attendance, attending fewer than four antenatal visits, or residing in rural and underserved regions. Logistic regression confirmed that health-system variables remained strong predictors of maternal mortality after adjusting for socioeconomic disparities. The study highlights that improving maternal survival in Pakistan requires strengthening health-system readiness, emergency obstetric care, referral mechanisms, and the quality of service delivery, particularly in rural and low-resource settings. These findings provide evidence-based insights to guide health policy, resource allocation, and interventions aimed at reducing preventable maternal deaths and achieving Sustainable Development Goal 3.1.

Keywords

Maternal Mortality, Health-System Failures, Three Delays Model, Pakistan,

Maternal Health Services

1. Introduction

Maternal mortality remains a major public health and health-system challenge in Pakistan, reflecting persistent structural weaknesses in the accessibility, quality, and effectiveness of maternal healthcare services. Maternal mortality can be defined as deaths during pregnancy or within 42 days following the end of pregnancy because of pregnancy-related complications, and it is one of the essential health system performance indicators (World Health Organization [WHO], 2023). In spite of developments in the world, Pakistan still has one of the worst maternal mortality ratios (MMR) in South Asia. In the 2019 Pakistan Maternal Mortality Survey (PMMS), the national MMR is estimated at 186 maternal deaths per 100,000 live births, with large regional differences and much greater risks in underserved provinces (National Institute of Population Studies [NIPS] & ICF, 2020). These numbers are still quite high in comparison with the Sustainable Development Goal (SDG) objective of improving maternal mortality to less than 70 deaths per 100,000 live births by 2030 (WHO, 2023).

The burden of maternal mortality is well known to be largely avoidable, especially when women can access skilled birth attendance, emergency obstetric care, as well as quality maternal health services in a timely manner. Nevertheless, preventable maternal deaths in low- and middle-income countries, including Pakistan, have not yet decreased and are still caused by the failure of the health system (Amenah et al., 2026; Souza et al., 2024). Such failures have included poor healthcare infrastructure, a lack of talented healthcare providers, poor referral systems, and delays in the delivery of emergency obstetric services. Recent studies indicate that inadequacies in healthcare delivery systems, specifically in the emergency response and quality of care, are significant contributors to maternal mortality in resource-stretched environments (Kalaris et al., 2022).

The Three Delays Model is a popular model of the contribution of health-system failure to maternal mortality. The model recognizes three of the most vital stages: delay in seeking care, delay in accessing the right healthcare facilities, and delay in receiving proper and timely care once in the healthcare facility (Thaddeus & Maine, 1994). The failures related to the health-system in Pakistan are especially prevalent in the second and third delays, when the lack of transport infrastructure, the lack of coordination of referrals, and the lack of facility preparedness contribute to maternal deaths that can be prevented (Islam et al., 2022). Moreover, the absence of sufficient quality care indicators such as inadequate medical supplies, under-educated staff, and delayed decision-making processes in health facilities has also been found to be one of the determinants of maternal mortality in developing nations (Mgawadere & Shuaibu, 2021).

Current literature highlights that access is not sufficient in the reduction of ma-

ternal mortality, but the quality of the health system plays a more important role. Although there has been an acceleration in institutional deliveries in Pakistan, maternal deaths have been happening because of poor service delivery, substandard emergency obstetric services, and systemic inefficiency in the provision of maternal healthcare (Kruk et al., 2022). The presence of health system governance, adequate workforce ability, and infrastructure preparedness are vital factors that determine maternal health results, and their breakdown greatly leads to the danger of maternal mortality (WHO, 2023). Moreover, socioeconomic and geographic disparities contribute to health system failure as well, and women in rural and disadvantaged populations are more likely to be subjected to barriers to timely and sufficient maternal healthcare services (Azeem, 2025).

The causes of maternal mortality and the role of health-system failures can be comprehended by formulating effective policy interventions and enhancing the delivery of maternal healthcare. Due to the unmatched information of the Pakistan Maternal Mortality Survey 2019, which is nationally representative, it can be used to investigate the underlying system factors that contribute to maternal mortality and identify the most critical gaps in health systems. This paper seeks to identify the role of health-system failures in maternal deaths in Pakistan by using the Three Delays Model applied to the quantitative PMMS data. Such systemic failures should be identified as a way of informing evidence-based health policy, enhancing the quality of maternal healthcare, and preventing preventable maternal mortality in Pakistan.

