



Comparative Analysis of Maternal Mortality in Selected Districts of Punjab, Pakistan

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Abstract

This study aims to estimate determinants of MM in selected districts of Punjab. Data have been extracted from 196 families from three respective districts. Education, safe water availability, sanitation, health infrastructure, immunization card, family size, residence, household income, and ANC visits are taken as independent variables. Education, family size, poor and middle income class variables had a positive and significant effect on the MM in DG Khan. This study revealed that education, safe water and income show positive and significant impact on MM in Chakwal district. While, sanitation variable, area of residence and health infrastructure shown negative and significant impact health. The study found that education, household income and family size had a positive and significant effect on the MM in Sialkot. While, Safe water availability, sanitation, health infrastructure and immunization card have negative and insignificant effect on female health. Government should give more strength to integrated reproductive and new born child health (IRMNCH) program.

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Introduction

The health of a nation's people is inextricably linked to its development. In addition, it is widely recognized as an essential predictor of a country's economic success (Sengupta, 2016). Health is more than just the deficiency of disease or weakness; it also refers to a state of complete physical, mental, and social well-being (Kuhn and Rieger, 2017). "The Lancet (2009)" defined health as the body's capacity to adapt to new challenges. After the Alma-Ata Declaration was signed in 1978, the slogan "Health for All" became a signature motto (Birn and Krementsov, 2018). Thus, one of the Millennium Development Goals (MDGs) was developed to increase people's health. In 2015, the

United Nations set 17 life-changing goals for the global economy's welfare (Judd, 2020). SDG 3 is one of 17 goals that strive to ensure everybody's health and well-being, comprising a strong commitment to eliminating AIDS, TB, malaria, and other infectious diseases by 2030. Pakistan is a signatory to the SDGs-2030 and must accomplish Goal 3: "Well-being for all at all ages" (Aziz et al., 2021). Unfortunately, Pakistan is amongst the South Asian countries confronting the highest maternal mortality (MM). MM consider as reflection of health status of any economy. However, Figure 1 identifies Pakistan as the nation of South Asia that has the highest maternal death rate than SDGs.

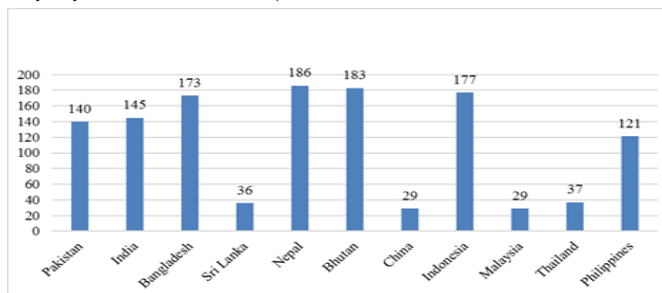


Figure 1: Maternal Mortality comparison in Asia

Source: Writer's own constructed on the data from WDI (2017)

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In contrast, Pakistan has a total population of 199.1 million people, ranking sixth globally, with a fertility rate of 3.1, a dependency ratio of 58, and an aging index of 12.82 (Government of Pakistan, 2016-2017). “Pregnancy is special, let’s keep it safe” was the slogan for World Health Day in 1998. Unfortunately, many women have terrible health and sometimes die during their

pregnancies. MM refers to the death of pregnant women between the first day of pregnancy and 40 days following birth (WHO, 2019). It is measured as the number of maternal deaths per 1 lac pregnant women who are still living. Figure 2 explains the MM number of Punjab as compared to Pakistan.

