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Demographic and Socio-economic Characteristics Impact on Fertility in Pakistan

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Fertility is the actual reproductive performance of an individual, a couple which determines the country's population size. Pakistan is the 5th most Populus country in the world with high fertility rate in regional countries. The trustworthy secondary data were taken from National Institute of Population Studies, Pakistan and analyzed. The mean and standard deviation of children ever born (CEB) was estimated 3.2±2.41. Poisson and logistic regression models were applied to study the substantial role of eight socio-economic and demographic variables regarding CEB. Poisson regression illustrated that contraceptive and length of marriage positively correlated with CEB, whereas the women education, age at marriage and wealth index showed an inverse relationship with CEB. The women education i.e., illiterate, primary education, secondary education and higher education is 50%, 13.9%, 20.8% and 15.3% and the corresponding mean CEB are 2.73, 2.48, 2.34, and 2.16, respectively. The logistic regression model demonstrated the negative relation between the odds ratio and women education and age at marriage while the family size and length of the marriage were found to be positively correlated. If the respondent remains married for 10+ years, the odds ratio of having a large family is increased by a factor of 21.352 keeping the effect of other variables kept constant. The fitted parsimonious logistic regression model's correct classification for small family, large family and overall are 82.3%, 83% and 82.7% respectively. The findings, thus, have enormous implications for the Government and Population welfare Departments about policies formulations .

Keywords: Poisson and Logistic regression, Children ever born, education

The rapid population growth has become a very critical issue globally and especially in developing nations like Pakistan, India, Bangladesh etc. Pakistan is being struggle with the issue of population growth since its inception. In 1947, the population of Pakistan was 32.5 million and ranked the world's 13th most populous nation (Afzal, 2009; Elahi, 2012). In 2020, the Pakistan was ranked the 5th most Populus country with an estimated population of 215.25 million out of which 61% population in the age of 15-64 years. It indicates that Pakistan has high population growth rate and infant mortality

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rate i.e., 1.9 and 55.7 respectively which are at highest position among all regional countries except Afghanistan. Although, these rates are decreased during the last three years, even then are very high. On the other hand, Pakistan has very limited resources and the increasing population trend is putting a substantial pressure on its resources (Economic Survey, 2020). The total fertility rate in Pakistan with slight decline was 3.6 births per women during 2017-18 which was 3.8 in 2012-13 (NIPS, 2018). Almost similar alarming situation of extraordinary burden over its limited resources was also indicated in the study of population growth (Elahi, 2012). Total fertility rate is closely correlated with population growth rate and considered to be very good predictor of a country's future population pattern (Getis & Fellmann, 2004). Fertility analysis helps to understand about social status and population densities of a country. This information has its significance for the Governments upcoming population and development policies. Sathar and Casterline (1998) mentioned that the Government of Pakistan is trying to limit the population growth via different population welfare programs since 1960, However, the targets may not be achieved yet as desired. Kamal and Pervaiz (2011) Hakim (1994) reported that government of Pakistan failed to achieve the population welfare targets due to different energy crises like electricity, gas etc. as well as noncooperation of the society about small family size. The author also mentioned, there is need to critically review the demographic and socio-economic variable who effect the fertility. The most important is that convincing of the society about small family and implementation of population welfare programs by any means. Afolayan and Afolayan (2009) explored the psycho-social factors influencing the acceptance of family planning methods in young adults. The study revealed that religion, culture, knowledge of reproductive health services, dangers of abortion and accessibility to family planning facilities are some major psycho-social factors influencing family planning. Zakria et al., (2013) analyzed fertility pattern of Pakistan for the period between 1984 and 2007 using the Hadwiger function as well as the Peristera and Kostaki model. The gross reproduction rates (GRR), age specific fertility rate (ASFR) and TFR were also discussed in this study. Nesa and Islam (2009) discussed the four variables i.e., wealth index, women's education, region of residence and place of residence to analyze the fertility pattern of Bangladesh. Muhammad et al., (1999) looked into the married women attitude about contraception. The factors connected to the use of contraceptives were proposed to be included in a parsimonious log-linear model. Contraceptive use was found to be strongly correlated with women's education and family income. Zakria et al., (1999) illustrated the relationship between various socioeconomic and demographic factors and the fertility paradigm. It was categorical mentioned that women education may be considered the most crucial factor in slowing the population growth. Wei et al., (2018) studied the socioeconomic factors that affect desired fertility of rural women in Shaanxi, China. The results of a multi-stage stratified sampling procedure on a sample of 2,516 women revealed that the mean lifetime desired fertility for rural women is approximately 1.71, which is lower than the total fertility rate at the replacement level. The financial cost of having children, age at marriage, and social security benefits have a significantly inverse relationship with desired fertility. Jalil and Zakar (2016) used the binary logistic regression to study the risk factors of low birth weight and analyzed the pregnancy intent, breast feeding, mode of delivery, antenatal care utilization and demographics characteristics i.e., age, education, and type of place of residence. The findings indicated that mother’s illiteracy, age, rural place of residence, unintended pregnancy, breastfeeding and utilization of antenatal care are significant risk factors of low birth weight. Khattak (2019) discussed the variations in fertility preferences using time series data by ARDL model. It was found