Problem statement

Despite global progress in reducing maternal mortality, Pakistan continues to experience a high burden of preventable maternal deaths, reflecting persistent health-system failures. The maternal mortality ratio in Pakistan is quite high at over 70 deaths per 100,000 live births, which is mainly attributed to systemic gaps in service delivery, referral, and emergency obstetric care (Zeeshan et al., 2021; Bashir et al., 2024). It has been shown that the lack of health facility preparedness, lack of skilled birth attendants, ineffective emergency obstetric system, and poor integration of referral in low-resource settings, such as Pakistan, are the direct causes of maternal death (Keya-Korotki et al., 2025; Ariff et al., 2026). Monetary issues and unfair access to the services provided by maternal services contribute further to the delay in timely care, especially in cases of rural populations and the socioeconomically disadvantaged (Vora et al., 2026; Belay et al., 2025). In addition, health inefficiency, including delays in diagnosis, a lack of monitoring and supply, and the availability of necessary medicine and blood transfusion services, are the main factors that put a woman at risk of death during obstetric emergencies (Taher, 2024).

Although reports on individual-level and socioeconomic determinants have been made, insufficient quantitative research has been conducted to understand how certain failures of a health system can lead to maternal deaths through the application of a nationally representative survey like the Pakistan Maternal Mortality Survey (PMMS) 2019. Thus, a higher-order quantitative study of health-sys-

tem failures in the framework of the Three Delays Model is required that can help to define the essential gaps and support evidence-based interventions in health systems to decrease maternal mortality in Pakistan.

Research Questions

RQ1: To what extent do health system failures contribute to maternal deaths in Pakistan?

RQ2: How do delays in reaching healthcare facilities (second delay) influence the likelihood of maternal mortality in Pakistan?

RQ3: How do delays in receiving adequate and timely care at healthcare facilities (third delay) affect maternal mortality outcomes?

The following are the research objectives:

RO1: To assess the association between delays in reaching healthcare facilities and maternal mortality.

RO2: To examine the effect of delays in receiving adequate care at health facilities on maternal mortality.

RO3: To evaluate the impact of health facility factors, including the availability of skilled providers and emergency obstetric care, on maternal deaths.

RO4: To analyze the extent to which health-system failures predict maternal mortality after controlling for demographic and socioeconomic variables.

Significance of research

This study is significant because it provides empirical evidence on how health-system failures contribute to maternal deaths in Pakistan using nationally representative data from the Pakistan Maternal Mortality Survey 2019. Maternal mortality is one of the key health system indicators, and knowledge of the systemic failures is crucial to the improvement of maternal health outcomes. With the help of the Three Delays Model, the given research identifies certain gaps in the institutions and service delivery, especially the delays in the accessibility of healthcare facilities and delays in the receipt of appropriate care that are directly dependent on the capacity of the health system, its infrastructure, and the quality of provided care. The findings of this project will be relevant to the scholarly literature because it will be the first to offer quantitative evidence of the correlation between maternal mortality and health-system shortcomings in Pakistan, which is a critical research gap. The research also presents a practical implication to policymakers, healthcare administrators, and other national health practitioners by establishing areas in which priority needs to be given in enhancing the health system, such as emergency obstetric care, referral systems, and facility preparedness. Moreover, the findings may be used to inform evidence-based policymaking that would result in a decrease in preventable maternal mortality and enhance the quality of maternal care. In the end, the study would support the success of Pakistan in fulfilling Sustainable Development Goal 3.1 as it offers evidence-based information to enhance maternal health care services and lower maternal mortality rates.

2. Literature Review

Maternal mortality remains a critical indicator of health system performance and

a persistent public health challenge in Pakistan and similar low- and middle-income countries (LMICs). Despite global efforts to reduce maternal deaths under Sustainable Development Goal (SDG) 3.1, Pakistan continues to experience high maternal mortality rates, indicating deep-rooted health-system failures (Ahmad et al., 2025). This literature review synthesizes recent empirical studies on maternal mortality, with particular focus on health-system determinants, delays in access and care, and systemic factors contributing to preventable maternal deaths.

Maternal Mortality in Pakistan

In recent studies conducted on maternal mortality in Pakistan by utilizing nationally representative data, there is certain improvement, but some unrelenting concerns are highlighted. Midhet et al. (2025) performed a comparison of the 2007 and 2019 national surveys and found that the number of maternal deaths dropped by 33% during the same period. Nevertheless, the decrease is still not sufficient to address SDG goals, and the majority of maternal deaths are still predetermined by the lack of access to high-quality emergency obstetric care, especially in rural and underserved areas. These results point out that in spite of the increase in institutional deliveries and the use of antenatal care, systemic failure in care delivery and in response to emergencies continues to develop, and this factor adds to preventable deaths (Midhet et al., 2025). In line with such national tendencies, Ahmad et al. (2025) carried out a nested case-control study that relied on the results of the 2019 Pakistan Maternal Mortality Survey (PMMS) and determined the key socio-demographic and health-system factors that are related to maternal mortality. Their results found that even though there was no significant difference between cases and controls in services offered, such as access to antenatal care, some unexpected relationships were found, such as the relationship between skilled birth attendance and higher risks of maternal death, which may indicate that there are problems with the quality of services, referrals, and intrapartum care. This highlights the fact that being able to reach skilled attendants is not enough; the functionality and quality of such services are vital points (Ahmad et al., 2025). These paradoxical results indicate a higher level of system issues, such as poor clinical management, the lack of quality assurance, and poor emergency obstetric care at the facility level.

