The Effect of Health Infrastructure, Adult Literacy, and Household Characteristics on Antenatal Care (ANC) Coverage in Punjab (Pakistan)

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Objective: The present study is a cross district analysis of the effect of health infrastructure, adult literacy, and household characteristics on antenatal care (ANC) use in Punjab (Pakistan).

Data and Methodology: The unit of analysis is a district. By covering a panel of 35 districts of Punjab, the study has collected the yearly data for the time period 2010 to 2016. The percentage of pregnant women of reproductive age received ANC services in each district is taken as dependent variable. Health physical infrastructure, adult literacy rate, and the percentage of households: having own house, using improved sanitation facilities, and receiving remittances from abroad are taken as explanatory variables. The study used panel Generalized Method of Moments (GMM) to estimate the effects of the explanatory variables on antenatal care.

Results: Ranking of the districts on the basis of ANC coverage shows that amongst the 34 districts of Punjab province, Bahawalnagar, Rajanpur, Pakpattan, Kasur, Bahawalpur, and Rahim Yar Khan districts are at the bottom with the lowest use of ANC services by the pregnant mothers. The GMM estimates show that health physical infrastructure, adult literacy rate, and the percentage of households having their own house are positively and significantly affecting the ANC use in Punjab-Pakistan. Hence confirming the healthcare services utilization framework of Andesen and Newman (2005) which explains that formal healthcare system (health physical infrastructure), predisposing factors (adult literacy rate), and enabling factors (households having their own houses) significantly matter in fostering better use of healthcare services.

Conclusion: The study advocates the need for investment in health physical infrastructure as well as in overall literacy. At the same time, it suggests that for the better coverage of ANC the geographical targeting can result into better outcomes.

Keywords:
Antenatal care use
Health infrastructure
Adult literacy rate
House ownership
Punjab

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1. INTRODUCTION

Many of the stillbirths, infant mortalities, and maternal deaths due to pregnancy-related issues can be prevented through better healthcare during pregnancy and childbirth. And over the world only 64% of women receive adequate prenatal care during their pregnancy (The World
Health Organization, 2016). The post-2015 development agenda\(^1\) does not seem to be materialized into reality without adequate use of antenatal care (ANC) services. The very first target of the third Sustainable Development Goal aims to bring the global maternal mortality ratio below 70 per 100,000 live births till 2030 (The United Nations, 2019). While according to the estimates, in 2017 the global maternal mortality ratio stood at 211 and in 2016 nearly 20 per cent of the global live births were attended by the unskilled healthcare staff (The World Bank, 2019).

In Pakistan the percentage of pregnant women receiving antenatal care services was 86.2 in 2018, while maternal mortality ratio was estimated as 140 per 100,000 live births in 2017 (The World Bank, 2019). Although this ratio is lesser than that of in India and Bangladesh but still remains too high in comparison with the maternal mortality ratio in Sri Lanka (see the table). The situation regarding ANC services use is also uneven among various regions of the country.

<table>
<thead>
<tr>
<th>Region</th>
<th>Pregnant women receiving prenatal care (%)</th>
<th>Maternal mortality ratio (modeled estimate, 100,000 live birth)</th>
<th>Births attended by skilled health staff (% of total)</th>
<th>Literacy Rate, Youth Total (% of People ages 15-24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>Year 2016 86.7</td>
<td>Year 2017 211</td>
<td>Year 2016 81.0</td>
<td>Year 2019 91.7</td>
</tr>
<tr>
<td>South Asia</td>
<td>78.7</td>
<td>163</td>
<td>75.5</td>
<td>90.0</td>
</tr>
<tr>
<td>India</td>
<td>79.3</td>
<td>145</td>
<td>81.4</td>
<td>91.7 (year 2018)</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>63.9</td>
<td>173</td>
<td>49.8</td>
<td>94.9</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>98.8</td>
<td>36</td>
<td>100.0 (year 2014)</td>
<td>98.8(year 2018)</td>
</tr>
<tr>
<td>Pakistan</td>
<td>86.2 (year 2018)</td>
<td>140</td>
<td>69.3 (year 2018)</td>
<td>74.5 (year 2017)</td>
</tr>
</tbody>
</table>