that fertility is positively associated with infant death rate and participation of female in labor force while it is inversely related with real income, unemployment, inflation, and GDP growth rate. Nahar et al., (2019) analyzed the determinants of fertility in Bangladesh by using cumulative fertility approach. It was strongminded that being Muslim, age at first birth, illiteracy, no access to mass media, use of contraceptives are associated with children ever born. Laksono and Wulandari (2021) used the data of 34,353 childbearing age couples to analyze the factors affecting the family size in Indonesia. The binary logistic regression was performed. The findings are consistent with that of the studies (Zakria et al., 1999). Keeping in view the significance of population issues, specifically the fertility sphere, the Pakistan children ever born secondary data along with other socioeconomic and demographic factors were analyzed using the passion regression and logistic regression and examined the impact of important variables towards family size determination.

Method

Data Description

The most authentic and reliable source of population data, Pakistan Demographic and Health Survey (PDHS), published by the National Institute of Population Studies (NIPS), Islamabad were taken and analyzed (NIPS, 2018). The updated data included 3334 ever been married women along with eight key socio-economic and demographic variables. According to the objectives of the study and nature of the data, the two most appropriate statistical models i.e., Logistic and Poisson regression models have been applied. Zhang (2011) provided an illustration of the Poisson regression model in the following mathematical form:

$$\mu_i = \exp\left(a + X_{1i}b_1 + X_{2i}b_2 + \cdots + X_{ki}b_k\right)$$

Where μ_i represents the distribution's mean, a is a constant, and b denotes the group's variance from the reference category's mean. The relationship is nonlinear among explanatory variables and the mean number of children (μ_i). The Children ever born (CEB) is regarded as the response variable in Poisson regression analysis.

Similarly, Agresti (1996) described the following general mathematical form of logistic regression model:

$$\log\left(\frac{p}{1-p}\right) = logit(p) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ \ldots\ldots\ldots\ldots\ +\beta_p X_p$$

The total number of children born per family are divided into two groups to make the response binary i.e., small families (≤ 2 Children) and large families (2+ children). The remaining eight variables i.e., age at marriage, length of marriage, education of women, wealth index, employment status, use of contraception, region, and place of residence are regarded as explanatory variables. The logic behind to use the logistic regression is to predict the correct classification % regarding family size preference of the respondents.

Results and Discussion

Table 1

Summary Statistics of Total Number of Children Ever Born

Total No. of Women	Mean CEB	S.D.	Mode	Median	$X_{(1)}$	$X_{(n)}$
3334	3.20	2.41	2	3	0	13

Table 1 summarized the basic statistics of total number of children ever born. There are 3334 women in total, with a maximum of 13 CEB and 0 minimum, while most of the women have two children, the mean and median numbers of CEB are 3.20 and 3, respectively. The average dispersion among all cases is 2.41.

