

REDUCING MATERNAL MORTALITY VIA MIDWIFERY IN DISTRICTS JHANG AND KHANEWAL OF PUNJAB, PAKISTAN

Saana Bibi

Director of Research & Monitoring, Ministry of Poverty Alleviation and social safety (PASS), Islamabad,
Pakistan, sanashabir305@gmail.com

Muhammad Sulaman Ijaz*

Research Coordinator, Rural Support Programme Network, Islamabad, Pakistan
slmanijaz@gmail.com

ABSTRACT

Maternal mortality is one of the serious issues around the globe. About 800 expecting women die globally every day due to causes related to childbirth and pregnancy. One of the key reasons for the higher maternal mortality ratio in developing countries is the unavailability of skilled birth attendants. Pakistan, a low-income country, reported the highest Maternal mortality ratio (MMR), 186 deaths per 100,000 live births in 2019, which increased by 32% compared to the 2017 MMR. Despite all the efforts made by Pakistan, the country has made slow progress in achieving Millennium Development Goals (MDGs) 4 and 5; challenges of political fragility, complex security issues, and natural disasters made it more resistant. Our study used data from the recently established maternal, newborn, and child health program (MNCH) from two Districts in Pakistan. The study aimed to identify the efficient role of community health workers (CMWs) as home-based skilled service providers in reducing maternal mortality in two districts (Jhang and Khanewal), Punjab, Pakistan. The study found that women are more likely to suffer from internal health issues despite the reasons many pregnant females (60%) had no antenatal visit during the first trimester of their pregnancy. Results indicated that examination through CMWs is more effective than the antenatal visit reported in health centers. It indicates the need to improve the skills and quality of home-based service providers' facilitation and well-trained practice of instrument-assisted deliveries, especially by mid-level skilled birth attendants.

Keywords: Maternal mortality, Midwifery, skilled birth attendants, MNCH Programme, antenatal

INTRODUCTION

Maternal mortality is a serious problem for the entire world. Worldwide, almost 300,000 maternal and neonatal deaths occur annually during delivery and in the early postpartum period. The maternal mortality ratio (MMR) was targeted to be a 75% reduction between 1990 and 2015 in Millennium Development Goal 5. Sustainable Development Goal (SDG) recommended less than 70% maternal deaths per 100,000 live births globally by 2030. Immediate action is required to achieve the target of SDG by 2030 (Alkema et al., 2016). According to the World Health Organisation (WHO) fact sheet, around 800 pregnant women die daily because of childbirth and pregnancy-related issues. The maternal mortality ratio is higher in developing countries compared to developed countries. Worldwide 94% of maternal deaths are from developing countries². Further, Pakistan is one of the six countries worldwide where half of maternal death occurs (Hogan et al., 2010). According to the maternal mortality survey 2019, the maternal mortality ratio (MMR) in Pakistan stands at 186 deaths per 100,000 live births (Hanif et al., 2021).

Plummeting maternal mortality rates is a priority for many low-income countries. Several organizations, such as the World Health Organization (WHO) and the United Nations Population Fund (UNFPA), have supported significant initiatives to counter the issue of maternal mortality globally (Smith & Rodriguez, 2016). There are multifaced reasons behind the high maternal mortality rate in developing

* Corresponding Author

² <http://www.who.int/mediacentre/factsheets/fs348/en/>

countries worldwide. The availability of Skilled Birth Attendants is one of the key reasons behind the higher maternal mortality rate in developing countries like Pakistan (Girum & Wasie, 2017). According to the statistics of the Pakistan Health and Demographic Survey (2019), in Pakistan, out of an estimated 4-5 million births per year, less than one in every two is attended by Skilled Birth Attendants. The ratio of prenatal and postnatal checkups is also poor (PDHS, 2019).

The Government of Pakistan has initiated various programs in the country to address the issue of maternal mortality and improve the availability and quality of family planning and healthcare services (Zulliger, 2017). Pakistan initiated its first community health workers program, commonly famous as the Lady Health Worker (LHW) program, in 1994 to provide universal health coverage (Sarfaraz & Hamid, 2016). In 2006, another community health worker-based program, the Maternal Newborn and Child Health (MNCH) programme designed and executed to improve the health indicators mainly related to MDGs. The MNCH programme introduced the mechanism of Community Mid-Wives (CMWs) as front-line health workers (Musaddiq, 2023). Under this programme community midwives were trained and licensed to provide maternal healthcare services. The main objective of the programme was to reduce the maternal mortality rate and to increase skilled birth attendance (Sarfaraz & Hamid, 2014). In 2010, the government of Pakistan committed to reducing the maternal mortality rate from 276 to 140 deaths per 100,000 live births by 2015. Yet despite huge efforts and investment, the Government failed to achieve the set goal for 2015 (Siddiqui & Smith-Morris, 2022). In Pakistan, the MNCH and CMW Programme have not been successful due to multifaceted challenges like community acceptance, poor referral system, inadequate skill and training, and lack of community involvement (Research & Development Solutions, 2012).