Education has been shown to have a deep effect on a mother’s use of maternal healthcare services. Global analysis of maternal mortality showed that the level of female literacy and schooling were significantly associated with maternal deaths. According to a report, as compared to an educated woman an uneducated woman has 2.7 times larger risk of maternal mortality (Tunçalp, Souza, & Gülmezoglu, 2013). Literature also reveals that adequate use of ANC services could be achieved by educating the women and through the provision of adequate knowledge regarding healthcare options (Chiang et al., 2012; Nisar & White, 2003; Safdar, Inam, Omair, & Ahmed, 2002). Educated partners have also been found to be more aware of the pregnancy-related complications (Shariff & Singh, 2002). Household’s wealth or financial wellbeing has significant role in the adequate usage of ANC services. Poor economic status of the family leads to poor access and inadequate number of ANC visits by the women (Agus & Horiuchi, 2012; Edward, 2011).

In Punjab, due to existing inter-regional disparities, the discrepancies concerning the utilization of ANC services are inevitable among different regions and districts of the country. The present study is unique in the context that, for investigation, it includes social, economic, and contextual realities of Punjab province as predisposing, and enabling factors of the ANC services use.

2. LITERATURE REVIEW

In the literature, we have added literature related to antenatal care and health infrastructure to establish the link between ANC and health services through the literature.

Bhatia and Cleland (1995) examined the association of issues with subsequent health-related behavior during pregnancy and childbirth. As less than one-fifth of the mothers had a postnatal checkup, there was a marked disparity between antenatal and postnatal treatment.

\(^1\) Accomplishment of Sustainable Development Goals (SDGs)
Significant determinants of the use of maternal health services were the level of education, economic status, and religion of the mother.

In a cross-sectional study, Fatmi and Avan (2002) by employing multivariate logistic regression identified the factors affecting utilization of antenatal care services in Sindh, Pakistan. The result revealed that a woman's socioeconomic status was the major determinant of the use of antenatal care.

Gokhale, Rao, and Garole (2002) investigated the effect of women's education on mortality reduction through increasing use of maternal and child health (MCH) services. Women's illiteracy had more damaging effects in the rural area as compared to the urban area. Male literacy has been beneficial in improving the use of services to reduce infant mortality rates, than female illiteracy.

Arthur (2012) studied the impact of wealth on the maternal health care by using the data from Ghanian Demographic and Health Survey for 2008. Univariate and multivariate analyses were employed to investigate the impact of wealth and socioeconomic variables on antenatal care use. The result found that there was a positive association between the wealth status and use of antenatal care. Variations were found among urban and rural dwellers in terms of the use of antenatal care.

Pillai, Maleku, and Wei (2013) examined the relationship between female literacy and maternal mortality ratios. The study used the data from 1970 to 2000 for 143 developing countries. The study used the latent growth curve approach to determine the dynamic relationship between female literacy and maternal mortality ratio. According to the study, a dent in the maternal mortality ratio was found with an increased female literacy rate. The study proposed that, given their ability to produce sustained reductions in mortality rates in developing countries, female literacy programs were of immense value in reducing maternal mortality ratios.

Adjiwanou and LeGrand (2014) evaluated gender discrimination by women's household decision-making at the individual and contextual level by permissive gender performance concerning tolerance of women's violence and assesses its effect on the use of maternal health services in rural Africa.

Majrooh, Hasnain, Akram, Siddiqui, and Memon (2014) have analyzed primary health care facilities in terms of both, scope and quality of antenatal care in Punjab Pakistan, by using a multistage sampling technique for the nine districts of Punjab. The study employed a Univariate analysis. The study showed a very insufficient coverage and efficiency of ANC services, as perceived by the clients and observed during the study, the consistency of ANC is highly impaired. More than 50% of consumers are not satisfied with their ANC Services.

Mamoon, Raza, and Arshed (2014) studied the reasons behind poor health standards in the workforce. The regional data from the Punjab region (Pakistan) indicate that the main factors that could reduce the infant mortality rate are fertility ratio, number of hospitals, education, and proxy incomes. In 2011 health levels were lower compared to 2004, according to the dummy variables of the GMM model.