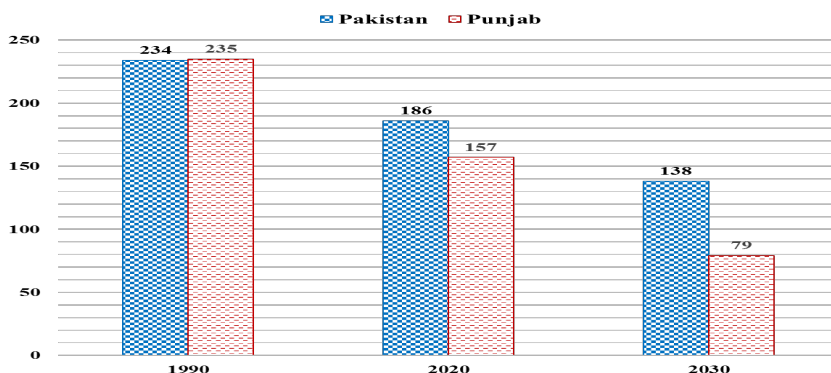


Figure 2: Maternal mortality numbers of Pakistan and Punjab

Source: Author’s own calculation based on the data from NIPS (2019)

In 1990, MM rates in Punjab and Pakistan were compared. But in 2020, MM numbers in Punjab are still higher than in Pakistan. So, Punjab has the highest MM numbers in Pakistan. Maternal health outcomes are more related to pregnancy and child birth outcomes, including miscarriage, prenatal abortion, stillbirth, and maternal death. MM remains the main cause of death among women in developing countries (Aziz *et al.*, 2020). Maternal health is unidirectional and bidirectional related to the health of an economy (Centers for Disease Control, 1999; Ki-Moon, 2010). So it is concluded that MM is the fundamental problems in Punjab, Pakistan, which should be addressed. So this study aims to investigate factors of MM in selected districts of Punjab, Pakistan. Existing study filled the research gap by estimating important socio-economic factors influencing MM at the regional level.

Material and methods

The random sampling technique has been used for selecting 3 districts in Punjab, DG Khan, Chakwal, and Sialkot. A short description of these three districts is given below:

DG Khan

In the southwest of Pakistan, the DG Khan region is located. There are two major cities, DG Khan and Taunsa. According to the MICS survey, DG Khan having 54 IM numbers, and 60 deaths per 1000 alive birth, which is well short of SDGs standards. So, because of large numbers in MM, DG Khan is taken into this study.

Chakwal

The boundary between Chakwal districts comprises Rawalpindi and Attock’s northern regions, in the east Jhelum, in the southern areas Khushab, and the west Mianwali. While Chakwal has a maternal death rate of 276 per 100,000 people (department of CEO, DHA, Chakwal).

Sialkot

Sialkot is a 354-square-kilometer areas district that stretches from the Ravi Valley in the southeast to the Chenab River in the northwest. According to the MICS report, Sialkot has an IM of 55, whereas Punjab has 60 deaths per 1000 live births (department of CEO, DHA, Sialkot).

Data Collection and Sources

The data was collected by questionnaires. The questionnaire that was supposed to capture the data was field-tested. The questionnaire was updated, completed, and processed in light of the pre-testing results. The required data was then collected by interviewing 196 household respondents where maternal death have been occurred in one year (1 January, 2018 to 31 december, 2018). We examined the following sources of data information for acquiring observed information for study:

- 1) Monthly basis health data (DHIS).
- 2) Tehsil-level municipal administration,
- 3) Maternal and newborn child integrated program (IRMNCH) data.
- 4) Union council

level (Local Government Center) data
Public, private clinics from three districts.

Econometric Model

The following model is used in this study to find determinants of maternal mortality:

$$MM = f(\text{EduM}, \text{SW}, \text{SN}, \text{HIF}, \text{IC}, \text{FS}, \text{HI}, \text{ANC}, \text{AR}) \quad (1)$$

Model Specification and Data

The model for determinants of health status in the Punjab district has the following econometric specification and functional form.

$$MM = f(\text{EDUM}_w, \text{SW}, \text{SN}, \text{HIF}, \text{IC}, \text{FS}, \text{AR}, \text{HI}) \quad (2)$$

$$MM = \beta_1 + \beta_1 \text{EDUM}_w + \beta_2 \text{SW} + \beta_3 \text{SN} + \beta_4 \text{HIF} + \beta_5 \text{IC} + \beta_6 \text{FS} + \beta_7 \text{AR} + \beta_8 \text{HI} + \mu \quad (3)$$

Table 1. Variables and its Description

Table 1 summarizes the descriptions of all variables utilized in the study.