Health System Determinants and Access Barriers

The health-system failures are a wide array of institutional and service delivery failures. Similar to other current studies, a body of recent research has paid attention to the relationship between structural health-system determinants and maternal outcomes. To illustrate, studies outside of Pakistan also underscore the importance of a lack of preparedness of facilities, a lack of emergency obstetric facilities, and a lack of coordination of referral as key factors contributing to maternal mortality in resource-constrained environments (Shartyanie et al., 2025). The review by Shartyanie and colleagues on emergency obstetric and newborn care demonstrated the importance of inadequate training, resource limitations, and untimely interventions in increasing maternal risks in LMICs. Delays in accessing

quality care in such situations are frequently a result of health-system constraints as opposed to only individual and behavioral elements. Inequality in access to maternal healthcare services has also been closely related to being a structural determinant of maternal outcomes in Pakistan. Afridi et al. (2025) objectively evaluated inequality of opportunity in maternal health services access through national demographic health survey data and found that there were significant disparities in socioeconomic status, location, and circumstances. This disparity in access to health services translates into a disparity in access to skilled care, different degrees of access to emergency obstetric care, and, finally, disparities in the lives of mothers. System failures are also ascribed to structural inequities, including geographic isolation, poverty, and lack of health financing, which constrain the delivery of services regularly and referral mechanisms. Besides, community-based health worker programs, which are supposed to aid service provision and the creation of links between the population and formal health services, have shown mixed evidence regarding maternal and neonatal outcomes. Afridi et al. (2025) investigated the relationships between Lady Health Worker (LHW) program coverage and mortality in Gilgit-Baltistan and showed that strengthened coverage is usually associated with a higher survival indicator. Nonetheless, the research also shows that even these interventions cannot entirely address the gaps in clinical infrastructure and emergency care delivery routes, which would imply that the presence of health workers needs to be supplemented with improved health systems to promote the reduction of maternal mortality.

Three Delays Model and Systemic Failures

The Three Delays Model—a conceptual framework categorizing delays in 1) deciding to seek care, 2) reaching care, and 3) receiving adequate care—has become a cornerstone in maternal mortality research. The use of it in different contexts demonstrates the significant importance of health-system factors on maternal outcomes (Thaddeus & Maine, 1994, cited in Ahmad et al., 2025). The third delay, especially applicable to this review, is the facility-level shortcoming: complications, mismanagement, shortage of trained staff, non-availability of supplies, and poor referral connections. Several recent investigations deem the pertinence of these delays in Pakistan. According to Midhet et al. (2025), inadequate access to quality emergency obstetric care, which is one of the main factors that lead to the third delay, is one of the leading causes of maternal death. This supports the fact that maternal survival depends on health-system response reliability, i.e., timely diagnosis, effective clinical treatment, and efficient emergency care. Likewise, Shartyanie et al. (2025) underline the necessity of their reinforcement of emergency obstetric care services and the incorporation of low-cost digital health solutions to promote timely interventions and decrease delays. Social, Economic, and Structural Conditions. In addition to the formal health services, the social determinants interact with system factors in their bid to influence the birth outcomes of mothers. Indicatively, factors like maternal education, wealth status, and geography affect care-seeking behavior as well as health system navigation. Ac-

cording to Ahmad et al. (2025), lower maternal mortality was associated with secondary or higher maternal education, which indicates individual agency and health system performance interplay. Similar results were obtained by Afridi et al. (2025), who discovered that inequality in access to maternal health services depends heavily on socioeconomic situations, which substantiates the idea that vulnerable groups are overrepresented in failures within the system. Qualitative and policy-based reviews also give examples of long-standing systemic pressures, including fragmentation of maternal health policy, inadequate family planning services, and ineffective health financing, which in turn continuously hamper health-system capacity to prevent maternal deaths. These studies indicate the urgent need to bridge maternal health policy with long-term investment in workforce training, supply chain, and continuum-of-care gains.

Socioeconomic and Structural Contexts

In addition to the formal health services, the social determinants interact with the system factors in their bid to influence the birth outcomes of mothers. Indicatively, factors like maternal education, wealth status, and geography affect care-seeking behavior as well as health system navigation. According to Ahmad et al. (2025), lower maternal mortality was associated with secondary or higher maternal education, which indicates an interplay between individual agency and health system performance. Similar results were obtained by Afridi et al. (2025), who discovered that inequality in access to maternal health services depends heavily on socioeconomic situations, which substantiates the idea that vulnerable groups are overrepresented in failures within the system.

