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A SPATIAL ANALYSIS OF MATERNAL HEALTH CARE IN PUNJAB, PAKISTAN

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Abstract
The aim of this study is to analyze the barriers associated with maternal healthcare in Punjab (Pakistan) and to identify the factors contributing to maternal mortality. The study used the Multiple Indicator Cluster Survey (MICS-2018), data to analyze the socio-economic inequalities and determinants in the use of the maternal healthcare in Punjab. The analysis of concentration curve and concentration index showed an inequality in the utilization of the maternal health services among different socio-economic groups. The lowest wealth quintile is underutilizing the maternal health services as compared to the richest quintile. Furthermore, maternal health services are more pronounced amongst women living in the urban areas than those living in the rural areas. The occurrence of the maternal deaths is also higher in the lowest quintile. Therefore, it can be concluded that low utilization may contribute to higher maternal mortality. The logistic regression is also performed to analyze the determinants of the maternal mortality for potential household. According to the results, if the household head is literate, there will be a lower level of risk of maternal death. The odd ratios of household heads and a lower risk of mortality persisted over 1.0002 times. The unsafe drinking water is more associated with maternal deaths and increased the risk of maternal deaths by 1.142 times. An increase in income is more likely to enhance the chance of maternal survival by 1.16 times. So, by putting it as the main cause of death, it may be concluded that maternal deaths occur due to low-utilization of the maternal health services.

Keywords: Maternal Healthcare, Maternal Mortality, Child Health

1. Introduction

In recent years, focus on the socio-economic consequences of poor maternal health has increased. Maternal health impacts women's empowerment, house-hold wellbeing, and socio-economic development of a country. Unexpected maternal mortality sets off a multitude of shocks to the economic wellbeing of households, particularly, in underdeveloped areas, where the household is treated as an economic unit and without any social protection benefits it has to provide for its self-sustenance needs. Women in today's world have many roles besides being home-makers, they are

working in diverse fields along with the added responsibility of procreating. Globally, the maternal deaths have been reduced to 38 percent i.e., from 451,000 maternal deaths in 2000 to 295,000 maternal deaths in 2017. The Maternal Mortality Rate MMR has also declined from 342 deaths per 100,000 live births to 211 deaths per 100,000 live births United Nations Children's Fund (UNICEF, 2019). According to the estimates given by World Health Organization (WHO 2017), the global growth rate of a decline in the MMR during 2000 to 2017 was 2.9 percent. Despite of this significant decline, the maternal mortality has remained the major reason of death amongst women of reproductive age in many least developing countries (LDCs) and developing countries between 2000 to 2017 (WHO, UNICEF, UNFPA, World Bank, 2015).

Punjab is the most populous province of Pakistan with more than 11 million people (Population Census Pakistan, 2017). The maternal healthcare in the province of Punjab has been given commendable importance during the last decade (Punjab Economic Report, 2017). Given the importance of maternal healthcare to reduce morbidity and mortality in the province of Punjab, the supply of efficient, affordable, and accessible health care services has been assured. Furthermore, numerous health strategies and reforms have been introduced by the government to improve the maternal health indicators and achievement of the targeted maternal health outcomes. Despite showing better progress in some health indicators, the maternal mortality indicator in the province of Punjab has unfortunately not shown promising results.

According to the latest data from the Multiple Indicator Cluster Survey MICS (2018), a substantial increase can be observed in the MMR. It has touched 180 deaths per 100,000 live births in 2018 which was previously recorded as 178 per 100,000 in 2015 by World Health Organization and World Bank. According to the Punjab Health Sector Plan, the target was to reduce MMR by 140 deaths per 100, 000 but the MMR has increased to 180 deaths per 100,000 live births in Punjab. The data implied that the average annual growth rate of decline is only 2.61 percent, which is lower than the South Asia. This increased MMR sheds light on the current situation and quality of healthcare services available to mothers in Punjab.

The quality of maternal healthcare services can also be measured through the proportion of antenatal consultation, place of delivery, skilled birth attendant, contraceptive prevalence rate, total fertility rate, and post-natal care consultation etc. According to the WHO estimates, about 88 percent to 98 percent deaths due to pregnancy may be prevented by facilitating the pregnant women with good quality health care services. The risk factors related to maternal deaths in the province of Punjab may be avoided by providing quality and timely medical services and healthcare. The delay in seeking medical care increases the risk factors and sometimes makes complicated pregnancies life-threatening. The regional socio-economic disparities such as poverty, illiteracy, inadequate infrastructure of water and sanitation, and cultural and social barriers are some of the risk factors which cause delays and repudiate the access to maternal health care services. Three types of delays have been observed in the province of Punjab in seeking medical care for pregnant women. The first delay may be attributed to decision making from households in seeking medical care for pregnant women, i.e., the family and household head may be reluctant to seek medical care at the health facility from skilled medical personnel and usually call traditional midwives. The second delay occurs due to the lack of transportation or other necessary arrangements to reach the health facility. The third delay occurs due to the unavailability of trained/skilled medical staff at the health facility (Yasir et al. 2009). With a high MMR, Punjab as well as Pakistan would not been able to achieve the SDG target of reducing maternal mortality to 70 per 100,000 live births by 2030.

The quality and quantity of health services might differ significantly across districts and regions. In the province of Punjab, the maternal and child health indicators seem to be the worst in some of the districts. It is imperative to identify the influencing factors and system-wide challenges of maternal and child healthcare in these districts. Due to lack of district level data on maternal mortality, the study is confined to province level. The analysis of risk factors is very important for both the preventive and curative measures of maternal health care.

1.1 Objective of the Study

The aim of the study, subsequently emerged from the above discussion, is to understand the situational analysis of maternal health in Punjab based on the available data. The study also utilized econometric analysis to identify the important determinants of maternal health. The objective of the study is also to analyze the inequalities in the utilization of maternal healthcare services among different socio-economic groups. The study also to assesses the important household level determinants associated with maternal mortality. Based on all these analysis recommendations for interventions to reduce maternal morbidity and mortality are also provided.

1.2 Organization of the Study

The study is organized as follows: section 2 describes a critical review of literature. Section 3 explains the situation of maternal health care in Punjab. Section 4 specifies the methodology for the study. Section 5 explains the empirical estimations. In last, section 6 gives conclusion and some important policy recommendations.

2. Review of Literature

There are various economic, cultural, environmental, and health related factors that impact the maternal healthcare. The review of literature identified numerous studies which draw attention to wide-ranging determinants that contribute towards the risk factors leading to maternal deaths. Some of them are discussed below:

David et. al. (2014) found a significant number of maternal mortalities and morbidities from the Maputo Province of Mozambique as a result of economic factors including lack of money for medical costs and transportation. Delay in transfers of high-risk mothers to specialized health care facilities led to the delay in diagnosis, treatment, and response to emergency complications by the health care providers. Fawole & Adeoye (2015) analyzed that women who were employed throughout the year, received the skilled antenatal care frequently and childbirth through a skilled attendant. Resultantly, they were less likely to be involved in risk factors associated with maternal mortality as compared to those who were not economically independent. The households' economic resources are also found as an important determinant in seeking health care. Michael et al., (2010) conducted their study in Bangladesh and found that household wealth is positively related to healthcare utilization. Furthermore, the economic factors may also be reflected in the per-capita health spending at the state level which influenced maternal mortality (Buor and Bream, 2004). The involvement of economic factors is associated with a low rate of maternal death rates.