Majrooh, Hasnain, Akram, and Siddiqui (2015) examined important resources mandatory in primary healthcare facilities for the provision of ANC services in Punjab, Pakistan. Univariate analysis was employed on cross-sectional data from the nine districts of Punjab. The study concluded that 28 percent of the hospitals, in general, had poor infrastructure and in 16 percent of the health facilities, equipment availability was poor. In rural health centers, infrastructure and the availability of equipment and supplies were generally better than in basic health units.

Dahiru and Oche (2015) have determined the factor that affect the utilization of antenatal care, place of delivery, and postnatal care indicators in Nigeria. The study used the DHS data for 2013 and employed both bivariate and multivariate logistic regression analysis. The findings of the study showed that, nearly four ANC visits were made by 54% of women, 37 percent delivered in health care services, and within two months of births 29 percent of newborns had postnatal
care. Maternal and husband's education, place of residence, wealth level and parity are the factor which affect these three MCH services.

John, Binu, and Unnikrishnan (2019) by applying the ordinary least squares investigated the determinants of antenatal care use in India while using district level household survey data from 2012 to 2013. The study found that there was a positive relationship between antenatal care and health infrastructure, staff, and services. The spatial trend of the percentage of pregnant women with complete ANC was found to be correlated with education and birth order.

Noh et al. (2019) examined the factor affecting the utilization of ANC in Sindh, Pakistan. Logistic regression model was used to analyze the data. The result of the study showed that 83.5% of women received one or more ANCs and 95% mainly from doctors, but only 57.3% received four or more prescribed visits and only 53.7% received initial ANCs in the first three months of their visits.

### Table 2

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Country</th>
<th>Data Type</th>
<th>Time period</th>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>Estimation technique</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillai, Maleku, and Wei (2013)</td>
<td>143 developing countries</td>
<td>Cross-sectional</td>
<td>1970-2000</td>
<td>maternal mortality ratio</td>
<td>Female literacy rate, age, GDP</td>
<td>Latent growth curve (LGC)</td>
<td>There is a negative relationship between female literacy rate and maternal mortality ratio</td>
</tr>
<tr>
<td>Fatmi and Awan (2002)</td>
<td>Pakistan</td>
<td>Cross-sectional survey</td>
<td>1997</td>
<td>Antenatal care use</td>
<td>Infrastructure and availability of equipment, essential supplies, medicines, and infection control items</td>
<td>Multivariate logistic regression analysis</td>
<td>A significant determinant of the use of antenatal care is the social status and economic situation of a woman.</td>
</tr>
<tr>
<td>Majrooh et al. (2014)</td>
<td>Pakistan</td>
<td>Multistage sampling method</td>
<td>2010-2011</td>
<td>Antenatal care use</td>
<td>Low coverage and quality, social factors, miscellaneous home services</td>
<td>Univariate analysis</td>
<td>Half of the predicted births are reported and 1/3 are dropped on follow-up visits.</td>
</tr>
</tbody>
</table>
3. THEORETICAL FRAMEWORK

Theoretical underpinnings of the current study are embedded in the healthcare services utilization model proposed by Andersen and Newman. The description of the model is given below.

![Healthcare Services Utilization Framework](image)


Figure 1 exhibits how the main components of the framework interact. Societal determinants of utilization affect the individual determinants indirectly via health services system and directly as well. Then various types of individual determinants further shape the health services utilization pattern of the individual.

The health care system provides formal health care goods and services in society. Formal health care goods and services (i.e., providing physician-, hospital-, and dental-care, drugs, health appliances, and services provided by other health care practitioners).

According to the framework, the type of volume of health service a person uses is dependent on: (1) the predisposition—due to demographic (e.g., age, gender, marital status), social structural (e.g., education, family size, occupation, religion), and attitudinal or belief
related characteristics—of the individual to use services; (2) enabling characteristics (like household income, health insurance coverage, or other source of third-party payment, accessibility to the source) which permit to satisfy a need relating to health service utilization; (3) his illness level.