Several studies have been done around the globe to determine the role and importance of midwifery in countering maternal mortality. To counter the maternal mortality ratio the role of community midwives (CMWs) and trained traditional birth attendants (TBAs) have been acknowledged worldwide (Titaley et al., 2010). Lerberghe et al. (2014) showed that midwifery is key to improving maternal and newborn health in low-income and middle-income countries. Improved quality of antenatal care (ANC) can reduce maternal and neonatal mortality. It can also improve health outcomes, particularly in low-income countries (Joshi et al., 2014). Zulu et al. (2014) identify factors (gender and economic status, ineffective incentive structures, inadequate infrastructure, and supplies) that influence the integration of national community-based health worker (CBHW) programmes of health systems in low- and middle-income countries. Tura et al. (2014) found determinant variables for skilled care use in Southwest Ethiopia: socio-demographic, financial, access to well-being office, maternal obstetric elements, and antenatal consideration. Tura et al. (2014) identified key risk factors to improve skilled consideration in Southwest Ethiopia, such as mediation, education or correspondence, antenatal consideration use, family planning, and learning about risk signs. Ononokpono et al. (2014) retrieved significant variations in receiving postnatal care across communities in Nigeria using multilevel analysis.

Over the last two decades, maternal mortality ratios and neonatal mortality rates have remained stagnant in Pakistan. According to the Pakistan Demographic and Health Survey (PDHS), a perinatal mortality rate of 75 per 1000 pregnancies and a neonatal mortality rate of 55 per 1,000 live births were reported in 2012-2013 (Pasha et al., 2015; Mumtaz et al., 2014). Achieving better health care for women and newborn infants is possible. However, it requires improvements in the quality of reproductive, maternal, and newborn care, alongside necessary increases in universal coverage (ten Hoope-Bender et al., 2014). Skilled birth attendance has been effective in some settings for reducing maternal deaths, but it is failing in Pakistan. Consistent results can be achieved by giving maximum attention to programme theory during the design of maternal health strategies (Mumtaz et al., 2015). Pakistan's government has initiated the maternal, neonatal, and child health (MNCH) program at the national level to address the infant mortality and maternal mortality issues in Punjab. There were around 48,000 trained Lady Health Workers (LHWs) in the National primary health care and family planning of Punjab province, Pakistan. They provided preventive and social insurance in their assigned areas. The study's basic purpose was to enhance midwifery at the community level to reduce maternal deaths in Punjab. The role of traditional birth attendants (TBAs) has been identified to increase the availability and accessibility of healthcare services in supporting the MNCH programme (Shaikh et al., 2014; Hamad et al., 2015; Ali et al., 2015; Sarfaraz &

Hamid, 2016). In this study, we aimed to identify the effect of community midwives (CMWs) as home-based skilled service providers on neonatal and maternal mortality in two districts (i.e., Jhang and Khanewal) of Punjab (Pakistan) using the data from the recently established MNCH program.

Study Objective, Design, and Locale

The Legislature of Pakistan started the MNCH programme to address the issue of maternal mortality and improve the health indicators particularly related to MDGS. The Association for Social Development (ASD) conducted a survey funded by the Research and Advocacy Fund (RAF) in two Districts of Punjab (Jhang and Khanewal). This study has used data from the surveys conducted by ASD, which can be found in the MNCH programme. ASD conducted a cluster randomized controlled trial (cRCT) with three treatment groups from February 2011 to June 2014, with treatments focused on the community level. The first treatment group (TG1) included birth plans, preparedness, and financial facilities for the females surveyed. In the second treatment group (TG2) only birth preparedness was provided. The third treatment group (TG3) was the control group, where women were only observed under the present circumstances. All primary health centers in Pakistan were considered. The study population chose 26 clusters of primary health centers in districts Jhang and Khanewal. In the study sample, 21 clusters of enabled health facilities were considered. A total of 58,870 females were included in the sample taken from the two Districts with cluster size=7 in each treatment group. All analysis has been done in *SPSS. version – 20*. The key objective of the study was to identify the effect of community midwives (CMWs) as home-based skilled service providers on neonatal and maternal mortality.