Table 2

Estimates of Poisson Regression Model and Test Statistics

Categorized Variables		Women %	Mean CEB	B	Wald Chi-Square	d.f	P-value	Exp(B)
Intercept		-	-	0.602	221.998	1	0.000	1.826
Age at marriage					40.456	3	0.000	-
< 20		56.8%	2.85	Ref.				1
20 – 24	(AM_2)	31.3%	2.56	-0.106	20.713	1	0.000	0.899
25 – 29	(AM_3)	9.9%	2.38	-0.178	18.214	1	0.000	0.837
30+	(AM_4)	2.0%	1.98	-0.363	13.156	1	0.000	0.695
Marriage Duration					1700.956	1	0.000	-
<10		49.0%	1.49	Ref.				1
10+	(MD_2)	51.0%	3.94	0.973	1700.956	1	0.000	2.646
Women Education					43.140	3	0.000	-
Illiterate		50.0%	2.73	Ref.				1
Primary	(WE_2)	13.9%	2.48	-0.095	9.929	1	0.002	0.909
Secondary	(WE_3)	20.8%	2.34	-0.151	23.814	1	0.000	0.860
Higher	(WE_4)	15.3%	2.16	-0.233	34.175	1	0.000	0.792
Wealth Index					23.987	2	0.000	-
Low		40.8%	2.61	Ref.				1
Medium	(WI_2)	19.3%	2.40	-0.084	9.144	1	0.002	0.919
High	(WI_3)	39.9%	2.26	-0.146	23.223	1	0.000	0.864
Work Status					0.000	1	0.986	-
Not Working		87.5%	2.42	Ref.				1
Working	(WS)	12.5%	2.42	-0.001	0.000	1	0.986	0.999
Contraceptive					167.922	1	0.000	-
Non-User		63.5%	2.12	Ref.				1
User	(C_U)	36.5%	2.77	0.268	167.922	1	0.000	1.308
Region					16.655	7	0.020	-
Punjab		22.2%	2.38	Ref.				1
Sindh	(R_S)	21.9%	2.33	-0.020	0.417	1	0.518	0.980
KPK	(R_K)	14.1%	2.52	0.058	3.020	1	0.082	1.060
Balochistan	(R_B)	14.4%	2.59	0.087	6.627	1	0.010	1.091
GB	(R_G)	5.7%	2.33	-0.019	0.179	1	0.673	0.981
ICT	(R_I)	6.2%	2.31	-0.029	0.370	1	0.543	0.972
AJK	(R_A)	8.9%	2.39	0.005	0.016	1	0.898	1.005
FATA	(R_F)	6.5%	2.53	0.061	1.938	1	0.164	1.063
Place of Residence					0.031	1	0.861	-
Rural		49.8%	2.42	Ref.				1
Urban	(PR_U)	50.2%	2.41	0.004	0.031	1	0.861	1.004

Ref: Reference Category

Tables 2 revealed the parameter estimates and test statistics at each level of explanatory variable using the Poisson regression. Most of the variables are categorized into two categories while the wealth index into three categories. The remaining variables i.e., women's education, region and age at marriage each one is categorized into four categories. The average CEB to women aged below 20 was 2.85. The parameter estimate's negative sign illustrates an inverse relationship between mean CEB and age at marriage whereas the relationship between marriage duration and mean CEB is positive. Pakistan's overall literacy rate is around 59 percent while the literate women percentage is only 47. It is an indication towards challenging circumstances for Pakistan. The women education i.e., illiterate, primary education, secondary education and higher education is 50%, 13.9%, 20.8% and 15.3% and the corresponding mean CEB are 2.73, 2.48, 2.34, and 2.16, respectively. It supports that mean CEB and education have an inverse relationship. There is also a negative relationship between wealth index and mean CEB. Additionally, the results show that only 12.5% of respondents are working whereas a major % of the respondents is not working. Surprisingly, the mean CEB of both groups are exactly same. Similarly, the contraceptive user has also shown an intriguing pattern. The contraceptive users have a higher mean CEB than non-users. It could be because the respondents typically start using contraceptives after having the desired number of children. It shows that contraceptive methods are used to prevent unwanted pregnancies or for spacing between births only rather than to reduce the size of the family. Similarly, the women % in different areas of the region as well as the place of residence are different, but the mean CEB are approximately same, it again supports the mentality of large family size preference. To investigate the impact of various socioeconomic variables on the mean number of CEB, the Poisson regression model was fitted. Only two variables work status and place of residence were found to be non-significant in explaining Pakistan's fertility pattern. The parameter estimates with P-values are given in Table 2, and the parsimonious Poisson regression model is as follows

$$\mu_i = \exp(0.602 - 0.106AM_2 - 0.178AM_3 - 0.363AM_4 + 0.973MD_2 - 0.095WE_2 - 0.151WE_3 - 0.233WE_4 - 0.084WI_2 - 0.146WI_3 + 0.268C_U + 0.087R_B)$$