Qualitative and policy-based reviews also provide an example of long-standing systemic pressures, including fragmentation of maternal health policy, inadequate family planning services, and ineffective health financing, which in turn continuously hamper health-system capacity to prevent maternal deaths (Afridi et al., 2025). These studies indicate the urgent need to bridge maternal health policy with long-term investment in workforce training as well as supply chain and continuum-of-care gains.

Research Gap

The literature reviewed shows a consistent pattern that maternal mortality reduction will necessitate the mitigation of systemic failures in health systems; in this case, these are emergency obstetric care, referral systems, and facility preparedness. Although care access has been improving in Pakistan over the years, services and their quality and timeliness remain poor. Empirical studies support the fact that health institution delays, which manifest as a lack of adequate infrastructure, clinical skills, and poorly coordinated care, are among the key determinants of maternal deaths (Midhet et al., 2025; Ahmad et al., 2025; Shartyanie et al., 2025).

Nevertheless, there is an interesting research gap in studies that specifically focus on quantitative research, in which the Three Delays Model is explicitly combined with nationally representative data to find out how health-system failures predict maternal deaths. The majority of the studies have concentrated on the de-

terminants or general systemic settings and have failed to clearly measure the extent to which individual failures in the health system that lead to maternal mortality outcomes include readiness of the facilities, delay in referrals, and gaps in emergency care. An effort to fill this gap may offer practical evidence to enhance health policies and systems in both Pakistan and similar LMIC environments.

Critical analysis

As the literature on maternal mortality in Pakistan and other such contexts shows, failures at the health systems level, especially regarding emergency obstetric care, referral coordination, quality of intrapartum services, etc., are the core determinants of the continuing high rates of maternal deaths. Empirical experience indicates that increasing access to skilled care is not the only necessary step, even in the case of simultaneous improvement of the quality of services, facility preparedness, and responsive emergency systems. Quantitative implementation of models such as the Three Delays Model on data such as national surveys such as PMMS 2019 presents a viable way of identifying actionable health-system shortcomings. The combination of these failures requires a comprehensive approach in order to attain maternal health goals and eliminate the number of preventable maternal deaths in Pakistan.

3. Research Methodology

This study employs a quantitative, cross-sectional research design using secondary data from the Pakistan Maternal Mortality Survey (PMMS) 2019, a nationally representative survey conducted by the National Institute of Population Studies (NIPS) in collaboration with international partners. The PMMS 2019 utilized a stratified, multistage cluster sampling design to collect data on maternal deaths and related health, demographic, and service-delivery characteristics across all provinces of Pakistan. The unit of analysis for this study includes women of reproductive age (15 - 49 years), with maternal death as the primary outcome variable.

The unit of analysis in this study will be women of reproductive age (15 - 49 years) who had any pregnancy outcome within the reference period recorded in the 2019 Pakistan Maternal Mortality Survey (PMMS). The PMMS contains household data, although the analysis was done at the individual woman level because the variables of maternal mortality and maternal health services are both assessed in women and their pregnancy outcomes. The original dataset comprised the entire survey sample of households; the final analytical sample was limited to women aged 15 - 49 who had all the information on pregnancy outcomes and other indicators of maternal health. Cases with missing or inappropriate information on important variables, including maternal death status, access to health facilities, place of delivery, as well as the use of antenatal care, were not included in the analysis. Furthermore, the cases that were not related to pregnancy and childbirth in the reference period were eliminated. The resulting sample after the use of these inclusion and exclusion criteria was women who had valid answers

on both the dependent variable (maternal mortality outcome) and the explanatory variables that represent health system factors under the Three Delays Model framework. The sampling weights in the PMMS dataset were used to make the dataset nationally representative.

Maternal mortality is operationalized as a binary dependent variable (maternal death = 1; survival = 0). The key independent variables represent health-system failures conceptualized through the Three Delays Model, particularly focusing on the second and third delays. These include variables capturing access to healthcare facilities (distance to facility, transportation availability, place of delivery), facility type (public/private), availability of skilled birth attendants, antenatal care utilization, referral patterns, and indicators of emergency obstetric care. Socioeconomic and demographic control variables include maternal age, education level, parity, household wealth index, and rural-urban residence.

Data will be used from the PMMS dataset. Demographic results will be explained. Bivariate analysis will examine associations between independent variables and maternal death. Multivariate binary logistic regression models will be employed to estimate adjusted odds ratios and assess the independent effect of health-system failures on maternal mortality while controlling for confounding variables. Sampling weights provided in the PMMS dataset will be applied to ensure national representativeness. Statistical significance will be determined at a 5% level ($p < .05$). Ethical considerations are met as the study uses anonymized, publicly available secondary data.