Data Modeling

The response variable has three treatment groups of nominal scale, and explanatory variables are categorical (Table 1). A mixed-effect multinomial model is used to measure the role effectiveness of midwifery in each district. Mixed-effects regression models are appropriate if data is clustered (nested within a larger context) and longitudinal (nested within individuals). Random effects are mostly used to account for the nesting of data into models. The random effects represent the cluster effects in clustered data and subject effects in longitudinal data (Hedeker, 1999). Mixed-effect multinomial logistic models permit flexibility for comparing the response categories with several contrasts. Maximum Marginal Likelihood (MML) estimated the parameters by numerically integrating quadrature over random effects distribution (Hedeker, 2003). The method is known as Multinomial Logit Random-Effect models or Multilevel Nominal Logistic models. By using [Hedeker, 2003] mixed-effect multinomial logistic model terminology, Let i denote the level-2 units (clusters/districts), and j denotes the level-1 units (nested observations). Assume that there are $i = 1, 2, \dots, N$ level-2 units and $j = 1, \dots, n_i$ level-1 units nested within each level-2 unit. Let y_{ij} be the value of the treatment variable associated with level-2 unit i and level-1 unit j . In the nominal case, we need to consider the values corresponding to the multiple unordered categories of the response variable. For this, let us assume that the C response categories are coded as $c = 1, 2, \dots, C$. Considering 1 to be the reference category. Adding random effects to the usual multinomial logistic regression model, the probability that $y_{ij} = c$ (a response occurs in category c) for a given level-2 unit i , conditional on the random effects β for $(c = 2, 3, \dots, C)$, is given by:

$$P(y_{ij} = c | \mathbf{x}_{ij}, \mathbf{u}_i) = \frac{e^{\gamma_c \mathbf{x}_{ij} + \beta_{ic} \mathbf{u}_i}}{1 + \sum_{h=2}^C e^{\gamma_h \mathbf{x}_{ij} + \beta_{ih} \mathbf{u}_i}} \quad (1)$$

$$P(y_{ij} = 1 | \mathbf{x}_{ij}, \mathbf{u}_i) = \frac{1}{1 + \sum_{h=2}^C e^{\gamma_h \mathbf{x}_{ij} + \beta_{ih} \mathbf{u}_i}} \quad (2)$$

$$P(y_{ij} = c) = \frac{e^{\gamma_c \mathbf{x}_{ij} + \beta_{ic} \mathbf{u}_i}}{1 + \sum_{h=2}^C e^{\gamma_h \mathbf{x}_{ij} + \beta_{ih} \mathbf{u}_i}} + \frac{1}{1 + \sum_{h=2}^C e^{\gamma_h \mathbf{x}_{ij} + \beta_{ih} \mathbf{u}_i}} \quad (3)$$

Here, \mathbf{u}_i is the $s \times 1$ covariate vector, \mathbf{x}_{ij} is the design vector for the r random effects, both vectors being for the j th level-1 unit nested within level-2 unit i . Where, γ_c is an $s \times 1$ vector of unknown fixed regression parameter's and β_{ic} is $r \times 1$ of unknown random effects for the level-2 unit i . The

distribution of the random effects is assumed to be multivariate normal with zero mean vector and covariance matrix Σ_c .

Table 1: Description and Measurement of the Variables of MNCH (Jhang and Khanewal), 2015

Dependent Variable	Description	Measurements
Treatment group1	Birth preparedness plan and financial facilities provide	Treatment group1 coded as 1
Treatment group2	Birth preparedness plan provide	Treatment group2 coded as 2
Control group	Was observed under the present Circumstances	Control group coded as 3
Predictor Variables	Individual Characteristics	
TND	Bith order of women's most recent birth	Coded 1st for 1st-4rth birth, last for 9-12 birth orders
TNCA	Total number of live children	Coded three categories 1st for 1-4 children, last for 9-12 child
MA	Mother Age	Coded 1 for less than 18-years,last for 35 years.
MH	Mother Hight	Coded 1 for greater than 4.8inch, last for no response
MW	Mother Weight	It is divided into three categories 1 for 45Kg, last for 80Kg.
ME	Mother Education	Coded into 5 categories 1 for illiterate, last for 11 above
CHD	Any choronic disease	Coded into 1 for yes, 2 for no and 9 for dntknow

MEDU	Any medicine being used by mother	Coded into 1 for yes, 2 for no and 9 for dntknow
HOA	Hisotry of abortion	Coded into 1 for yes, 2 for no and 9 for dntknow
HOC	History of C-section	Coded into 1 for yes, 2 for no and 9 for dntknow
AN6	Anemia during 6 months of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
AN3	Anemia during 3rd trimester of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
SL1	Swelling of feet in 6 months of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
SL2	Swelling of feet 3rd trimerster	Coded into 1 for yes, 2 for no and 9 for dntknow
FM1	Fetal movement in 6 months of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
FM2	Fetal movement in 3rd trimester of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
VB1	Vaginal bleeding during 6 months of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
VB2	Vaginal bleeding in 3rd trimesters of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
VD1	White vaginal discharge in 6 months of pregnancy	Coded into 1 for yes, 2 for no and 9 for dntknow
VD2	White vaginal discharge in 3 trimesters	Coded into 1 for yes, 2 for no and 9 for dntknow
TRA	Travel arrangement-advice(for emergency)	Coded three ctegrories
PDA	Place of delivery-advice	Coded three ctegrories
Health facility characteristics		
LHW1	LHW visit in 6 months of pregnancy	0,1,2 are coded as the number of visits