Variables	Abbreviation	Description of Variables
Dependent Variables		
Maternal Mortality	MM	=1 for non-occurrence of maternal death during maternal life = 0 for occurrence of maternal death during maternal life
Independent Variables		
Female education	EDUM	=1 Primary education =2 Secondary education =3 Higher education
Safe Water	SW	=1 if safe water is available =0 if safe water is not available
Sanitation	SN	=1 if washroom facility is available =0 if washroom facility is not available
Health Infrastructure	HIF	=1 if there is any health facility available near household =0 If no health facility is not available near household
Immunization card	IC	=1 if immunization card is available =0 if immunization card is not available
Family size	FS	Total numbers of family members of the household.
Residence	AR	=1 if household is situated in urban area =0 if household is situated in rural area
Household Income	HI	=1 Poor income class =2 Middle income class =3 Higher income class
Antenatal Care	ANC	=1 if maternal women perform at least 2 ANC visits per month. =0 If maternal women perform less 2 ANC visits per month

Methodology: Logistic Regression

For describing health status, an existing study uses logistic and multinomial techniques. The influence of socioeconomic factors of household variables on health status is determined using

logistic regression. In addition, multivariate analysis is being used, and the general function is as follows.

$$Y_i = f(X_1)_i = (1,2,3 \dots \dots n) \quad (4)$$

Where:

Y_i describes the Health Status

X_i describes different independent variables

When dependent variable is in binary category while independent variables is in binary form, or continuous. (Starkweather and Moske, 2011). Equation 5 explains the logistic equation from simple linear regression, where “Y” is considered as dependent variable.

$$Y_i = \alpha_0 + \alpha_1 X_{1i} + \mu \tag{5}$$

Where:

Y_i denotes the dependent variable, a_0 and a_1 are used as intercept and slope, while X_i represents independent variables.

$$Y_i = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \dots + \alpha_n X_{ni} + \varepsilon_i \tag{6}$$

Logistic regression is similar to the ordinary least square (OLS). For example, equation 7 explains that if there is only one independent variable X_1 , we can construct the probability of “Y”.

$$P(Y) = \frac{1}{1 + e^{-(\alpha_0 + \alpha_1 X_{1i})}} \tag{7}$$

For equation 7, $P(Y)$ describes the occurrence of “Y” based on natural logarithm explained by “e”

Logistic regression and linear regression have many similarities, due to binary or categorical form of nature, we cannot apply the linear regression (Mohammadi et al., 2014). In logistic regression as the dependent variables is categorical or binary form, the condition of linearity cannot apply. So we can transform the non-linear form by taking log of the equation.

Results and Discussion

Descriptive Analysis

Table 2 presents an estimate of the association between several socio-economic variables and MM in three Punjab districts chosen for study.

Table 2. Distribution of Maternal Outcome by District wise

District	Maternal Mortality	Maternal Alive	Total
DG Khan	42	42	84
Chakwal	30	30	60
Sialkot	26	26	52

Region of Residence and Maternal Mortality

Maternal mortality is influenced by the area or region in which a woman lives. As previously stated, there is a lower likelihood of MM in urban

areas. More health-care facilities, such as hospitals, 24-hour delivery systems, and other emergency health services, are available in urban areas. Therefore, MM and residence are expected to be highly correlated.

Table 3. Distribution of Maternal Outcome by Region of Residence

Region	Maternal Mortality	Maternal Alive	Total
	66	32	98
Rural	(81.48) [67.35]	(27.83) [32.65]	(50.00) [100]
	15	83	98
Urban	(18.52) [15.31]	(72.17) [84.69]	(50.00) [100]
	81	115	196
Total	(100) [41.33]	(100) [58.67]	(100) [100]

Source: Author’s calculations based on Survey

Table 3 divides the responses of the maternal women is divided by area of residence. For example, the table describes that MM in rural areas is 81.48% while this MM in urban areas is 18.52%. A big difference in MM between urban

and rural areas reveals that the MM rate in rural areas is very high compared to urban areas.