4. DATA AND METHODOLOGY

Based on the theoretical framework and after going through the literature, the functional and econometric forms of the models for the current study could be specified as below:

4.1. Model Specification

\[ \text{Antenatal care} = f(\text{health infrastructure, access to improved sanitation, adult literacy rate, having own house, receiving remittances from abroad}) \]

Econometrically,

\[ \text{ANCARE}_{it} = \beta_0 + \beta_1 \text{HEALTHINFRA}_{it} + \beta_2 \text{SANITATION}_{it} + \beta_3 \text{LITERACY}_{it} + \beta_4 \text{OWNHOUSE}_{it} + \beta_5 \text{REMITTANCE}_{it} + \epsilon_{it} \]

Table 3

<table>
<thead>
<tr>
<th>Variable Code</th>
<th>Variable Name</th>
<th>Unit of Measurement</th>
<th>Expected Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANCARE</td>
<td>Antenatal care coverage at least once</td>
<td>percentage</td>
<td>Dependent Variable</td>
</tr>
<tr>
<td>HEALTHINFRA</td>
<td>Health Physical Infrastructure</td>
<td>Index constructed by making sum of total number of hospitals, dispensaries, rural health centers, and maternal &amp; child health centres</td>
<td>positive</td>
</tr>
<tr>
<td>SANITATION</td>
<td>Access to improved sanitation facility</td>
<td>percentage</td>
<td>positive</td>
</tr>
<tr>
<td>LITERACY</td>
<td>Adult Literacy 15-24 years</td>
<td>percentage</td>
<td>positive</td>
</tr>
<tr>
<td>OWNHOUSE</td>
<td>Having own House</td>
<td>percentage</td>
<td>positive</td>
</tr>
<tr>
<td>REMITTANCE</td>
<td>Receiving remittances from abroad</td>
<td>percentage</td>
<td>positive</td>
</tr>
</tbody>
</table>

4.2. Data Source

For the present study, the unit of analysis is a district. Taking into account a cross section of 35 districts of Punjab, the study has covered the yearly data from the annual reports of Punjab Development Statistics for the time period 2010 to 2016.

4.3. Estimation technique

The study used Panel GMM to estimate the effect of the explanatory variables on antenatal care use (Baum, Schaffer, & Stillman, 2003; Wooldridge, 2002). Evidence has been given that GMM estimates are compatible with the Pooled OLS model and are accurate even when there is no heteroscedasticity in the model.

5. RESULTS AND DISCUSSION

As it has been mentioned earlier that the unit of analysis for the current study is a district. Except for the health infrastructure (index) all the variables in the model specified are measured in percentages. According to the Punjab Development Statistics report 2019, the districts of Punjab have been ranked in descending order regarding the percentage of pregnant women of reproductive age received ANC services, the percentage of adult literacy, the percentage of
households having own house, using improved sanitation facilities, and receiving remittances from abroad. A color scheme comprising of dark green, light green, yellow, orange, and red colors respectively represents relatively high, medium, low, lower, and the lowest status of a district with respect to a particular variable. With the help of a cartographic software PhilCarto, the districts have been divided into five different classes by choosing an option of clustering the regions through equal frequencies. Afterward, each class has been placed in descending order and manually colored.

A Generalized Method of Moment (GMM) is used to find the empirical results. The results have shown that health infrastructure and antenatal care use are positive and significantly related to each other. It was found that in 2006 to 2012 maternal health rate increase due to higher education and belonging to the richest quintile, exposure to mass media, and availability of complete continuum of care. In Brazil found that in 1997 to 2012 maternal health rate decrease and failing to meet the MDGs. In Pakistan on Punjab level in 2013 maternal health rate decrease due to the highest social group services poorer members and the lowest social group felt pressure the use of services and face financial problems for the use of services.