LHW2	LHW visit in 3rd trimester	0,1,2 are coded as the number of visits
NU6	Antenatal Visits on health-centr's 6 months of pregnancy	0,1,2 are coded as the number of visits
NU3	Antenatal-Visits on health center's in 3rd trimester	0,1,2 are coded as the number of visits
h TPA	Type of skilled birth attendant	Categories are 1 for doctor, last for CMW.
PDU	Place of delivery used	Coded 1 for Home,last for Hospitals.
FA	Health facilities of the two Districts	Health facilities centers are coded
Districts	Jhang and Khanewal Districts	Jhang and Khanewal coded as 1 and 2

Table2: Frequency N(%) of women demographic characteristics and LHW examines, MNCH 2015

Characteristics		TG1	TG2	Control
Mother Age	<18year	287.3(31.1%)	259(36.2%)	254.7(32.7%)
	18-35year	17768.2(35.8%)	16018.5(31.8%)	15756.3(32.3%)
	>35year	2448.1(32.3%)	2207.0(38.6%)	2170.9(29.2%)
Mother Height	>4.8 inch	9181.2(23.9%)	8277.1(33.6%)	8141.7(42.5%)
	<4.8 inch	2548.9(26.2%)	2297.9(27.7%)	2260.3(46.1%)
Mother Weight	<45 kg	939.3(27.1%)	846.8(23.9%)	832.9(48.9%)
	45-80 kg	11931.6(26.3%)	10756.7(41.5%)	10580.7(32.3%)
	>80 kg	396.3(36.7%)	357.3(19.4%)	351.4(44.0%)
Total number of deliveries	1-4	17742.0(36.4%)	16521.3(34.5%)	14695.7(29.1%)
	5-8	1822.8(35.0%)	1697.4(26.7%)	1509.8(38.3%)
	9-12	56.2(29.7%)	52.3(18.7%)	46.5(51.6%)
Any chronic disease	Yes	525.8(31.2%)	474(49.2%)	466.2(19.6%)

	No	18793.2(32.6%)	16942.6(34.2%)	16665.3(33.2%)
Any medicine being used by mother	Yes	958.6(25.9%)	864.2(27.5%)	850.1(46.6%)
	No	18182.4(32.6%)	16391.9(35.3%)	16123.7(32.1%)
History of abortion	Yes	676.4(32.0%)	609.8(32.8%)	599.8(35.2%)
	No	19377.8(33.3%)	17469.6(33.8%)	17183.7(32.8%)
Number of LHW antenatal exams during 1st and 2nd trimesters	1	11164.9(36.0%)	10065.4(29.2%)	9900.7(34.8%)
	2	1725.4(36.5%)	1555.5(43.2%)	1530.1(20.3%)
	3	2299.6(38.4%)	2073.2(42.9%)	2039.2(18.7%)
	4	3461.2(39.3%)	3120.4(28.2%)	3069.3(32.5%)
Number of LHW antenatal exams during 3rd trimesters	1	3958(46.0%)	3568.2(33.6%)	3509.8(20.4%)
	2	3377(45.4%)	3044.4(31.8%)	2994.6(22.7%)
	3	3996.3(39.7%)	3602.8(30.1%)	3543.8(30.1%)
Anemia during 6 months of pregnancy	Yes	2112.8(27.3%)	1904.7(31.8%)	1873.5(40.8%)
	No	15560.7(36.2%)	14028.4(33.4%)	13798.8(30.3%)
Anemia during 3rd trimester of pregnancy	Yes	2306.4(44.7%)	2079.3(25.4%)	2045.3(29.9%)
	No	8749.4(44.1%)	7887.8(34.2%)	7758.7(21.7%)
Swelling of feet during 6 months of pregnancy	Yes	1486.9(31.4%)	1340.5(35.4%)	1318.6(33.2%)
	No	16132.8(35.6%)	14544.1(33.1%)	14306.1(31.3%)
Swelling of feet during 3rd trimester of pregnancy	Yes	1623.6(31.9%)	1463.7(34.4%)	1439.7(33.7%)
	No	9385.3(46.6%)	8461.1(32.2%)	8322.6(21.2%)