Family size and Maternal Mortality

The size of the household also has an impact on

MM. The higher the family size, the greater the MM chances. Table 4 shows the relationship between MM outcome and family size. When family size lies from (1-4), 21.57 % of MM women involve out of the total maternal outcome. On the

other hand, the family size (9-12) person causes increases the MM up to 60.87%. Moreover, family member size (13-16) boosts the MM up to 78.18%.

Table 4. Distribution of Maternal Outcome by family Size

Size of HH	Maternal Mortality	Maternal Alive	Total
1-4	11 (11.22) [21.57]	40 (40.82) [78.43]	51 (26.02) [100]
5-8	16 (16.33) [36.36]	28 (28.57) [63.64]	44 (22.45) [100]
9-12	28 (37.66) [60.87]	18 (17.5) [39.13]	46 (15.92) [100]
13-16	43 (3.94) [78.18]	12 (2.10) [21.82]	55 (1.70) [100]
Total	98 (65.21) [50.00]	98 (89.38) [100.00]	196 (66.09) [100.00]

Source: Author own calculations constructed through Survey

Education and Maternal Mortality

Table 5 reveals that education is the most vital determinant influencing the MM in all aspects. An illiterate woman is more likely to face the MM.

Education considering as a source of self-development, is closely linked with MM. Higher the education level, less probability of MM prevails.

Table 5. Distribution of Maternal Outcome by Maternal Education

Maternal Education	Maternal Outcome		Total
	Maternal Mortality	Maternal Alive	
Primary Education	41 (45.56) [64.06]	23 (21.70) [35.94]	64 (32.65) [100]
Secondary Education	29 (32.22) [45.31]	35 (33.02) [54.69]	64 (32.65) [100]
High Education	20 (41.01) [29.41]	48 (35.85) [70.59]	68 (15.92) [100]
Total	90 (118.79) [45.92]	106 (90.57) [117.78]	196 (81.23) [100.00]

Source: Author own calculations constructed through Survey

The relationship between maternal education and MM is explained in Table 5. An primary educated woman is more likely to face MM 64.06 % higher than higher educated women. The

likelihood of MM decreases as one's educational level rises. Educated women can better care for their health, thus reducing the MM.

Empirical Analysis

Table 6 explains the results of logit model for measuring the effects of determinants of MM in DG Khan.

Table 6. Determinants of Maternal Mortality in DG Khan

Dependent Variable: Maternal Mortality						
Independent Variables	Coef.	S.E.	Wald	Df	Sig.	Exp(B)
[Overall Education]			7.821	2	.020	
[Primary=1.00]	2.994	1.268	5.575	1	.018	19.973
[Secondary Class=2.00]	3.604	1.295	7.741	1	.005	36.757
Safe Water (SW)	-2.029	0.815	6.194	1	0.013	0.131
Sanitation (SN)	-0.040	1.003	0.002	1	0.968	0.961
Health Infrastructure (HIF)	-0.322	0.234	1.894	1	0.169	0.725
Immunization card (IC)	-1.576	1.071	2.164	1	0.141	0.207
Family Size (FS)	1.137	0.403	7.962	1	0.005	3.117
Area of residence (AR)	-3.415	1.919	3.169	1	0.075	0.033
Overall Income			4.173	2	0.124	
[Poor Class=1.00]	2.380	1.185	4.032	1	0.045	10.809
[Middle Class=2.00]	1.104	1.025	1.160	1	0.282	3.017
Antenatal Care (ANC)	-0.810	0.397	4.176	1	0.041	0.207
Constant	0.179	3.854	0.002	1	0.963	1.196

A Variable(s) entered on step 1: Femaledu, HHincome, residence, safewater, imcard, fs, Healthinfrastructure, sanitation.