Furthermore, some studies have highlighted that the social factors influence risk factors thus contributing to the MMR. The illiteracy on part of a pregnant woman or her husband or family may also result in driving ahead the MMR. Similarly, another factor influencing the maternal health and maternal mortality is the high fertility rate as the high number of children per women may rupture her uterus, thereby resulting in maternal mortality as in case of developing countries (Buor & Bream, 2004).

Apparently, cultural factors are also critically important in preventing maternal mortality. For example, a delay from the expecting mother, her husband or family in seeking treatment and appropriate care, due to any reason, increases the probability of maternal mortality. Sometimes the pregnant women's odds of utilizing the health facilities were strongly inclined by the practices of their co-resident and their close relatives (mother-in-law and sisters-in- law etc.). It is also a norm at some places that a wife cannot seek healthcare without husband's permission as women's decision-making in matters of reproduction and sexuality is found very limited in most part of the Nigerian region (Adegoke, 2013). For instance, women's autonomy in the household decisions is also of utmost important for her own healthcare as the dependency of pregnant women has harmful effects on the maternal mortality (Woldemicael & Tenkorang, 2010).

Some studies have highlighted that the health indicators are involved in risk factors of maternal deaths. Mahwish (2004) explored that among all women seeking antenatal care, about 75 percent visited female doctors or the Lady Health Visitors (LHVs) only one time for antenatal care. The

study investigated that the antenatal care was not routine practice in pregnant women in the district under study. The author also explored that most of the women used the services of traditional birth attendant. Ali *et al.* (2004) has shown that post-natal health checkups were not very common in the poor urban settlements of Karachi. Only 24 percent of the women visited for post-natal health checkups and this proportion was lower than other developing countries including Philippines (58 percent) and India (40 percent). The result of their study revealed that prolonged labor pains and maternal age were associated risk factors with postpartum hemorrhage.

Disparities or inequalities in the utilization of maternal healthcare are also evident to be diverse between different socio-cultural and economic conditions such as (Bobo et al., 2017) found considerable inequity between and within regions of Ethiopia in the use of maternal health services. Maternal education and economic empowerment were the main contributors of inequality in the utilization of maternal healthcare services in Ethiopia. Similarly, a research conducted in six countries including Ethiopia, Madagascar, Uganda, Cameroon, Zambia and Zimbabwe (Nazmul, et al., 2015) evaluated the socio-economic inequalities in the use of prenatal care, contraceptive usage and institutional deliveries. The results demonstrated the geographical and wealth-based inequalities in the utilization of maternal health services which had changed the pattern of reducing maternal mortality, Takondwa et al., (2018) assessed the magnitude of the inequities and their determinants in coverage of maternal health services in Burkina Faso and found literacy and distance are the main determinants of inequality.

So, we can conclude from the discussion that socio-cultural, economic and geographic areas are the important contributors of maternal healthcare utilization and inequalities in these contributors may affect maternal mortality.

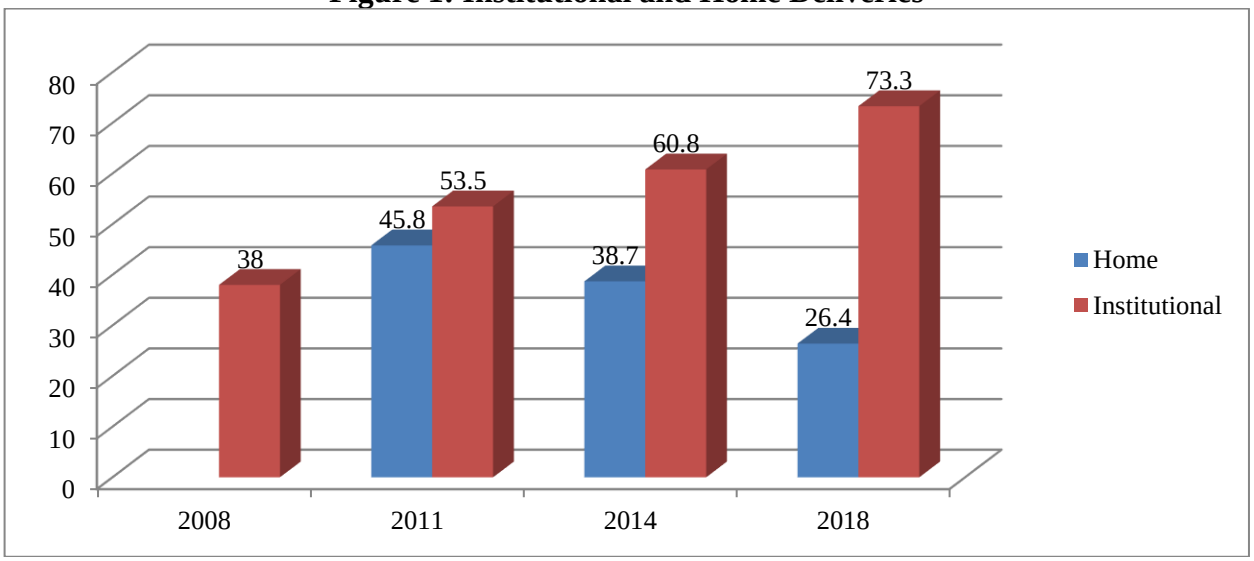
3. Situational Analysis of Maternal Healthcare in Punjab

The literature has signified the high MMR in less developed countries in various studies, it has identified the risk factors contributing to maternal death, and emphasized on the need for institutional deliveries and skilled staff for women during labor and delivery. The risk of maternal and neonatal deaths can be reduced substantially through regular and proper antenatal care checkup and delivery under safe and hygienic conditions. To analyze the maternal healthcare in Punjab, the trend analysis of these indicators is given below.

3.1 Place of Delivery

Most of the maternal complications arise during or immediately after the child birth. So, delivery at home is a risk factor as home delivery especially by an unskilled attendant may result in a risk of an unknown magnitude. Only skilled personnel have the training to save the mother's and child's life. In case of life-threatening conditions, there is an option for the skilled birth attendant to immediately deliver the baby by cesarean section or forceps or to arrange appropriate treatment for the patient. But these complications can be least handled at home as the odds of mother or fetus death can increase (Alan, Hoff & Schneiderman 2015). According to the data, the institutional deliveries have increased in the province of Punjab between 2011 and 2018, yet 26 percent deliveries are taking place at home.