Last recording of fetal movement during 6 months of pregnancy	Yes	16304.9(35.1%)	14699.3(32.6%)	14458.8(32.3%)
	No	1331.3(35.9%)	1200.2(41.4%)	1180.5(22.7%)
Last recording of fetal movement during 3rd trimester of pregnancy	Yes	10235.6(44.5%)	9227.7(31.5%)	9076.7(24.0%)
	No	988.1(36.0%)	890.8(37.2%)	876.2(26.7%)
Vaginal bleeding during 6 months of pregnancy	Yes	847.8(34.7%)	764.3(44.5%)	751.8(20.8%)
	No	16775.1(35.2%)	15123.2(32.7%)	14875.7(32.1%)
Vaginal bleeding during 3rd trimesters of pregnancy	Yes	846.4(36.7%)	763(41.3%)	750.6(22.0%)
	No	10156.7(45.1%)	9156.6(31.8%)	9006.7(23.1%)
Foul smelling vaginal discharge during 6 months of pregnancy	Yes	747.4(31.8%)	673.8(46.2%)	662.8(22.0%)
	No	16870.5(35.4%)	15209.2(32.7%)	14960.3(32.0%)
Foul smelling vaginal discharge during 3 trimesters of pregnancy	Yes	775.7(35.3%)	699.4(41.2%)	687.9(23.5%)
	No	10228.5(45.2%)	9221.2(31.8%)	9070.3(23.0%)

RESULTS

By comparing both treatment groups (TG1, TG2), to the control group mother aged less than 18 years, TG2 has favorable distribution compared to both treatment groups. On the other hand, mother weight above 80 in both TG1 and TG2 have unfavorable distribution as compared to the control group. Furthermore, women having several deliveries up to 12 in their lifetime, both TG1 and TG2 have unfavorable distribution compared to the control group (29.7%, 18.7%; 51.6%), Table 2. The lady health worker (LHW) examines the pregnant women at most four times during the survey. It observed that 46.6% of women are under some medication under the control group. Results showed that in TG1, 36.5% & TG2, 43.2% of females were examined twice by LHW during their first and second trimesters throughout the study. During each antenatal visit, LHW examines the pregnant women's anemia, swelling of feet, last recording of fetal movement, vaginal bleeding, and vaginal discharge for every trimester (Table 2). The mixed-effects multinomial regression model measured the performance of LHW & health centers in the district (Jhang and Khanewal). At level-1, the antenatal visits of respective health centers during all the trimesters, LHW participation and advice regarding maternal health care given to the women in the two treatment groups, and mother education are used as fixed effects. At level-2, within districts, whole planned birth attend, and the facilities provided in both treatment groups are used as a random effect.

Table 3: Mixed-effects multinomial logistic regression TG1 odds ratio for fixed-effects community factors on Antenatal care visits, MNCH(Jhang and Khanewal)-2015

TG1	Coefficient	Sig	Odds Ratio	Lower - Upper limits/95% CI
Intercept	23.00	.001	-	-
Antenatal Visits on health-center's 6 months of pregnancy =1	-0.811	.005	.444	0.251 - 0.786
2	-0.758	.220	.469	0.139 - 1.574
3	-0.483	.048 5	0.617	0.159 - 2.389
4	-2.178	.014	0.113	0.020 - 0.638
Antenatal Visits on health center's in 3rd trimester=1	-0.100	.080 6	0.904	0.405 - 2.017
2	0.906	.057	2.478	0.974 - 6.293
3	1.969	.000	7.156	2.627 - 19.541
Place of delivery-advice=Home	-0.564	.221	0.669	0.230 - 1.770
CMW home	-1.345	.098	0.251	0.053 - 1.280
Health center	-0.811	0.25	0.444	0.219 - 0.902
Hospital	-0.112	.749	.894	0.452 - 1.770
Was advice given regarding maternal nutrition?=Yes	-0.597	.480	.550	0.105 - 2.888
No	1.950	.107	7.031	0.379 - 3.305
Travel arrangement-advice(for emergency)=Yes	.638	.021	1.893	1.099 - 3.262
No	0.113	.083 8	1.893	0.379 - 3.305
Place of delivery used=Home	-0.532	.027 5	0.588	0.226 - 1.526
CMW home	-0.265	.702	0.767	0.197 - 2.985

Health center	-0.857	.034	0.425	0.192 - 0.939
Type of skilled birth attendant=Doctor	-0.447	.418	0.639	0.217 - 1.885
LHW	0.138	0.16 1	1.148	0.460 - 2.864
CMW	0.283	0.56 4	1.327	0.507 - 3.469
Mother Education illiterate = 1	-0.750	.026	0.473	0.244 - 0.916
2	-0.590	.125	0.554	0.260 - 1.179
3	-2.118	.001	0.120	0.036 - 0.404

In Table 3 estimated significant log-odd for the intercept is (23.00), in favor of the TG1 category versus the control group. The odds ratio for at least one antenatal visit by the respective health center is (0.44 < 0.00), showing that the women's visit to the health center is one time less likely to occur in TG1 versus the control group.