Source: Author own calculation, using SPSS version 23

Table 7 describes the Logistic Regression analysis for the determinants of MM in DG Khan district. Primary educated women have more chances of having MM as compared to higher educated women. Women with no education have a higher risk of MM, whereas women with more education have a lower risk of MM. Increasing women's schooling years lowered the risk of several maternal health problems during pregnancy/birth by up to 29%. Raising women's education appears to reduce short birth intervals and unplanned pregnancies. On the other hands, women having low education more chances of maternal mortality. Primary level women have less knowledge regarding their health care and ANC care. It is possibly due to changes in women's cognitive skills, economic resources, and independence. So there is less likelihood of MM (Karlsen *et al.*, 2011).

Secondary educated women have more chances of having MM as compared to higher educated women. Education and maternal health have positive relationship among them. As education level increase it causes positive impact on maternal and decrease in mortality (Thaddeus and Maine, 1991; Shen and Williamson, 1999).

Women having better safe water facility have less chances of having MM as compared to women without safe water facility. Safe water facility have positive impact on maternal health. But on the other hands, WHO report on water, sanitation and hygiene also endorse that water quality is poor and toxic. It can influence maternal women's health negatively. Poor water is highly linked with the MM (Golding *et al.*, 1989; Benova *et al.*, 2014; WHO, WASH, 2015).

As household having good sanitation facility have less chances of having MM as compared to household without sanitation facility. If a bathroom facility is available, it is connected with a lower risk of MM. The researchers (Cheng *et al.*, 2012) also endorsed that sanitation facility availability increases the maternal women's survival rate.

Households having health infrastructure have less chances of MM as compared to people have no access to health infrastructure. A good health infrastructure availability like; medicine and health care services and road distance can bring down the MM rates. Contrarily, decision-making delays in health care treatment provision and deficient health facilities result in a high MM

numbers ([Khan and Pradhan, 2013](#); [Hanson et al., 2015](#)).

Immunization includes TT vaccination during pregnancy, if women have TT vaccination during pregnancy have less chances of maternal mortality as compared with women have partial or no vaccination of immunization. Therefore, increases in women's vaccination may decrease the likelihood of death occurrence. WHO also endorse that if immunization increases in the pregnancy period, there will be less chances of MM numbers ([Singh et al., 2012](#); [Giles et al., 2018](#)).

As family size increase, households have more chances of having MM as compared to women have small family size. Therefore, if there is an increase in the number of children, decline the resource allocated to mothers and affects their general health outcomes. If women pregnant again and again more chance of mortality ([Wu and Li, 2012](#); [World Health Organization, 2019](#)).

As female belong from urban area having less chances of MM as compared to women who belong from rural areas. While, urban areas have additional facilities than rural areas in DG Khan, so fewer maternal death chances are less than in rural areas. In urban areas, women are educated have more knowledge and awareness regarding

ANC and medical care. Women living in rural areas have been considered related to inadequate ANC facilities linked to living in the urban area ([Naseem et al., 2017](#); [Hanif et al., 2021](#)).

Female from poor economic status have more chances of MM as compare to rich female. The poor have more chances of maternal mortality as compared to rich. Thus, income surges the lesser chances of MM; on the other side, reducing annual income and expenditure can increase maternal death. Our results are matched with the study ([Wang et al., 2003](#)).

Middle class female also show more chances of MM as compare to high income women. The positive value which shows that middle income women have more chances of maternal mortality as compared to the rich ([Jeong et al., 2020](#)).

As ANC visit increase, women have less chances of death as compared to women have less numbers of ANC during pregnancy. If women have seven ANC visits according to WHO standards, there is less chance of MM. ANC is considered as the best therapy for maternal women as well as for an upcoming child. [Noh et al. \(2019\)](#) and [Kaaya et al. \(2021\)](#) also support the results of this study.

The model summary is given as follows:

Table 7. Model Summary for DG Khan District for MM

-2 Log likelihood	52.154
Pseudo R square	0.535

a Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table 8 describes the results of logit model for calculating the effects of socio-economic

variables on maternal mortality in Chakwal district.