Figure 1: Institutional and Home Deliveries



Source: MICS, Punjab (various issues)

3.2 Antenatal and Postnatal Care Coverage by Skilled Personnel

The adverse pregnancy outcomes in the maternal care include low rates of prenatal consultations. Despite the significant efforts made by the Government of Punjab (GoPb) in improving the health standards of women and new born child, there still remains room for improvement in the maternal health indicators, which is a great challenge in achieving the SDG 3. To look at the conditions of maternal care in the province of Punjab, the study is going to analyze selected 3 indicators (table 1). The maternal health checkups following birth in facility or at home have decreased from 86 percent to 70 percent during 2014 to 2018. Some studies have highlighted that the certain healthcare behavior are also risk factors for maternal deaths. Mahwish (2004) explored that among all women seeking antenatal care (ANC), around 75 percent females visited doctors or a Lady Health Visitor (LHVs) only once for an ANC. The study investigated that the ANC was not a routine practice in pregnant women in the district under study. The author also explored that most of the women used the services of traditional birth attendant. Ali *et al.* (2004) has shown that postnatal health checkups were not very common in the poor urban settlements of Karachi. Only 24 percent of the women went for postnatal health checkups and this proportion was lower than other developing countries including Philippines (58 percent) and India (40 percent). The result of the study revealed that prolonged labor pains and maternal age were associated risk factors with postpartum hemorrhage. So, the prenatal consultations are a valuable source to gather information and predict suspected dangers in pregnancy of women. The prenatal consultations can also help in alarming the partner regarding the upcoming decisions that one would have to make in case of emergency during the child birth. Shenson, (2015) has elaborated the role of prenatal consultation from a neo-natologist perspective as it can be helpful for not only mother but also for parents, child, physicians, and the health care delivery system as a whole. Thus, the vital role of Pre-Natal Care (PNC) cannot be ignored in the maternal care.

Furthermore, the postnatal consultations are the most neglected component in the continuum of care of women in deprived areas due to the issue of affordability and lack of awareness regarding its importance. According to a study by (Rwabufigiri, 2016), Pre-Natal Care PNC is most important for avoiding any danger to the child and mother mortality rates. Regular pre and post natal care can turn the tides in favor of the mother, present born child, and the future children. The value of PNC shows an improvement in the province of Punjab.

Table 1: Antenatal and Postnatal Care Coverage

Indicator	2011	2014	2018
Percentage of mothers with have 4 or more antenatal care visit	40.5	48.0	52.9
Antenatal care (BP, Urine Specimen & Blood Test Taken)	41.3	45.3	52.6
Health check following birth while in facility or at home		86.0	70.1

Source: MICS, Punjab (various issues)

3.3 Social Indicators

It is evident from the literature that social indicators including education increase the awareness regarding utilization of health services. Additionally, the educated women are expected to have paid jobs and they are more likely to contribute in household expenditure that enhances their autonomy in decision-making process in individual and household issues including the utilization of health services. The incidence of poverty also seemed to be high in the province of Punjab. It can be observed that about 26 percent of the total population of Punjab is multi-dimensional poor (table 2). Women, who belong to wealthy households are three times more likely to receive adequate ANC than those in the lowest quintile (Acharya, 2017). Moreover, early childbearing at the age below 18 when adolescents are not physically mature increases pregnancy-related complications and the odds of damaging the reproductive tract (Goli et. al., 2015). In Punjab, the rate of early childbearing has decreased from 59.5 percent to 54.2 percent. The use of contraceptives is important for maternal health to regulate and control fertility. It saves mothers from the hazards of unwanted pregnancy. But unfortunately, the use of contraceptives has not significantly improved in Punjab over the last decade.

Table 2: Social Indicator Characteristics (Punjab)

Year	Adult Literacy Rate (15-24)	Incidence(H) of Poverty[1]	Early Child Bearing Women (15-19) who have had a Live Birth or are Pregnant with First Child	Percent of Women currently married who are using any type of Contraceptive
2004	68.0	49.7	-	36.0
2008	73.0	43.2	-	32.0
2011	66.0	38.1	59.5	35.2
2014	72.6	31.4	58.8	38.7
2018	74.9	**26.1**	54.2	34.4

Source: MICS, Punjab (various issues)

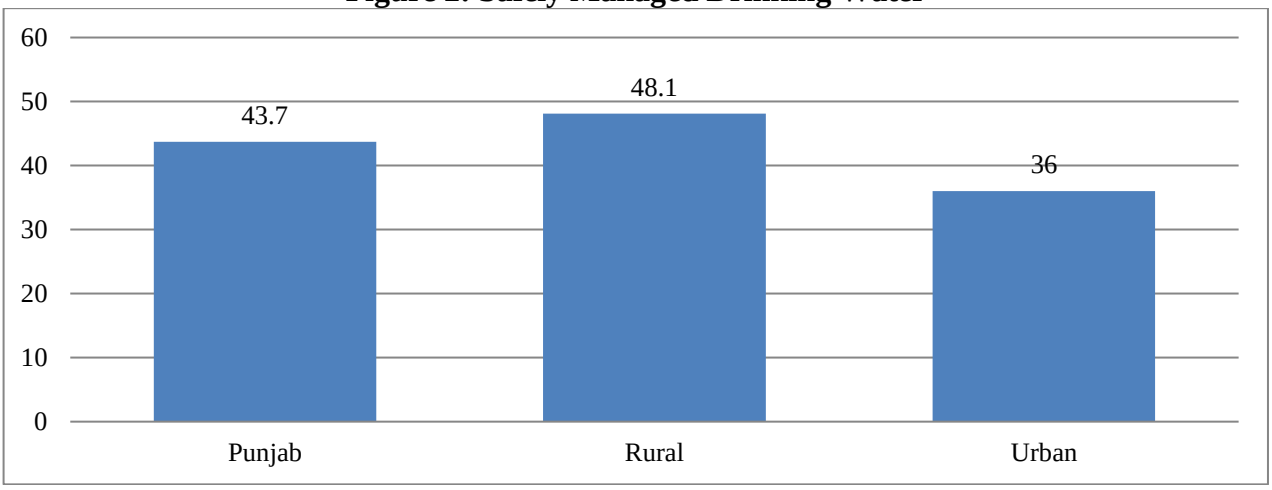
3.4 Environmental Factors (Safely Managed Water and Improved Sanitation)

The evidence from the literature strongly suggests that poor Water and Sanitation Hygiene (WASH) influences maternal and reproductive health outcomes to the extent that it should be given importance in health strategies (Cheng et al. 2012). The routes through which the poor WASH facilities can possibly influence maternal and reproductive health include the ill health, distress, harmful behaviors, and other adverse outcomes (Benova,et. al., 2014). Easy access to safe water and sanitation improve the women's health as good quality water can protect the pregnant women from serious diseases including typhoid and hepatitis etc. The access in the province of Punjab is 43.7 percent which indicates that more than half of the population is not drinking safe water (figure 2). As far as improved sanitation is concerned, 80 percent of the total population in the province of

[1] The data is extracted from Multidimensional Poverty in Pakistan 2014-15, whereas the value for year 2018 is extracted from MICS 2018