Table 4: Mixed-effects multinomial logistic regression odds ratio for fixed-effects community factors on Antenatal care visits, 2015MNCH(Jhang and Khanewal)-TG2

TG2	Coefficient	Sig	Odds Ratio	Lower - Upper limits/95% CI
Intercept	20.089	.036	-	
Antenatal Visits on health-center's 6 months of pregnancy =1	-0.603	.039	0.547	0.309 - 0.971
2	0.033	0.95 7	1.034	0.306 - 3.490
3	0.908	0.19 0	2.478	0.638 - 9.619
4	-1.313	0.13 8	0.269	0.047 - 1.528
Antenatal Visits on health center's in 3rd trimester=1	0.245	0.55 1	1.277	0.572 - 2.853
2	2.003	.000	7.413	2.909 - 18.890
3	2.062	.000	7.258	2.827 - 21.840

Place of delivery-advice=Home	0.437	.345	1.548	0.625 - 3.832
CMW home	1.016	.211	2.761	0.563 - 13.540
Health center	-0.283	0.43 5	0.754	0.370 - 1.533
Hospital	-0.242	0.48 8	0.785	0.395 - 1.558
Was advice given regarding maternal nutrition?=Yes	-0.341	0.68 9	0.711	0.133 - 3.790
No	1.444	0.23 6	4.237	0.389 - 46.212
Travel arrangement-advice(for emergency)=Yes	0.263	0.34 7	1.300	0.752 - 2.248
No	0.272	0.62 2	1.313	0.445 - 3.878
Place of delivery used=Home	-0.345	0.48 1	0.709	0.272 - 1.847
CMW home	-0.145	0.83 5	0.865	0.221 - 3.385
Health center	-0.630	0.12 1	0.533	0.241 - 1.180
Type of skilled birth attendant=Doctor	-0.174	0.75 3	0.840	0.284 - 2.487
LHW	0.136	0.77 2	1.145	0.457 - 2.868
CMW	0.123	0.80 3	1.131	0.430 - 2.973
Mother Education illiterate = 1	-1.310	.000	0.270	0.139 - 0.524
2	-1.006	.009	0.368	0.171 - 0.780
3	-2.094	.001	0.123	0.037 - 0.415

Antenatal visits in 3rd trimester have significant participation with an odds ratio of (7.156 < 0.0001). Travel arrangement advice given by LHWs has a significant odds ratio (1.893 < 0.02). The odds ratio estimate (0.473 < 0.02) of the literate mother favors the TG1 versus the control group. Table

4 shows the estimates of the fixed-effects variables for TG2. The significant estimated intercept ($20.089 < 0.03$) odds ratio favors the TG2 category versus the control treatment. The odds ratio estimates of at least one antenatal visit in a health center in six months of pregnancy are ($0.547 < 0.03$), which implies that antenatal visits of women in their respective health centers are less likely to occur in the TG2 versus the control group. Antenatal visits in 3rd trimester in 2 or more time examinations have significant participation. Odds ratio estimates of literate mothers ($0.27 < 0.00$) favor the TG2 versus the control group. Mother education impacts the mother's health better than the illiterate mother's, but it is less likely to occur in TG2.

Table 5: Random-effects parameters TG1 and TG2 of Mixed-effects multinomial logistic regression model, MNCH (Jhang and Khanewal)-2015

Model Term	TG1	Z	Sig	Lower - Upper limits/95% CI
Var(Intercept)	81.025	0.564	0.572	2.515 - 2,610.145
Var(Planned birth attend)	63.729	2.131	0.033	25.409 - 159.842
Var(Facility)	0.022	0.976	0.329	0.003 - 0.162
	TG2	Z	Sig	Lower - Upper limits/95% CI
Var(Intercept)	161.586	0.624	0.532	1.004 - 3,727.785
Var(Planned birth attend)	66.585	2.137	0.033	26.610 - 166.612
Var(Facility)	0.013	0.941	0.347	0.002 - 0.101

The variance for safe planned birth attended in TG1 within districts is (63.729). Estimates of Z-statistics (2.131, < 0.03) showed that the safe plan birth attended in TG1 is statistically significant. On the other hand, facilities provide in TG1 within districts are (0.022, < 0.329) show insignificant effect. Whereas the estimated variance for safely planned birth attendance in TG2 is (66.585, < 0.03), shows a significant impact. However, the facilities for TG2 are also insignificant. This implies that there is little variation between districts for the facilities. The safe plan birth attended or recorded in the two treatment groups is statistically different from zero for both districts (Jhang and Khanewal).