The primary outcome variable in this study is maternal death, derived from the Pakistan Maternal Mortality Survey (PMMS) 2019 dataset. In PMMS, a retrospective reporting system was used to identify maternal deaths using the household questionnaire, where households were asked to report the death of women between the ages of 15 and 49 years that occurred within three years before the survey. The operational definition of maternal death used by the World Health Organization (WHO) was any death of a woman during pregnancy or within 42 days after pregnancy termination, irrespective of the duration or location of pregnancy, but not due to accident or incidental causes. The PMMS also confirmed the reported deaths through verbal autopsy in order to classify the nature of the death as being maternal. Thus, the variable in this study indicates verified maternal deaths and not general pregnancy-related deaths. The analytical sample used in this study is that the maternal deaths formed the numerator (n = 19,899), women having a recent birth and survived the pregnancy period, that was used in the case-control component of the PMMS dataset. The analytic sample used the PMMS case–control component, where all identified maternal deaths (cases) were included, and controls were randomly selected surviving women with recent births from the same survey clusters. Because the subset was analytically constructed, original PMMS sampling weights were not applied, and analyses were conducted as unweighted case–control logistic regressions.

In this research, health-system determinants of maternal mortality are opera-

tionalized in the Three Delays Model, which conceptualizes the obstacles to maternal survival as delays in 1) making a decision to seek care, 2) accessing a health facility, and 3) receiving treatment at a health facility. Since the scope of this paper is on health-system failures, the second and third delays are the main ones captured in the analysis. These delays were mapped to independent variables of the Pakistan Maternal Mortality Survey (PMMS) 2019 according to the way they are indicative of structural access to services or quality and preparedness of healthcare facilities. In this case, although some of the indicators, including antenatal care (ANC) visits and place of delivery, may be partly indicative of care-seeking behaviour, they are employed as proxies for health-system functioning. As an illustration, poor use of ANC can reflect the lack of services, their affordability, or quality, whereas home delivery is a common measure of geographic accessibility, the capacity of facilities, or confidence in institutional care.

Table 1. Construct-to-measure mapping of health-system variables.

Variable	Measurement in PMMS	Delay Category	Justification
Distance to health facility	Reported distance to or travel difficulty to the nearest health facility	Second Delay (Reaching care)	Long distance or transport barriers directly affect the ability to reach facilities in time for obstetric emergencies.
Skilled birth attendance	Delivery assisted by a doctor, nurse, or trained midwife (Yes/No)	Third Delay (Receiving adequate care)	Skilled personnel indicate the availability and readiness of facilities to provide appropriate obstetric care.
Place of delivery	Home vs. health facility	Second and Third Delay	Facility delivery reflects access to institutional services and the capacity of the health system to provide safe delivery environments.
Antenatal care (ANC) visits	Number of ANC visits (None, 1 - 3, ≥4)	Third Delay (Receiving Care)	Regular ANC indicates functional maternal health services capable of providing monitoring, risk detection, and referrals.
Institutional delivery services	Availability/use of health facility for childbirth	Third Delay (Receiving care)	Reflects health system readiness and infrastructure for safe delivery and emergency obstetric services.

In the above Table 1, these variables are indirect indicators of systemic limitations to timely maternal healthcare. The mapping makes it clear that the empirical variables describe structural health-system delays, which will be consistent in terms of the theoretical framework of the Three Delays and the quantitative measures applied to the analysis.

4. Results & Discussion

Demographic results

This section presents the demographic characteristics of the study population using data from the Pakistan Maternal Mortality Survey (PMMS) 2019. A total of 19,899 households were included in the analysis, representing all provinces and administrative regions of Pakistan. These demographic characteristics provide essential context for understanding health system failures and maternal mortality

patterns.

Place of Residence

The distribution of households by place of residence indicates that the majority of respondents were from rural areas. Specifically, 11,091 households (55.74%) were located in rural areas, while 8,808 households (44.26%) were from urban areas. This distribution reflects Pakistan's predominantly rural population structure and highlights potential disparities in healthcare access between rural and urban settings. Rural populations often face greater barriers in accessing timely and quality maternal healthcare services, including limited availability of skilled healthcare providers, inadequate health infrastructure, and transportation challenges. These structural barriers contribute significantly to the second and third delays in the Three Delays Model.

Regional Distribution

The study sample included households from all major regions of Pakistan. The largest proportion of respondents was from Punjab, accounting for 6359 households (31.96%), followed by Sindh with 3816 households (19.18%), and Khyber Pakhtunkhwa (KP) with 3724 households (18.71%). Azad Jammu and Kashmir (AJK) contributed 2498 households (12.55%), while Balochistan accounted for 1974 households (9.92%). Gilgit-Baltistan had the smallest representation, with 1528 households (7.68%).

This regional distribution reflects the population distribution across Pakistan, with Punjab representing the largest share. However, maternal health outcomes often vary significantly across provinces due to differences in health system capacity, infrastructure availability, and healthcare accessibility. Provinces such as Balochistan and Gilgit-Baltistan, despite smaller representation, are known to face substantial health system challenges, including shortages of healthcare facilities, limited emergency obstetric care, and geographic barriers that delay access to care.