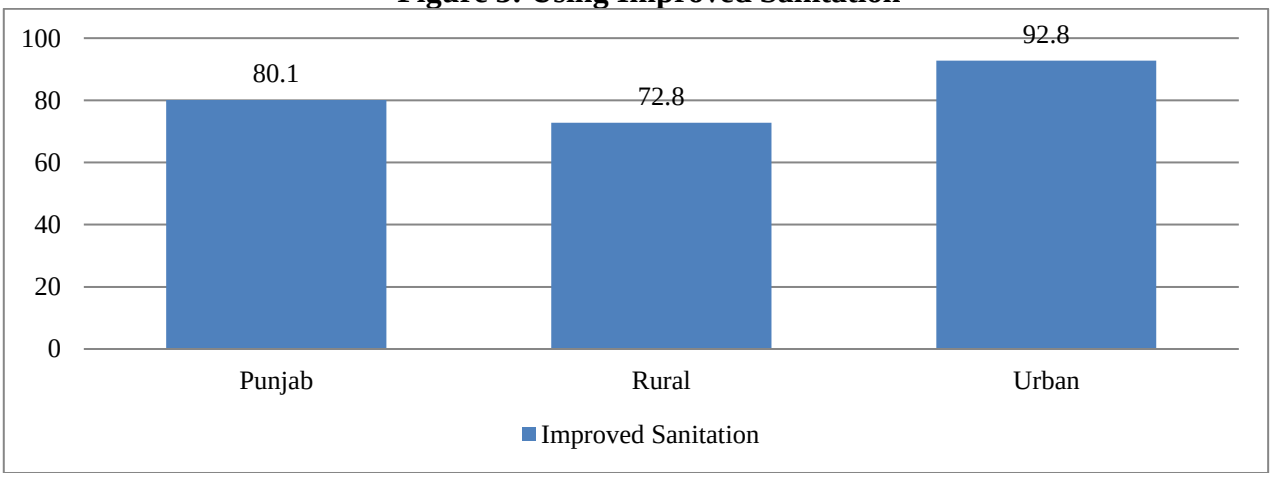
Punjab is using improved sources of sanitation (figure 3).

Figure 2: Safely Managed Drinking Water



Source: MICS, Punjab (various issues)

Figure 3: Using Improved Sanitation



Source: MICS, Punjab (various issues)

4. Methodology

The study used the data collected through multiple indicator cluster survey (MICS, 2018) for the analysis. The MICS survey was conducted by the Punjab Bureau of Statistics (BOS) with the technical assistance of the United Nations International Children's Emergency Fund (UNICEF), it is one of the richest sources of information available to examine the determinants of maternal health in Punjab. The variables derived from the literature are explained in the coming sections with respect to methodology.

4.1 The Concentration Index

To identify the strengths and gaps of important maternal health indicators, the analysis was carried out to find the inequalities for different socio-economic groups including poor-rich-rural-urban and educated-uneducated in utilization of maternal healthcare. The inequalities have been measured by constructing the Concentration Index (CI) and concentration curves. It is a widely used tool in research to measure the inequalities in health care. The advantage of the concentration curve and concentration index is that it can be computed from individual level data and so gives a picture of the complete distribution of health care services. A concentration index ranges between −1 to +1. The concentration curve lies below the line of equity, if the concentration index has positive value and depicts that most of the maternal health services have been utilized by the socio-economic

group. The concentration curve lies above the equity line, if the concentration index has negative value and shows that maternal health services are regressive and utilized by the poorest group. The concentration index is measured as:

$$\hat{I}\,C_T = 1 - \frac{\hat{\varepsilon}_T}{\hat{\mu}_T}$$

where $\hat{\mu}_T$ *is the average of variable T when the ranking variable Y is estimated as*:

$$\hat{\varepsilon}_T = \sum_{i=1}^{n} [\frac{(V_i^2) - (V^2{}_{i+1})}{V_i^2}]_{t_i}$$

$$\textit{and where } V_i = \sum_{h=i}^{n} w_h \quad \textit{and } y_1 \geq y_2 \geq y_3 \ldots\ldots\ldots y_n - 1 \geq y_n$$

3.1.1 Variables for Concentration Index

Antenatal Care visits: The WHO recommended antenatal visits are 4 or more. Using the data of MICS for 4 or more ANC visits, the responses were categorized into a binary outcome variable. The variable has taken the value "1" if the respondent used the service, and has taken the value "2" if not used.

Skilled Birth Attendant: If the delivery is attended by the skilled personnel, then the risk factors of the maternal deaths can be minimized, the response from the most recent birth of respondents was categorized into a binary outcome variable.

Institutional delivery: These are the childbirths taking place at private or public health facilities. By using the MICS data, the institutional delivery variable took a value of "1" for institutional delivery and value of "2" for home delivery.

Postnatal care: It is important to reduce the obstetric complications which are the most occurring cause of maternal death. Postnatal care within 2 days of delivery was considered as the outcome variable, taking a value of "2" if the respondent did not receive post-natal care and 1 if received.

Explanatory variables: The choice of socio-economic variables was guided by policy-relevant variables that have been identified through previous studies (Bon-Martens et. al., 2012) (Goli & Arokiasamy, 2014) (Goli et al., 2017). The explanatory variables include poor-rich, educated-uneducated, and rural-urban settings.

3.2 Binary Logistic Regression

The Binary Logistic Regression has been used to analyze the household determinants of maternal deaths. To find the important household level determinants of maternal mortality in Punjab, the dependent variable and independent variables are taken as given in table 4. The dependent variable takes the value "0", if there is no maternal death. Dependent variable will take the value "1" if there is any maternal death according to the definition i.e. the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management.

3.2.1 Household Model of Maternal Mortality

The model used for the application of binary logistic model is presented and described as follows:

$$\boldsymbol{MMi = \beta_0 + \beta_1 hlevel + \beta_2 WS11 + \beta_3 WS9 + \beta_4 windex5 + \varepsilon}$$

Dependent Variable

Maternal death has been used as a dependent variable in the study. In the MICS 2018, information about the deceased siblings was obtained through the sisterhood method. For each sister who died at an age of 12 or above, the respondent was asked additional questions to determine the cause of maternal death if the sister was pregnant when she died, died during childbirth, or the sister died

within two months of the termination of a pregnancy or childbirth. If the sister died within two months of the termination of a pregnancy or childbirth, the exact number of days was sought, as a death within 42 days is classified as postpartum. We have assumed that the household characteristics of deceased sisters are the same as of survival. In the literature, there is evidence that deceased siblings and respondents share similar characteristics (Meh et. al, 2019) (Ayadi, et al, 2015).

Independent Variables

The independent / explanatory variables of the binary logistic model are described as under in table 3:

Table 3: Explanatory Variables Used in Model of maternal mortality

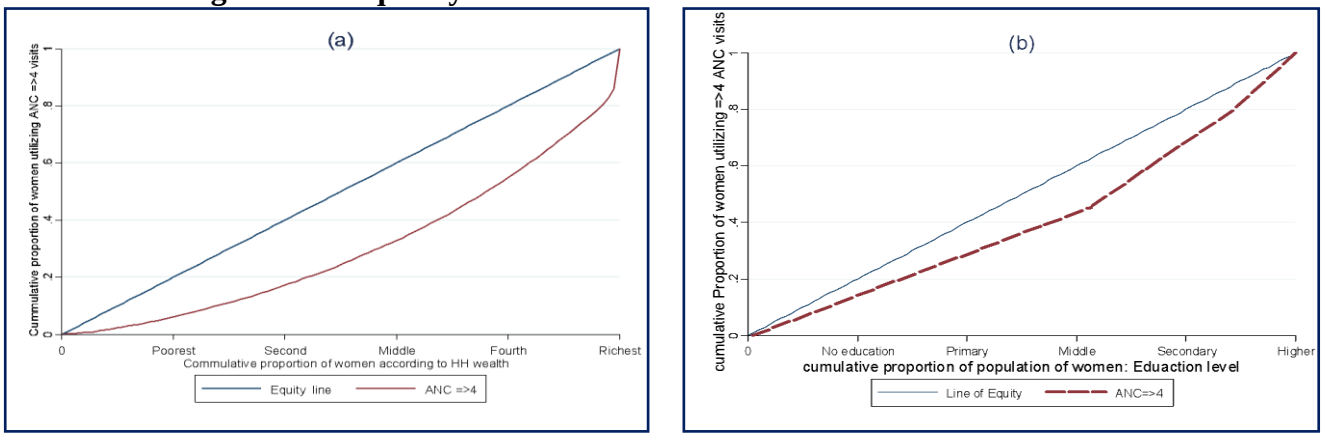
Variables	Description
helevel	Education of household head
windex5	Income Group
WS9	Treated water to make it safe for drinking
WS11	Improved sanitation