Table 8. Determinants of Maternal Mortality in Chakwal

Independent Variables	Dependent Variable: Maternal Mortality					
	Coef.	S.E.	Wald	Df	Sig.	Exp(B)
[Overall Education]			4.672	2	0.097	
[Primary=1.00]	1.420	1.263	1.264	1	0.261	4.138
[Secondary Class=2.00]	2.598	1.225	4.498	1	0.034	13.441
Safe Water (SW)	2.885	1.079	7.152	1	0.007	17.906
Sanitation (SN)	-2.663	1.416	3.537	1	0.060	0.070
Health Infrastructure (HIF)	-0.710	0.317	5.030	1	0.025	0.492
Immunization card (IC)	-0.640	0.837	0.585	1	0.444	0.527
Family Size (FS)	0.157	0.274	0.328	1	0.567	1.170
Area of residence (AR)	-7.194	2.782	6.685	1	0.010	0.001
Overall Income	3.849	1.563	8.095	2	0.017	46.931
[Poor Income=1.00]	-0.719	1.013	6.062	1	0.014	0.487

Dependent Variable: Maternal Mortality						
Independent Variables	Coef.	S.E.	Wald	Df	Sig.	Exp(B)
[Middle Income=2.00]			0.503	1	0.478	
Antenatal Care (ANC)	-0.339	0.360	0.886	1	0.347	0.713
Constant	8.313	4.095	4.121	1	0.042	4076.191

a Variable(s) entered on step 1: Femaledu, HHincome, residence, safewater, imcard, fs, Healthinfrastructure, sanitation.

Source: Author calculation, using the SPSS version 23.

Table 9 describes the Logistic Regression analysis for the determinants of MM in the Chakwal district. Primary educated women have more chances of having MM as compared to higher educated women in Chakwal ([McAlister and Baskett, 2006](#); [Karsen et al., 2011](#)) also indicates and endorse that, increase in the level of education reduces the MM risk.

Secondary educated women have more chances of having MM as compared to higher educated women. The positive value of coefficient describes that they have 2.598 more chances of MM as compared with higher education female ([McAlister and Baskett, 2006](#)).

Women having better safe water facility have less chances of having MM as compared to women without safe water facility. Unsafe water is associated with maternal health; it causes several water-borne diseases that ultimately cause maternal death ([Gould, 2010](#); [Cheng et al., 2012](#)).

People having efficient sanitation facility have less chances of having MM as compared to people without sanitation facility. WASH interventions may further increase the health and well-being of women. An increase in the water and sanitation facility makes chance less of maternal death, which is endorsed by ([Benova et al., 2014](#); [Komarulzaman et al., 2017](#))

Households having access to health infrastructure have less chances of MM as compared to people have no access to health infrastructure. Thus, increases in the health infrastructure, health services, ANC facilities show a positive association with maternal health. In addition, ([Gao and Kelley, 2019](#); [Phommachanh et al., 2019](#)) also support the results of this study.

Immunization includes TT vaccination during pregnancy, if women have TT vaccination during pregnancy have less chances of maternal mortality as compared with non-availability of immunization card. An increase in the immunization vaccine during pregnancy causes a

positive impact on maternal women. Furthermore, TT vaccine is very helpful during pregnancy, which WHO has suggested in many countries ([Pan American Health Organization, 2017](#)).

As family size increase, households have more chances of having MM as compared to women have small family size. Furthermore, women having good family relationships have more chances to use maternal health care, deliver in a health facility, more chances of survival of maternal women ([Allendorf, 2010](#)).

As female belong from urban area having less chances of MM as compared to women who belong from rural areas. Thus, there is less likelihood of MM in urban areas where health facilities are higher as compared to rural areas. [Kozhimannil et al. \(2020\)](#) also support this study's results.

Female from poor economic status have more chances of MM as compare to rich female. The poor have more chances of maternal mortality as compared to rich. Thus, high-income inflows lead towards the availability of high educational facilities and more health facilities for a household. The researchers ([Jeong et al., 2020](#)) also endorsed that high household income plays its part in reducing the MM.

Middle class female show less chances of MM as compare to high income women. The positive value which shows that middle income women have more chances of maternal mortality as compared to the rich in Chakwal district ([Jeong et al., 2020](#)).