Table 4

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>T statistics</th>
<th>P-Value</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEALTHINFRA</td>
<td>0.718</td>
<td>2.21</td>
<td>0.027</td>
<td>0.325</td>
</tr>
<tr>
<td>SANITATION</td>
<td>-0.036</td>
<td>-0.15</td>
<td>0.880</td>
<td>0.243</td>
</tr>
<tr>
<td>LITERACY</td>
<td>1.221</td>
<td>2.97</td>
<td>0.003</td>
<td>0.410</td>
</tr>
<tr>
<td>OWNHOUSE</td>
<td>1.927</td>
<td>3.59</td>
<td>0.000</td>
<td>0.814</td>
</tr>
<tr>
<td>REMITTANCE</td>
<td>0.417</td>
<td>-1.02</td>
<td>0.308</td>
<td>0.408</td>
</tr>
</tbody>
</table>

Diagnostic Statistics

| Sargan Hansen     | 0.267        |
| AR (1)             | 0.254        |
| AR (2)             | 0.169        |
| Exogeneity         | 0.892        |
| Exogenous (1)      | 0.240        |
| Exogenous (2)      | 0.391        |
According to the above result health infrastructure, adult literacy rate and house positively affect maternal health care (ANC).

The results show the existence of a positive and very significant relationship between the dependent and independent variables. Health infrastructure is highly significant and positively related to antenatal care, improvements in transportation, rural health centers, hospitals this helps to achieve development goals, also improved maternal health care in the case of postnatal care and prenatal care. The result shows that one unit increase in health infrastructure then 0.7187193 unit increase in maternal health due to the positive relationship between them in districts of Punjab. These findings are similar to results obtained by other studies that found health infrastructure improved maternal health care also increases. Lack of infrastructure increase the maternal death ratio, but improvements in health services equipments that are used in the hospitals due to automatically enhance maternal health care (Glatleider, 2006).

The results show that the existence of positive and very significant relation between adult literacy rate and antenatal care, how if women get married to a husband with high education, this improve the education of the population in general and women and girls in particular and availing appropriate package of maternal services. The result shows that one unit increase in education then 1.221584 unit increase in maternal health due to the positive relationship between them in districts of Punjab. Literacy rate increases then maternal health also increases. These findings are similar to results obtained by other studies that found that adult literacy rate increases maternal health care also improved. Women married to husbands with a low level of education, women from a household with no family member attending formal school, women who never experienced difficult labor, abortion/stillbirth, women who use the foot as means of transport, improving the education of the population, availing appropriate package of maternal services to use of maternal health care services (Hou & Ma, 2013; Zelalem Ayale, Belayihun, Teji, & Admassu Ayana, 2014).

The results show the existence of positive and highly significant relation between house and ANC, people own their house they show the financial condition of the household, and expect they can provide better facilities to their family, due to maternal health increase. The result shows that one unit increase in ownership of house then 2.927751 unit increase in maternal health due to the positive relationship between them in districts of Punjab. These findings are similar to results obtained by other studies which found that ownerships of house increase maternal health (Han, Nunes, & Drèze, 2010; Mamoon et al., 2014).

6. CONCLUSION AND POLICY SUGGESTIONS

The results have shown that health infrastructure and maternal health care are positive and significantly related to each other. Improvements in transportation, rural health centers, hospitals this helps to achieve development goals, also improved maternal health care in case of postnatal care and prenatal care, the studies of these all writers are in favor of health infrastructure improve then maternal health care also improve. Lack of infrastructure increase the maternal death ratio, but improvements in health services equipments that are used in the hospitals due to automatically enhance maternal health care (Glatleider: 2006). Ownership of house is also positively related to maternal health, in case ownership of house shows the wealth status of the people if they have strong wealth status then they avail the maternal services regularly due to maternal health improves. Rental areas and low-income families are at exceeded risk from health problems and other health and welfare risks. Poor housing conditions have a long-term effect on physical conditions (Chamberlain & MacKenzie, 2001). Education is a powerful factor that positively affects the maternal health if women have educated then properly attend the visits during pregnancy for the good health of mother and child. Women married to husbands with a low level of education, women from a household with no family member attending formal school, women who never experienced difficult labor, abortion/stillbirth, women who use the foot as means of transport, improving the education of the population, availing appropriate package of maternal services to use of maternal health care services (Hou & Ma, 2013; Zelalem Ayale et al., 2014).
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