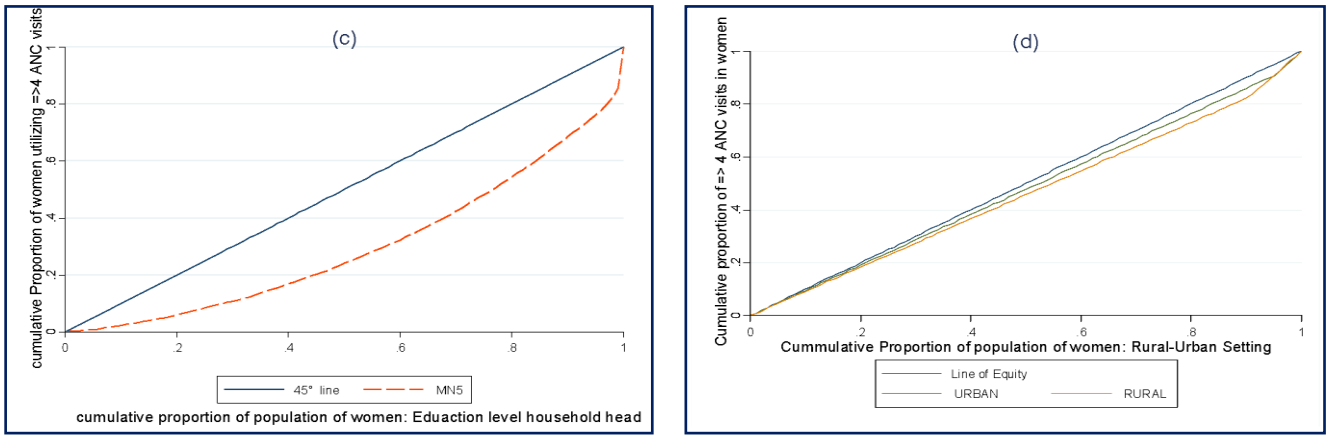
5. Empirical Estimations

The empirical analysis is divided into inequality analysis (through the estimation of concentration index) and to find the determinants of the study (through the estimation of binary logistic model). So, here we have presented the empirical results of our estimation.

The inequalities have been observed in utilization of the maternal health services as summarized in the analysis given below. The inequalities in the use of ANC services with 4 or more visits can be observed in the concentration curves for the outcome variable of ANC with 4 or more visits against different the explanatory variables including wealth status (figure 4a), education level of mothers (figure 4b), education level of household head (figure 4c), and area of residence (figure 4d). The line of equity in each figure showed the utilization of service in all groups irrespective of wealth, education, and rural-urban division. A concentration curve that lies below the equity line exemplified the situation where maternal health services are more concentrated to rich segment of society. The distance of concentration curve from line of equity showed the level of inequality. Figure (a) below demonstrated the wealth-related inequalities in utilization of ANC 4 or more visits. The figure for ANC clearly depicted that the curve is concentrated to the richer households. The fourth-ranked households are catching up to the richest households. There is an under-utilization or non-utilization of recommended ANC visits in the lowest quintile. Similar inequalities can be observed with education level of mothers (figure b) and education of level of household head (figure c), and the mothers with no or primary level of education are underutilizing the service. The low variability in utilization of ANC services can be observed in the rural and urban areas. The utilization is slightly high in the urban area as compared to the rural areas (figure d).

Figure 4: Inequality in antenatal care service use with 4 or more visits

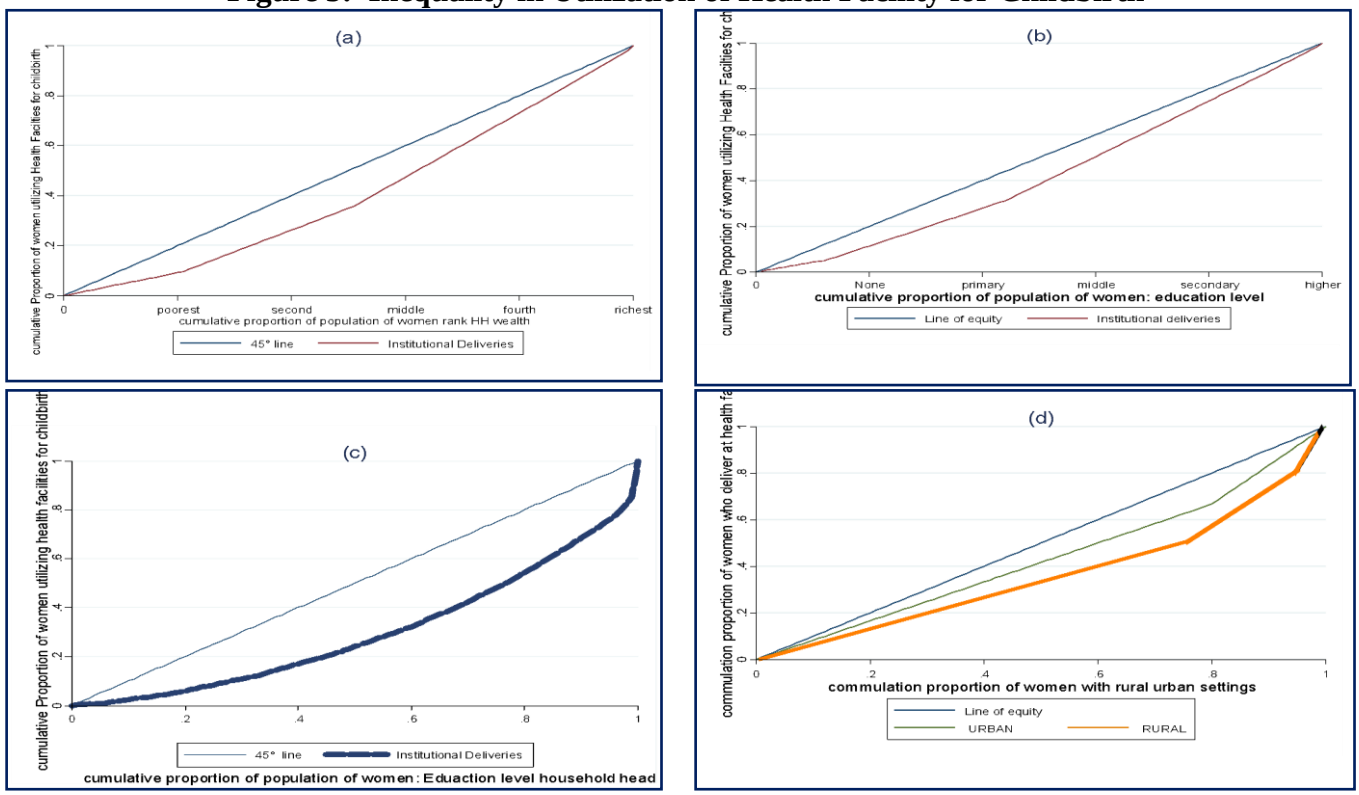




Source: Author's Calculations

The figure 10 showed the concentration curves of utilization of health facilities for childbirth. The concentration curve for the poorest quintile (figure 5a) lies below the line of equity, the concentration curve diverges from equity line for poorest and second quintile thereby indicating the non-utilization or low utilization of health facilities for childbirth among the poorest, while it is converging to equity line for fourth and richest quintile thereby indicating most of the utilization of health facilities for child birth by the two upper quintiles. Same is the situation with other explanatory variables such as the distance between the concentration curve for uneducated and primary level education of women (figure 5b), and uneducated household head (figure 5c) with the 45-degree diagonal that is highest than that of higher education level in both women and household head. The larger distance of concentration curve utilization of the institutional deliveries with women ranking to their household head education indicates the lower utilization of health facilities if household is uneducated or less educated. Similarly, the women living in rural areas also have less utilization of institutional delivery services than the ones in urban areas (figure 5d).