As ANC visit increase, women have less chances of death as compared to women have less numbers of ANC visit during pregnancy. As increases in the ANC visit improves the maternal health and reduces maternal death risk. ANC is acting as physical therapy during the pregnancy period. Our results are parallel with the study ([Das, 2017](#)).

The model summary is given as follows:

Table 9. Model Summary for Chakwal district for MM

-2 Log likelihood	40.871
Pseudo R square	0.506

a Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

The table 10 tells results of logit model for calculating determinants of the MM in Sialkot

Table 10. Determinants of Maternal Mortality in Sialkot

Dependent Variable: Maternal Mortality						
Independent Variables	Coef.	S.E.	Wald	Df	Sig.	Exp(B)
[Overall Education]			6.001	2	0.050	
[Primary=1.00]	4.308	1.921	5.029	1	0.025	74.274
[Secondary Class=2.00]	4.300	1.872	5.276	1	0.022	73.667
Safe Water (SW)	-0.105	1.281	0.007	1	0.935	0.900
Sanitation (SN)	-2.195	1.216	3.257	1	0.071	0.111
Health Infrastructure (HIF)	-0.260	0.224	1.343	1	0.246	0.771
Immunization card (IC)	-2.531	1.791	1.998	1	0.158	0.080
Family Size (FS)	0.910	0.688	1.747	1	0.186	2.483
Area of residence (AR)	-1.364	1.855	0.540	1	0.462	0.256
Overall Income			5.811	2	0.055	
[Poor Income=1.00]	5.603	2.356	5.657	1	0.17	271.287
[Middle Income=2.00]	5.414	2.642	4.199	1	0.040	224.632
Antenatal Care (ANC)	-2.139	0.855	6.257	1	0.012	0.118
Constant	0.235	5.038	0.002	1	0.963	1.265

a Variable(s) entered on step 1: Femaledu, HHIncome, residence, safewater, imcard, fs, Healthinfrastructure, sanitation.

Source: Author own calculation, using the SPSS version 23.

Table 11 describes the Logistic Regression analysis for the factors of MM in the Sialkot district. Primary educated women have more chances of having MM as compared to higher educated women in Sialkot district. There is a clear link between maternal health and women's education. In comparison to illiterate women, educated women might seek better health. In addition, the number of years spent in education instigates the probability that maternal women will have a better chance of survival as compared to maternal mortality ([Karlsen et al., 2011](#)).

Secondary educated women have also more chances of having MM as compared to higher educated women. Low education level are linked with higher maternal mortality ([Karlsen et al., 2011](#)).

Household having better safe water facility have less chances of having MM as compared to people without safe water facility. The researchers ([Semmelweis, 1983](#); [Karlsen et al., 2011](#); [Benova et al., 2014](#)) also supported that educated maternal women can better care for themselves, their diet, and nutrition level. Thus,

educated maternal women may have fewer chances of MM.

People having better sanitation facility have less chances of occurrence MM as compared to people without sanitation facility. The findings show that improving sanitary facilities has a positive impact on maternal women. The data reported in (WHO, UNICEF, 2012) reports also support that, increase in sanitation facilities result in decreased MM ([Tomasz, 2009](#); [Campbell et al., 2015](#)).

Households having health infrastructure have less chances of non-occurrence of MM as compared to people have no access to health infrastructure. Health infrastructure is a broad term that encompasses health-related services, medicine availability, and the presence of medical personnel. Therefore, increases in the health structure, skill birth attendance, and health professionals can reduce the risk of MM ([Nesbitt et al., 2016](#); [McGuire et al., 2021](#)).

Immunization includes TT vaccination during pregnancy, if women have TT vaccination during pregnancy have less chances of

occurrence of maternal mortality as compared with women have partial or no vaccination of immunization. Vaccines may keep women healthy and active, and as immunization rates rise, their risk of death falls. Similarly, TT immunization is one of the tried-and-true methods for eradicating maternal and neonatal tetanus during pregnancy ([Mamoro and Hanfore, 2018](#)).

As family size increase, households have more chances of having MM as compared to women having small family size. Women having large family size have more chance of MM ([Allendorf, 2010](#); [Bucher-Koenen et al., 2020](#)).