The relative rate of having more children is 0.899, 0.837 and 0.695 times higher for women who got marry at ages 20-24, 25-29 and 30+ respectively as compared to the reference category and keeping the effect of other variables kept constant. The outcomes are in line with the research findings (Hakim, 1994; Hakim, 1999; Kamal & Pervaiz, 2011; Khraif, 2001; Maitra, 2004; Weerasinghe & Paar, 2002). Since the marriage duration mean CEB are positively. The odds having more children is 2.646 times more than the reference group w.r.t. the length of the marriage. It should not come as a big surprise that fertility and marriage length have a strong positive relationship. Other polygamous Muslim nations like Bangladesh, the United Arab Emirate (UAE), Kingdom of Saudi Arabia and other Muslim countries illustrate similar fertility pattern. The Muslim clergy encourages marital couples to maintain long-term relationships for more children. The outcomes are in line with the studies (Atella & Rosati, 2000; Hashmi & Zafar, 1997; Khraif, 2001). The women with primary, secondary and higher education have relative childbearing rates i.e., 0.909, 0.860, and 0.792 times higher than the illiterate women. The mean CEB and the wealth index are negatively correlated and have a relative rate of having more children i.e., 0.919 and 0.864 times higher than that of the low-income women. The reason behind this belief among low-income couples that children are assumed to be an asset and a comfort during difficult times. The findings are

in line with the studies (Akpa & Ikpotokin, 2012; Hakim, 1999; Kamal & Pervaiz, 2011; Nesa & Islam, 2009; Weerasinghe & Paar, 2002). As far as the contraceptive user respondent, they have 1.308 times higher relative rate of more children than non-users. It indicates that, in Pakistan, contraceptive methods are used only after achieving the desired family size, not to reduce the family size. Furthermore, the religious beliefs discourage the contraceptive use to reduce the family size. The findings show that women from Balochistan and KPK are more likely to have multiple pregnancies than Sindhi, Punjabi, and other women. The outcomes are almost identical to those of the study (Hakim, 1994). The federal and provincial governments may not only attempt to reduce population growth rate, but also support and encourage the idea of small family norms. Consequently, to reduce the undue extra population pressure on limited resources.

Table 3

Parameter Estimates of Logistic Regression and Their Test Statistics

Categorized Variables		Percentage of Women		B	Wald Chi-Square	d.f	P-value	Exp(B)
		Small Family Size (≤2)	Large Family Size (>2)					
Intercept		-	-	-0.995	43.483	1	0.000	0.370
Age at marriage					16.217	3	0.001	-
<20		20.5%	36.3%	Ref.	-	-	-	1
20 – 24	(AM_2)	16.1%	15.2%	-0.300	7.179	1	0.007	0.741
25 – 29	(AM_3)	6.2%	3.7%	-0.390	5.017	1	0.025	0.677
30+	(AM_4)	1.5%	0.4%	-1.153	9.234	1	0.002	0.316
Marriage Duration					912.226	1	0.000	-
<10		37.9%	11.2%	Ref.	-	-	-	1
10+	(MD_2)	6.4%	44.5%	3.061	912.226	1	0.000	21.352
Women Education					26.336	3	0.000	-
Illiterate		18.4%	31.6%	Ref.	-	-	-	1
Primary	(WE_2)	5.4%	8.5%	-0.126	0.641	1	0.423	0.881
Secondary	(WE_3)	10.9%	9.9%	-0.451	9.426	1	0.002	0.637
Higher	(WE_4)	9.6%	5.7%	-0.876	24.470	1	0.000	0.416
Wealth Index					6.644	2	0.036	-
Low		15.7%	25.1%	Ref.	-	-	-	1
Medium	(WI_2)	8.0%	11.2%	-0.178	1.526	1	0.217	0.837
High	(WI_3)	20.5%	19.4%	-0.394	6.630	1	0.010	0.674
Work Status					0.273	1	0.601	-
Not Working		39.5%	48.0%	Ref.	-	-	-	1
Working	(WS)	4.8%	7.7%	0.081	0.273	1	0.601	1.084
Contraceptive					187.927	1	0.000	-
Non-User		35.0%	28.6%	Ref.	-	-	-	1
User	(C_U)	9.3%	27.1%	1.540	187.927	1	0.000	4.663
Region					12.351	7	0.090	-
Punjab		9.5%	12.7%	Ref.	-	-	-	1
Sindh	(R_S)	11.2%	10.7%	-0.388	6.653	1	0.010	0.679
KPK	(R_K)	5.9%	8.2%	0.055	0.105	1	0.746	1.056
Balochistan	(R_B)	5.8%	8.6%	-0.041	0.055	1	0.814	0.960
GB	(R_G)	2.5%	3.3%	-0.319	1.794	1	0.180	0.727
ICT	(R_I)	3.0%	3.3%	-0.194	0.760	1	0.383	0.823
AJK	(R_A)	4.0%	5.0%	-0.042	0.046	1	0.830	0.958
FATA	(R_F)	2.6%	3.9%	0.076	0.118	1	0.731	1.079
Place of Residence					0.030	1	0.863	-
Rural		23.5%	26.7%	Ref.	-	-	-	1
Urban	(PR_U)	20.8%	29.0%	0.020	0.030	1	0.863	1.020