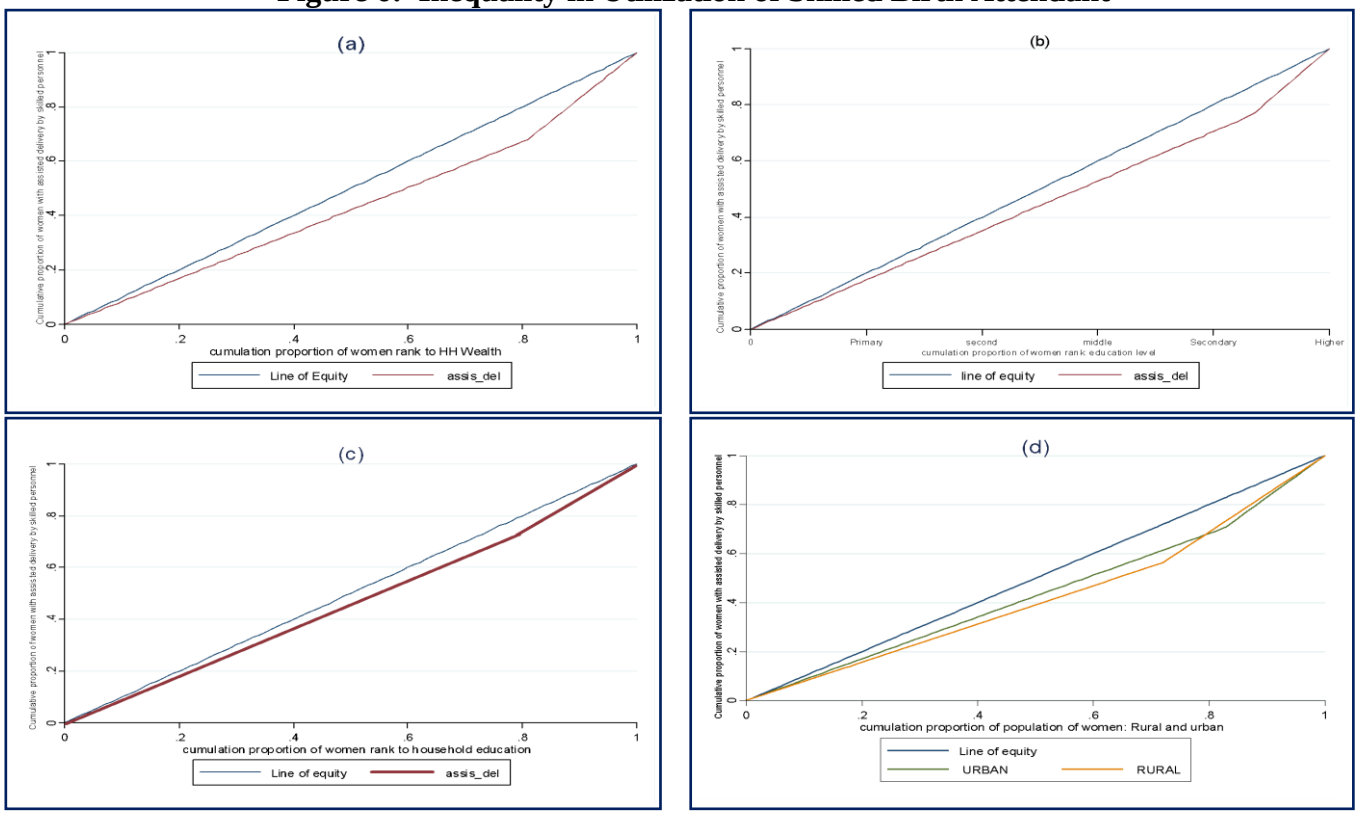
Figure 5: Inequality in Utilization of Health Facility for Childbirth



Source: Author's Calculations

Likewise, women from the poorest quintile least used the assisted deliveries by the skilled personnel than other quintiles. Like other maternal health services discussed above, assisted delivery by skilled personnel was also pretty much affected by maternal education and household head education. Women residing in the urban area had higher uptake of this variable than those living in the rural areas.

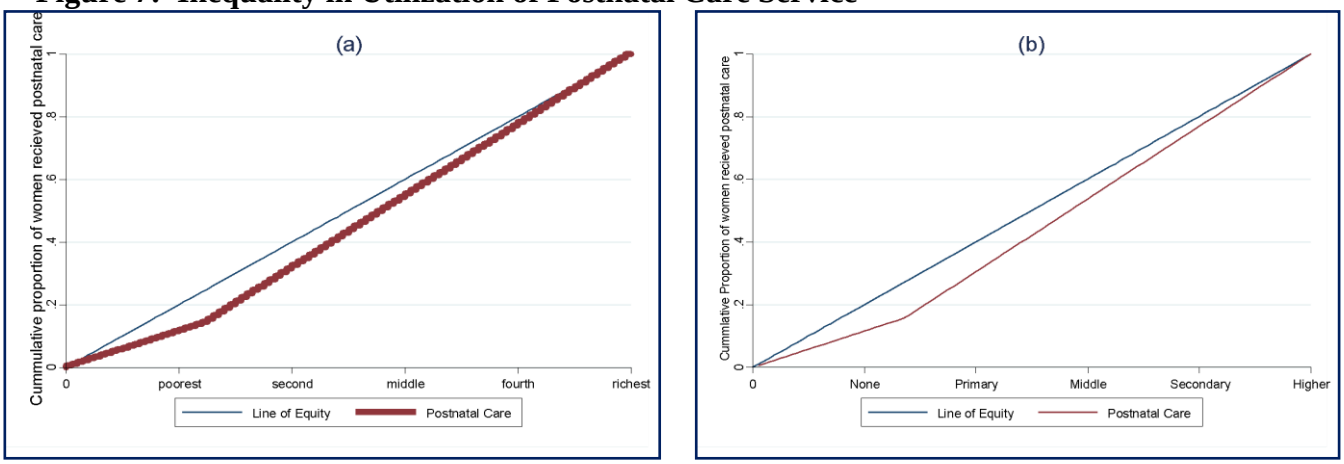
Figure 6: Inequality in Utilization of Skilled Birth Attendant