As female belong from urban area having less chances of occurrence of MM as compared to women who belong to rural areas. Furthermore, [Midhet et al. \(1998\)](#) and [Kozhimannil et al. \(2014\)](#) also endorsed that compared to urban areas, where rural areas have more chances of MM owing to a lack of facilities such as low-grade clinics.

Female from poor economic condition have more chances of MM as compare to rich female. The poor have more chances of maternal

mortality as compared to rich. One risk factor for MM is a woman's socioeconomic status. Low levels of income have a negative influence on maternal health. Mother and Mother, (2012) also supported that maternal women having lower household income confront more occurrence of MM than the higher-income women.

Middle income class females also have more chances of MM as compared to high income women. Income have positive and significant impact on the health of maternal women (Mother and Mother, 2012).

As ANC visit increases, women have less chances of occurrence of maternal death as compared to women having less numbers of ANC visit during pregnancy. Thus, ANC positively affects maternal health since it improves mother health and decreases maternal mortality. ANC refers to the specific medical therapy care that a pregnant woman receives from skilled healthcare providers to sustain a healthy pregnancy ([Das, 2017](#); [Ogu and Alesbeleye, 2018](#)).

The model summary is given as follows:

Table 11. Model Summary for Sialkot district in MM

-2 Log likelihood	27.214
Pseudo R square	0.578

a Estimation terminated at iteration number 7 because parameter estimates changed by less than .001

Conclusion

Maternal mortality is used as a health status indicator in existing study. Variables like female education, safe water availability, sanitation, health infrastructure, immunization card, family size, residence, household income, and ANC visit have influence on health status. The study found that education, family size, poor and middle income class variables had a positive and significant effect on the MM in DG Khan. However, safe water, sanitation facility, immunization card, area of residence, health infrastructure and ANC visit had a negative and insignificant effect on health status.

This study revealed that primary educated female category and family size can cause positive and insignificantly impact the health

status, but middle educated female, safe water and poor income categories show positive and significant impact. While, sanitation, area of residence and health infrastructure show negative and significant impact health. Furthermore, immunization card, middle income and ANC visit show negative and insignificant impact on health in Chakwal.

This study found that Sialkot is the highest income category district. The study found that education, household income and family size had a positive and significant effect on the MM in Sialkot. Safe water availability, sanitation, health infrastructure and immunization card have negative and insignificant effect on female health.

Policy and Suggestions

The study recommends various policy and

recommendation suggestions for future perspectives based on the findings.

- In many rural regions of each district, the mobile clinic should be launched since DG Khan has large rural areas with poor conditions for maternal mortality.
- There should be free mobile health care for each child and maternal woman in all districts.
- Refresher training programs should be conducted for nurses, lady doctors, and paramedical staff for technological up-gradation of the safe delivery system.
- Maternal women should be provided with a free supply of folic acid pills.
- Government should develop a dedicated policy on reducing infant and maternal mortality with all other connected departments.
- Government should seek digital software to record new pregnancies and newborn infants.
- Government should initiate women's education awareness initiatives.
- Women should be empowered to respect their fundamental human rights, including access to health care services
- Local government and project planners should take initiatives to provide movable toilet blocks built on more stable areas where there are more feasible options for the treatment of waste and sanitation.
- Community involvement in selecting and designing the water and sanitation facilities.
- Encourage water treatment at the point of use.
- Promote a sanitation package in each region for vulnerable households.
- Promote hygiene education for maternal women, especially in each district.
- Promote water and sanitation social marketing strategies in each district
- In the backward district households, promote patient-friendly pit latrines.
- Encourage subsidies to sanitation platforms in low-income districts for vulnerable households.
- Encourage the utilization of locally available materials for the construction of sanitation and hygiene facilities.
- Government should provide micro fiancé loaning to newly young couple that will further helpful for upcoming children.
- Government should launch new RO plant for safe drinking water.
- Government should give more strength to integrated reproductive and new born child health (IRMNCH) program that is total related with the maternal health.

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