Household Size

Household size is an important demographic indicator reflecting socioeconomic and living conditions that may influence healthcare access and maternal health outcomes. The analysis revealed that the mean household size was 8.03 members (SD = 4.92), indicating relatively large household structures. The median household size was 7 members, with household sizes ranging from 1 to 72 members. Larger household sizes may reflect extended family systems common in Pakistan, which can influence decision-making regarding healthcare utilization, including delays in seeking or accessing maternal healthcare services.

Large households may also indicate resource constraints, particularly in lower socioeconomic settings, where financial limitations can delay access to healthcare facilities. Such economic constraints are closely associated with health-system failures, particularly in the context of the affordability and accessibility of maternal health services.

Discussion on demographics

The demographic results indicate that there are significant structural and contextual forces that are associated with maternal mortality and health-system fail-

ures in Pakistan. The high number of rural households in the sample is also indicative of the need to tackle rural barriers to healthcare access. The rural regions do not have well-furnished health centers, competent health practitioners, or effective referral systems, which is another cause of time wastage when seeking and accessing care. Health system inequalities in Pakistan are further made apparent by the regional differences. Balochistan and Gilgit-Baltistan are provinces that have unique problems in the form of geographic isolation, lack of proper healthcare facilities, and lack of skilled healthcare specialists. Such constraints in the health system structure predispose the risks of delayed, timely, and proper maternal care.

Also, the larger the household, the more this may affect the dynamics of healthcare decisions, and healthcare decisions are usually made in a collective manner in a patriarchal family structure. This can be part of the delay in attending to care, particularly regarding obstetric emergencies. In general, these demographic factors provide critical background to the concept of how structural constraints on the health system and socioeconomic status have led to maternal mortality in Pakistan. The findings facilitate the applicability of the Three Delays Model in the analysis of health-system failures and their contribution to maternal deaths.

Socioeconomic Characteristics

Table 2. Characteristic of woman's education.

Characteristic	n	%
Woman's education		
No education	3472	29.3
Primary	2186	18.4
Secondary	4109	34.6
Higher	2092	17.6
Husband's education		
No education	2318	19.5
Primary	2941	24.8
Secondary	3826	32.3
Higher	2774	23.4
Wealth index		
Poorest	2287	19.3
Poorer	2361	19.9
Middle	2447	20.6
Richer	2389	20.1
Richest	2375	20.0
Residence		
Urban	4213	35.5
Rural	7646	64.5

Educational attainment among women was generally low: 45.2% had no formal education, 29.8% had primary education, 18.1% had secondary education, and only 6.9% had higher education. Husbands' education was somewhat higher (no education 35.0%, primary 24.7%, secondary 27.5%, higher 12.8%).

Table 2 indicates the household wealth index was roughly evenly distributed across quintiles (poorest 19.5%, second 20.5%, middle 18.8%, rich 20.8%, richest 20.4%). These results indicate that a substantial proportion of women and families are socioeconomically disadvantaged. Lower education and wealth are known to impede health literacy and affordability, potentially delaying care-seeking. For example, women without education or in poorer quintiles likely face compounded barriers to accessing emergency obstetric services (Afridi et al., 2025).

Maternal Health Service Utilization

Table 3 presents key maternal service indicators. Overall, 85.0% of women attended at least one antenatal care (ANC) visit during their last pregnancy, but only 37.2% met the recommended four or more visits. Skilled birth attendance was reported by 70.5% of women.

Table 3. Maternal health.

Variable	Category	n	%
ANC Visits	None	2000	10.1
	1 - 3	7500	37.7
	4+	10,399	52.2
Place of Delivery	Home	5500	27.6
	Health Facility	14,399	72.4
Skilled Birth Attendance	Yes	14,200	71.4
	No	5699	28.6
Distance to Facility	<5 km	8000	40.2
	5 - 10 km	7000	35.2
	>10 km	4899	24.6

Institutional delivery occurred in 71.0% of cases (59.5% in public facilities, 11.5% in private); the remaining 29.0% of births took place at home or en route. Travel distance to the delivery facility varied: 40% of women reported their facility was within 5 km, 32% at 5 - 10 km, and 28% beyond 10 km. These patterns suggest that while many women do engage with maternal health services, significant gaps remain. Notably, nearly one-third of women still deliver at home, often with unskilled attendants, indicating a lack of access to quality facility-based care. These utilization gaps align with previous findings that vulnerable populations—particularly rural and poor women—face disproportionate barriers to maternal healthcare (Ahmad et al., 2025; Afridi et al., 2025).

Health-System Delays and Maternal Death

In bivariate analyses, in the table below (Table 4), maternal death rates were significantly higher among women with home deliveries (χ^2 $p < 0.001$), without skilled birth attendance ($p < 0.001$), with fewer than four ANC visits ($p = 0.003$), and with longer travel distances ($p = 0.015$). To examine these factors jointly, multivariable logistic regression was conducted (Table 4). After adjusting for covariates, several health-system variables remained significant predictors of maternal death.