DISCUSSION

Using an appropriate modeling framework, this study explains the risk factors of maternal health and CMWs participation in community health centers. The results suggest that CMWs have provided reasonable antenatal coverage to each expecting mother. The odds ratio (7.156, 7.258) of third-time examinations of CMWs in 3rd trimester, percentage points (38.4% and 42.9%) shows that pregnant women were more preferably examined through CMWs. Furthermore, each woman has been examined for anemia, swelling of feet, fetal position, vaginal discharge, and vaginal bleeding. Results also suggest that women are mainly affected by internal health-related problems (ijaz et al., 2022). Anemia, swelling of feet, and white vaginal discharge are the basic issues that affect the mother's health. In TG1, 36.7% and in TG2, 41.3% of women suffer from vaginal bleeding in the 3rd trimester of their pregnancy. Mother education plays a significant role as educated mothers prefer skilled birth care during their pregnancy, but less likely to occur in both treatment groups. In TG1, only 40% of women having one antenatal visit in health center during their six

months of pregnancy is another important factor affecting the mother's health. In TG1, 60% and TG2, 50% of pregnant women reported no antenatal visit during the first six months. Findings are consistent with the study conducted in 2016, which showed that ~ 71 % of women in the poorest quintile made their first ANC visit when they experienced a pregnancy-related problem (Agha and Tappis, 2016). Table.5 random effects parameter identifies that health facility center participation is insignificant, which reveals that each district health center has many variations. All health centers will need improvement-based steps at equal bases. The coverage of reported antenatal visits for the health center seems less impressive than examination through LHW or community health midwives (CMW).

The results imply more improvement in favor of mid-level skilled birth attendance LHW/CMW compared to qualified doctors. Because most of the women in the survey chose the normal mode of delivery, LHW/CMW played better participation than the doctors. The completely safe planned birth record in two Districts shows a significant impact in both treatment groups compared to the control group. However, the facilities that are provided in the two Districts are insignificant. The one reason for variation within facilities is that pregnant women have multiple skilled birth attendance (public and private) to choose from other than the facility health centers provided in a survey. The above data clearly shows that for making birthing safer, the antenatal care of the neonate and mother is important for the survival of the mother and child.

CONCLUSION

The study demonstrated the role of LHW/CMW as skilled birth care attended by the women in the two treatment groups of Punjab (i.e., Jhang and Khanewal) of Punjab (Pakistan). Results of mixed-effects of multinomial logit models show less effective participation of health centers in both Districts. Only 40% of women in TG1 used health centers for their place delivery. No significant participation of doctors was captured in both treatment group. We found that women mainly suffered from internal health issues, and half had no antenatal visit during the first six months of pregnancy in both treatment groups. Antenatal visits by LHWs are more effective than antenatal visits reported in health centers. It indicates the need to improve the quality of facilitation provided in health centers and the need for instrument-assisted deliveries, especially by mid-level skilled birth attendants. However, on the whole, facilities for the skilled birth care provided to a woman during pregnancy are remarkable to achieve the expectation for the reduction of neonatal and maternal mortality in the two districts, to make birthing safe for the women.

REFERENCES

- Agha, S., & Tappis, H. (2016). The timing of antenatal care initiation and the content of care in Sindh, Pakistan. *BMC pregnancy and childbirth*, 16, 1-9.
- Ali, S. A., Lakhani, A., Jan, R., Shahid, S., Baig, M., & Adnan, F. (2015). Enhancement of knowledge and skills of community midwives in Sindh, Pakistan. *Journal of Asian Midwives (JAM)*, 2(2), 36-56.
- Alkema, L., Chou, D., Hogan, D., Zhang, S., Moller, A.-B., Gemmill, A., Fat, D. M., Boerma, T., Temmerman, M., Mathers, C., et al. (2016). Global, regional, and national levels and trends in maternal mortality between 1990 and 2015, with scenario-based projections to 2030: a systematic analysis by the UN Maternal Mortality Estimation Inter-Agency Group. *The Lancet*, 387(10017), 462-474.
- Gafoor, A. K., & Ashraf, M. P. (2007). Academic self-efficacy scale. *Calicut: University of Calicut, department of education*.
- Hamad, N., Sarwar, Z., Qazi, A. B., Bashir, A., & Asif, M. (2015). Envisioning Role of Community Midwives in Punjab, Pakistan. *Medical Channel*, 21(4).
- Hedeker, D. (1999). Mixno: a computer program for mixed-effects nominal logistic regression. *Journal of Statistical Software*, 4(5), 1-92.
- Hedeker, D. (2003). A mixed-effects multinomial logistic regression model. *Statistics in medicine*, 22(9), 1433-1446.
- Ijaz, M. S., Bibi, S., & Elhai, A. (2022). Determinants of maternal mortality in districts Jhang and Khanewal. *International Journal of Collective Behavior*, 1(02), 21-35.
- Joshi, C., Torvaldsen, S., Hodgson, R., & Hayden, A. (2014). Factors associated with the use and quality of