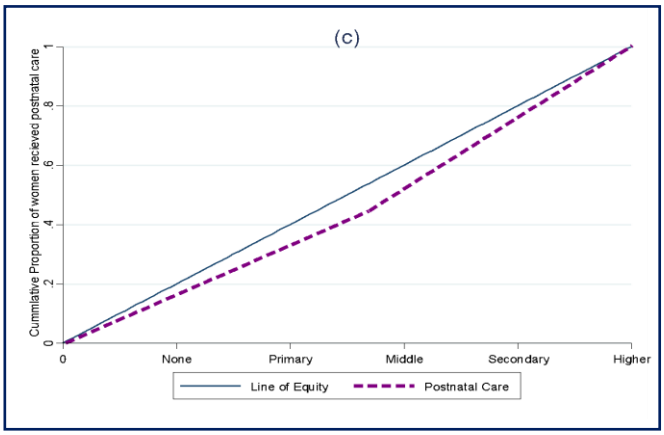


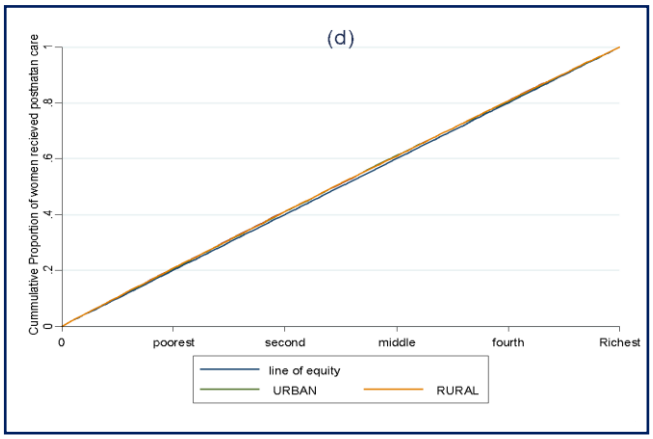
Source: Author's Calculations

The computed CI: 0.016 revealed that the richest women used the PNC service slightly higher than the poorest. The rate of PNC service in women among top wealth quintile was 1.87 times than that of the women at the bottom wealth quintile. But in case of rural-urban population, least inequalities can be observed in the utilization of PNC service. The concentration curve is overlapping the line of equity (figure d).

Figure 7: Inequality in Utilization of Postnatal Care Service







Source: Author's Calculations

Rate-ratio and Concentration Index for Maternal Health Services

The concentration indices (table 4-6) supported our findings of concentration curves. The ANC service with 4 or more visits was, by far, utilized by pregnant women belonging to the richest quintile than those from the lowest quintile. While analyzing the demand side barriers, Fawole & Adeoye (2015) analyzed that women who were resourceful throughout the year, received the skilled ANC frequently and childbirth through skilled attendant. Resultantly, they were less likely to be involved in risk factors associated with the maternal mortality as compared to those who were not economically independent. The households' economic resources are also found to be important determinants in seeking health care. Michael *et al.*, (2010) conducted their study in Bangladesh and found that the household wealth is positively related to healthcare utilization. The involvement of economic factors is associated with a low rate of maternal death rates. The results of Rate/Ratio analysis depicted that the rate of ANC service is 10 times higher in women at the richest quintile to that in the lowest wealth quintile. The concentration index was 0.157, which indicats that the rich women are more likely to use this maternal service. The computed concentration index also indicated that other maternal health services are utilized by women who
are economically better-off (table 4). These findings are similar with those reported in Namibia (Zere, et al., 2019). The educational disparities can also be observed in table 5. The women with higher level of education are 5.33 times more likely to use the ANC service with the concentration index of 0.131 thereby supporting evidence from Ethiopia (Firew Tekle Bobo, 2017). The computed rate-ratios revealed that the uptake of maternal health services is higher amongst women living in the urban areas than those living in the rural areas with the positive value of concentration index providing the evidence that the maternal health services are more concentrated among women living in the urban areas than those living in the rural areas (table 4).

Table 4: Rate-ratio (richest/poorest), Concentration indices standard error and confidence interval for maternal health services

Indicators	**Rate-ratio (Urban/Rural)**	**Concentration Index**	**SE**	**Confidence Interval**	
				Lower	Upper
ANC =>4	9.89	0.157	0.002	**0.151**	**0.162**
Institutional Deliveries	1.79	0.068	0.001	**0.067**	**0.069**
Skilled Birth Attendant	1.38	0.121	0.001	**0.119**	**0.123**
Postnatal Care	1.87	0.016	0.001	**0.017**	**0.015**

Source: Author's Calculations

Table 5: Rate-ratio Education Level (Higher/None), Concentration indices standard error and confidence interval for maternal health services

Indicators	Rate-ratio (Urban/Rural)	Concentration Index	SE	Confidence Interval	
				Lower	Upper
ANC =>4	5.33	0.131	0.002	**0.125**	**0. 135**
Institutional Deliveries	1.64	0.065	0.001	**0.066**	**0.064**
Skilled Birth Attendant	1.56	**0.** 110	**0.**.001	**0.108**	**0.113**
Postnatal Care	1.33	0.018	0.001	**0.019**	**0.017**

Source: Author's Calculations

Table 6: Rate-ratio Residential Areas (Urban/Rural, Concentration indices, standard error and confidence interval for maternal health services

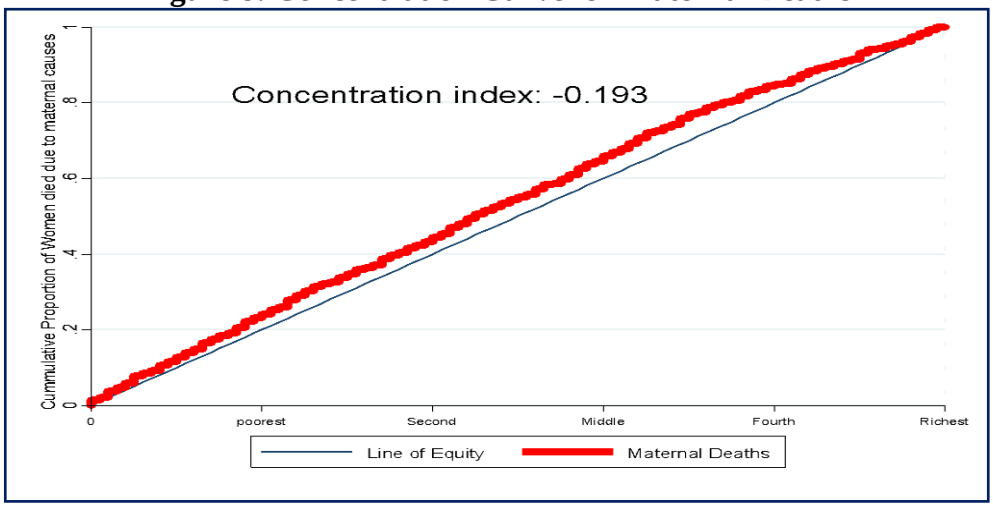
Indicators	Rate-ratio (Urban/Rural)	Concentration Index	SE	Confidence Interval	
				Lower	Upper
ANC =>4	**2.17**	**0.028**	**0.000**	**0.027**	**0.029**
Institutional Deliveries	**1.18**	**0.005**	**0.001**	**0.003**	**0.006**
Skilled Birth Attendant	**1.17**	**0.008**	**0.001**	**0.007**	**0.009**
Postnatal Care	**1.08**	**0.003**	**0.001**	**0.002**	**0.004**