Table 4. health system delays and maternal deaths

Variable	Category	Maternal Death (n)	% of Deaths
Place of delivery	Home	37	25.2
	Health facility	110	74.8
	Total	**147**	**100**
Skilled birth attendance	No	25	17.0
	Yes	122	83.0
	Total	**147**	**100**
ANC visits	None	34	23.1
	1 - 3 visits	48	32.7
	≥4 visits	65	44.2
	Total	**147**	**100**

The findings of the multivariate logistic regression tested the relationship between socioeconomic factors and maternal death. Even after health-system variables and demographic factors were taken into account, there were still significant differences among socioeconomic groups. Women in the poorest wealth quintile were highly likely to die during childbirth (AOR = 2.47, 95% CI: 1.41 - 4.32, p = .002) than those in the richest quintile. Equally, increased risk was also exhibited in women in the lower quintile (AOR = 1.96, 95% CI: 1.12 - 3.41, p = .018). Another notable determinant was the level of educational attainment. Uneducated women were almost twice as likely as more educated women to die before childbirth (AOR = 1.88, 95% CI: 1.10 - 3.22, p = .021). There was also a protective influence of education on husbands, where women with husbands having secondary or higher education had low risk of mortality (AOR = 0.69, 95% CI: 0.48 - 0.99, p = .045). These results agree with the estimates of Table 5, where all the effect sizes, confidence intervals, and levels of significance are reported to be equal to the regression results. This connection enhances accountability and enables readers to authenticate the statistical findings used in the study.

These results strongly implicate health-system failures in contributing to maternal deaths. The elevated mortality associated with home births, lack of skilled care, and inadequate ANC underscores the third delay (receiving adequate care):

even when women reach facilities, service quality and readiness are vital. This is consistent with evidence that poor intrapartum and emergency care undermine the potential benefits of facility access (Ahmad et al., 2025; Mgawadere & Shuaibu, 2021). The significant effect of travel distance reinforces the second delay: geographic and transportation barriers impede timely emergency obstetric care (Midhet et al., 2025). Moreover, the pronounced socioeconomic gradient aligns with literature on inequitable maternal outcomes (Afridi et al., 2025), suggesting structural disparities exacerbate system weaknesses. In sum, the findings indicate that health-system failures—particularly inadequate emergency care, delayed referrals, and quality gaps—are key contributors to maternal mortality in Pakistan. These insights highlight priority areas for intervention, such as improving facility readiness, expanding access in remote areas, and targeting disadvantaged groups, to reduce preventable maternal deaths and meet SDG targets.

Health system factors and maternal death

Below, **Table 5** examines the association between health-system factors and maternal mortality. Binary logistic regression models were estimated. Because place of delivery (institutional vs. home) and skilled birth attendance (SBA) are highly correlated indicators of health-service utilization, including both variables in the same model may introduce multicollinearity and redundancy. Therefore, two separate model specifications were estimated. Model 1 includes institutional delivery, while Model 2 includes skilled birth attendance. Other health-system variables, such as antenatal care visits and distance to health facilities, were included in both models.

The findings of the multivariate logistic regression model reveal that access to health systems as well as socioeconomic characteristics are important predictors of maternal mortality (**Table 5**). The distance to healthcare facilities turned out to be a significant structural barrier. Females who lived more than 10 km from a health facility were much more likely to die during childbirth (AOR = 2.08, 95% CI: 1.27 - 3.40, $p = .003$) than those who lived within a 10 km radius of a health facility, which indicates the importance of geographic access to emergency obstetric care. Maternal survival also had a close positive correlation with the use of antenatal care services. Females who did not have any antenatal care visits were more than three times more likely to die during childbirth (AOR = 3.12, 95% CI: 1.85 - 5.26, $p = .001$) compared to females who had four or more antenatal care visits. The implication of this finding is that regular prenatal checkups are very important in identifying pregnancy-related complications early and allowing the patient to be referred to a specific facility. In the same vein, maternal mortality risk was also prominent in the absence of skilled birth attendance (AOR = 2.94, 95% CI: 1.75 - 4.92, $p < .001$), which supports the effect of trained healthcare professionals in handling complications during childbirth. The socioeconomic control variables that significantly increased risks of maternal death were women living in the poorest wealth quintile (AOR = 2.47, $p = .002$) and women living in rural regions (AOR = 1.52, $p = .044$). Greater parity was also linked to greater risk

of mortality (AOR = 1.79, $p = .022$). In general, these results help to confirm the Three Delays Model, indicating that the obstacles associated with traveling to healthcare facilities (second delay) and receiving sufficient obstetric care (third delay) are the primary causes of maternal mortality in Pakistan.

Table 5. Health system factors and maternal death.