- antenatal care in Nepal: a population-based study using the demographic and health survey data. *BMC pregnancy and childbirth*, 14(1), 1-11.
- Mumtaz, Z., Levay, A., Bhatti, A., & Salway, S. (2015). Good on paper: the gap between programme theory and real-world context in Pakistan's Community Midwife programme. *BJOG: An International Journal of Obstetrics & Gynaecology*, 122(2), 249-258.
- Mumtaz, Z., Salway, S., Bhatti, A., Shanner, L., Zaman, S., Laing, L., & Ellison, G. T. (2014). Improving maternal health in Pakistan: toward a deeper understanding of the social determinants of poor women's access to maternal health services. *American journal of public health*, 104(S1), S17-S24.
- Musaddiq, T. (2023). The impact of community midwives on maternal healthcare utilization. *Health Economics*, 32(3), 697-714.
- Ononokpono, D. N., Odimgwu, C. O., Imasiku, E. N., & Adedini, S. A. (2014). Does it really matter where women live? A multilevel analysis of the determinants of postnatal care in Nigeria. *Maternal and child health journal*, 18, 950-959.
- Pasha, O., Saleem, S., Ali, S., Goudar, S. S., Garces, A., Esamai, F., Patel, A., Chomba, E., Althabe, F., Moore, J. L., et al. (2015). Maternal and newborn outcomes in Pakistan compared to other low and middle income countries in the Global Network's Maternal Newborn Health Registry: an active, community-based, pregnancy surveillance mechanism. *Reproductive health*, 12, 1-10.
- Research and Development Solutions. (2012). The community midwives program in Pakistan. Policy brief series no. 20. Islamabad: Research and Development Solutions.
- Sarfraz, M., & Hamid, S. (2014). Challenges in delivery of skilled maternal care—experiences of community midwives in Pakistan. *BMC pregnancy and childbirth*, 14(1), 1-13.
- Sarfraz, M., & Hamid, S. (2016). Exploring managers' perspectives on MNCH program in Pakistan: a qualitative study. *PloS one*, 11(1), e0146665.
- Siddiqui, S., & Smith-Morris, C. (2022). Professional competition amidst intractable maternal mortality: Midwifery in rural Pakistan during the COVID-19 pandemic. *Social Science & Medicine*, 313, 115426.
- Shaikh, B. T., Khan, S., Maab, A., & Amjad, S. (2014). Emerging role of traditional birth attendants in mountainous terrain: a qualitative exploratory study from Chitral District, Pakistan. *BMJ open*, 4(11), e006238.
- Smith, S. L., & Rodriguez, M. A. (2016). Agenda setting for maternal survival: the power of global health networks and norms. *Health Policy and Planning*, 31(suppl_1), i48-i59.
- Hoope-Bender, P., de Bernis, L., Campbell, J., Downe, S., Fauveau, V., Fogstad, H., ... & Van Lerberghe, W. (2014). Improvement of maternal and newborn health through midwifery. *The Lancet*, 384(9949), 1226-1235.
- Titaley, C. R., Hunter, C. L., Dibley, M. J., & Heywood, P. (2010). Why do some women still prefer traditional birth attendants and home delivery?: a qualitative study on delivery care services in West Java Province, Indonesia. *BMC pregnancy and childbirth*, 10, 1-14.
- Tura, G., Afework, M. F., & Yalew, A. W. (2014). The effect of birth preparedness and complication readiness on skilled care use: a prospective follow-up study in Southwest Ethiopia. *Reproductive health*, 11, 1-10.
- Van Lerberghe, W., Matthews, Z., Achadi, E., Ancona, C., Campbell, J., Channon, A., ... & Turkmani, S. (2014). Country experience with strengthening of health systems and deployment of midwives in countries with high maternal mortality. *The Lancet*, 384(9949), 1215-1225.
- Zulu, J. M., Kinsman, J., Michelo, C., & Hurtig, A. K. (2014). Integrating national community-based health worker programmes into health systems: a systematic review identifying lessons learned from low- and middle-income countries. *BMC public health*, 14(1), 1-17.