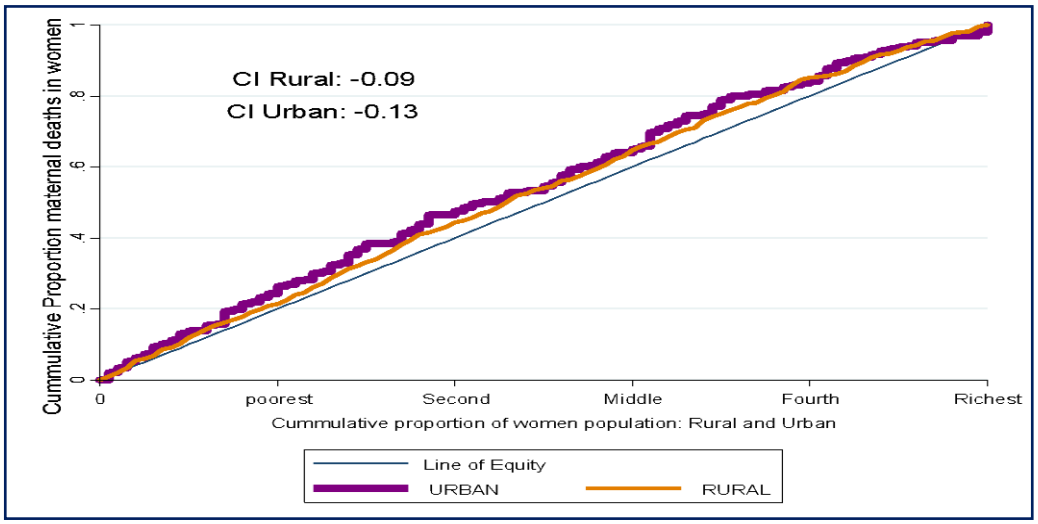
Source: Author's Calculations

Inequalities in Maternal Deaths w.r.t Wealth Quintiles and Geographical Regions of Punjab

According to micro data of the MICS (2018), most of the maternal deaths during pregnancy or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy and its management occurred in poorer women than the richest women. The concentration curve of maternal deaths lies above the equity line which showed that most maternal deaths occurred in the lowest quintile. The reason is cleared from the above analysis. There is an underutilization or low utilization of maternal health services in the lowest quintile than the other quintiles which increase the risk factors of maternal deaths. Although, the concentration curve is very close to the line of equity indicating that the inequalities are minimal in the maternal deaths. The concentration curves for urban/rural divisions also lie above the equity diagonal and both curves are overlapping thus indicating minimum inequalities according to the geographical region existed in maternal deaths, yet the poorest in both of the regions suffer with more deaths than the richest ones.

Figure 8: Concentration Curve for Maternal Deaths





Results and Discussion of Regression Analysis with Household Characteristics

The logistic regression is performed to analyze the social determinants of the maternal mortality for potential households in Punjab. The results presented below in the table 7:

Table 7: Results of Logistic Regression

Maternal Mortality	Odds Ratio	Std. Err.	z	P>|z|	[95% Confidence Interval]	
HeLevel	1.00021	0.03192	0.01	0.995	0.93955	1.06477
WS9	1.1425	0.2576	0.59	0.555	0.73442	1.77745
WS11	0.9152	0.09491	-0.85	0.393	0.74687	1.12149
WIndex	1.1667	0.04385	4.10	0.000	1.08384	1.25591
Constant	3.0697	1.4436	2.38	0.017	1.22124	7.71612
Number of Observations = 5003 LR chi2 (4) = 20.90 Prob> chi2 = 0.0003 Pseudo R2 = 0.0049						

Source: Authors Calculations

The significant social risk factor for maternal death was wealth status. The base category in "helevel" indicators is the primary literacy level or more i.e. if the household head is literate, there will be a lower level of risk of maternal death. The odd ratios of household heads and a lower risk of mortality persisted over 1.0002 times. The same has been reported in early studies like (Karlsen, 2011). In Punjab, household head education is not significantly related to the survival of mothers. As the base category in safe drinking water, the WS9 variable is the household that has not treated the water to make it safer. The estimated odds ratio of the WS9 showed that unsafe water will increase the risk of maternal deaths by 1.142 times. Several reasons articulated in the scientific literature may contribute to this relationship. The unsafe water increases the physical burdens on women of carrying water which translates into the decline of health of expectant women as they may suffer from anemia, vitamin deficiency, trachoma, and hepatitis with harmful effects. (Cumming, 2016). However, the unimproved sanitation is least associated with maternal deaths. The wealth status of the household plays a significant role and as the base category the mother belongs to the poorest families. It is evident from the results that mothers from poor families are more prone to deaths, because an increase in income is more likely to enhance the chance of maternal survival by 1.16 times. The poor spend least in absolute terms, but face the highest burden in relative terms thus making themselves the most disadvantaged in other expenditures that also affect the health condition of expectant mothers (Leone, 2013).

3. Conclusion

The antenatal care utilization with 4 or more visits (53 percent) in the province of Punjab is slightly higher than the South Asian (50 percent) region, but very low when compared to the developed countries (98 percent). The presence of skilled birth attendant is 76 percent in the province, also far less than the developed world (99 percent). Around 73 percent of deliveries take place at the health facilities in Punjab as compared to 74 percent in the South Asian region and 99 percent in the developed countries. This study has also analyzed the factors contributing to the availability and accessibility of maternal health indicators. The concentration curves and concentration index of maternal health services have depicted that women belonging to the poorest quintile use less maternal health services than the richest ones. Similarly, uneducated women, women whose household head is uneducated, and women living in the rural areas are prone to maternal death. The individual characteristics inter-mingle with household factors to further worsen the risk. In many ways, women who are extremely poor or have less educated husbands are at the risk of death. So, the results showed substantial inequalities amongst the poor–rich, educated-uneducated, and rural-urban groups in the utilization of maternal healthcare services. These inequalities have also been observed in maternal deaths. It can be concluded that despite the progress in the utilization of maternal healthcare services during the last two decades, the MMR remained high in the province of Punjab due to these socio-economic inequalities in maternal healthcare utilization. These results are important for policy makers in establishing more efficient policies and monitoring improvements in the maternal health services.

Recommendations

The study provides evidence to focus on following areas for reducing maternal deaths.

- Inequality in the provision of healthcare facilities across districts especially in rural areas in Punjab should be minimized. In this regard, health care budget as a percentage of GDP, maternal health care budget as percentage of total healthcare budget, and efficiency of utilizing the budget must also be increased.
- The study also suggests that the provision of safe drinking water and improved sanitation in the province of Punjab must also be enhanced in order to improve the standard of living of pregnant women.
- The government needs to review and strengthen its community strategies to educate the mothers and households to enhance the outreach of health care facilities to improve the maternal health indicators.
- The production of reliable and authenticated data on maternal cause-of-death must be ensured for all districts of Punjab, so that the targeted interventions must be introduced in the districts with worse conditions. The civil registration for all vital statistics can be considered in this perspective.
- Maternal healthcare may become more accessible, efficient, and responsive to the needs of pregnant women and new mothers by using ICT. To ensure that new technologies are implemented successfully and responsibly, it is critical to address concerns such as digital literacy to new mothers.

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