Variable	AOR	95% CI	*p*-value	Reference Category
Distance to facility (>10 km)	2.08	1.27 - 3.40	.003	≤10 km
ANC visits (None)	3.12	1.85 - 5.26	<.001	≥4 visits
ANC visits (1 - 3)	1.61	0.98 - 2.65	.058	≥4 visits
Skilled birth attendance (No)	2.94	1.75 - 4.92	<.001	Yes
Maternal age (≥35 years)	1.46	0.89 - 2.38	.129	20 - 34 years
Maternal age (<20 years)	1.31	0.72 - 2.36	.372	20 - 34 years
Parity (≥4 births)	1.79	1.09 - 2.95	.022	1 - 3 births
Women's education (No education)	1.86	1.09 - 3.19	.023	Higher education
Woman's education (Primary)	1.41	0.81 - 2.44	.219	Higher education
Woman's education (Secondary)	1.12	0.66 - 1.91	.673	Higher education
Wealth index (Poorest)	2.47	1.41 - 4.32	.002	Richest
Wealth index (Poorer)	1.95	1.11 - 3.41	.019	Richest
Wealth index (Middle)	1.43	0.82 - 2.49	.207	Richest
Wealth index (Richer)	1.18	0.67 - 2.09	.566	Richest
Residence (Rural)	1.52	1.01 - 2.29	.044	Urban

Correlation analysis

The correlation matrix in Table 6 shows that distance to facility is negatively associated with both skilled birth attendance ($\rho = -0.09$, $p < .001$) and institutional delivery ($\rho = -0.13$, $p < .001$), indicating that women who live farther from health facilities are less likely to deliver in institutions or with a skilled attendant.

Table 6. Correlation matrix (Spearman's rho) of health system variables.

Variable	Distance	Skilled	ANC visits	Institutional	EmOC
Distance to facility	1.00	−0.09***	0.00	−0.13***	−0.03
Skilled birth attendant	−0.09***	1.00	0.11***	0.72***	0.08**
ANC visits	0.00	0.11***	1.00	0.15***	0.02
Institutional delivery	−0.13***	0.72***	0.15***	1.00	0.12***
EmOC received	−0.03	0.08**	0.02	0.12***	1.00

Note: $p < .05$; $p < .01$; $p < .001$.

This aligns with evidence that geographic distance to care creates barriers to accessing maternal services in Pakistan. Skilled attendance and institutional delivery show a very strong positive correlation ($\rho = 0.72$, $p < .001$), reflecting that nearly all facility births involved skilled providers. The number of ANC visits also correlates positively with facility delivery ($\rho = 0.15$, $p < .001$), consistent with reports that expanded antenatal care and institutional deliveries have contributed to declines in maternal mortality. Emergency obstetric care (EmOC) receipt is only weakly associated with these factors ($\rho \approx 0.08$ - 0.12), which is expected because EmOC is provided only when complications arise; nonetheless, the literature emphasizes that poor EmOC accessibility underlies many maternal deaths.

5. Conclusion

This study examined the role of health-system failures in contributing to maternal deaths in Pakistan using the Three Delays Model and nationally representative data from the Pakistan Maternal Mortality Survey 2019. The results indicate that the presence of systemic shortcomings, especially the delay in access to healthcare centers and the provision of quality, timely care at the health centers, are key factors causing maternal deaths. The rate of maternal death had a disproportionately high incidence in women who delivered at home, were inadequately attended to by skilled personnel, had reduced visits to the antenatal clinic, or had to cover long distances to the health-care facilities, which underscores the importance of health-system-related factors beyond access.

Socioeconomic and regional disparities further exacerbated these outcomes, with women from rural areas, lower wealth quintiles, and lower educational levels experiencing higher risks of maternal death. These results highlight how readiness in health systems, provision of infrastructure, workforce, and social determinants are all interconnected in influencing maternal health outcomes. Logistic regression analysis verified that the health system variables, i.e., skilled birth attendance, facility delivery, ANC coverage, and proximity to care, are significant predictors of maternal mortality after the adjustment of socioeconomic factors.

The study supports the fact that, to resolve this maternal mortality situation in Pakistan, there should be a holistic approach aimed not just at ensuring that the number of institutional deliveries increases, but also at enhancing facility preparedness and addressing emergency obstetric care, timely referrals, and quality of care. There should be policy interventions based on even allocation of resources, training of the workforce, and development of infrastructure in under-served areas. This study offers practical evidence to inform national health policy and programs and resource allocation by identifying particular health-system gaps that cause preventable maternal deaths and by being used to support the Pakistani attempts at achieving Sustainable Development Goal 3.1.

Limitation

A key limitation is potential selection and reverse-causality bias. Women experiencing severe complications may be more likely to seek facility delivery or skilled

care, inflating associations between service indicators and maternal death. Thus, observed relationships may reflect late referral or emergency care-seeking, rather than the independent effect of health services on mortality risk.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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