Ref: Reference Category

Table 3 displayed parameter estimates and test statistics at each level of explanatory variable using the Logistic regression. The acronyms and categorization of each variable is the same as that of Table 2. The analysis indicated that there is negative correlation between the age at marriage and family size. The percentage frequency distribution of a large family size is 36.3%, 15.2%, 3.7% and 0.4% w.r.t to the age at marriage i.e., <20, 20-24, 25-29 and 30+ respectively. There is approximately 44.5% women who remain married for 10+ years have a large family while only 11.2% of women who remain married <10 years have small family. It established the positive correlation between the size of the family and the length of the marriage. The analyses illustrated that the women's educational attainment regulates the family size. Lesser the educational attainments, greater the family size preferences and vice versa. The large family size preferences % are 31.6%, 8.5%, 9.9% and 5.7% w.r.t. the illiterate, primary, secondary and higher respectively. On the other hand, with the increase of wealth, the % about larger family decreases slightly from 25.1% to 19.4%. There is only 7.7% working women preferred large family. Contrary, the 48% housewives preferred the large family. The results of contraceptive user respondents are very unexpected. Only 9.3% contraceptive users have small family while 27.1% have large family. As far as provincial perspective, Punjab, Sindh, KPK and Balochistan preferences % about large family 12.7%, 10.7%, 8.2% and 8.6%. The respondent's categorization about small or large family may be predicted based on socio-economic and demographic variables analysis using the logistic regression model. The four variables i.e., region, place of residence, wealth index and work status have non-significant impact on fertility while the other four variables i.e., marriage duration, age at marriage, women education and contraceptive have significant impact on fertility. The parsimonious logistic regression model is as under:

$$logit\left(\frac{p}{1-p}\right) = -0.995 - 0.300AM_2 - 0.390AM_3 - 1.153AM_4 + 3.061MD_2 - 0.451WE_3 - 0.876WE_4 - 0.394WI_3 + 1.540C_U - 0.388R_s$$

Table 3 revealed that there is inverse relationship between family size and age at marriage. In comparison to the reference category, the odds ratio rises by a factor of 0.741, 0.677 and 0.316 for respondents' preference about large family w.r.t got marry at age 20–24, 25–29 and 30+ years respectively holding the effects of other variables kept constant. The findings are in line with the studies (Hasan & Sabiruzzaman; 2008; Rahman et al., 2008)). Similarly, If the respondent remains married for 10+ years the odds ratio of having a large family is increased by a factor of 21.352 keeping the effect of other variables kept constant. It indicates that the likelihood of having a large family rises with long marriages. These findings are consistent with the studies (Atella & Rosati, 2000; Hashmi & Zafar, 1997; Khraif, 2001). Women Education and CEB are negatively correlated with each other. The findings indicate that the lower the education level, higher the fertility. The findings demonstrate that women with primary, secondary, and higher education are less likely than illiterate women to have large families. Hasan and Sabiruzzaman (2008) and Rahman et al., (2008) reported almost similar findings. The study also depicted that the contraceptive and fertility are positively correlated. The odds ratio indicated that the contraceptive users are 4.663 times more likely to have large families than non-users. It seems that contraceptive is not used to reduce the family but rather used only after a desired number of children or family completion. In other words, the contraception may be considered to space out pregnancies rather than to prevent them. The findings are in agreement with the studies (Butt & Jamal, 1993; Hashmi &

Zafar, 1997; Kamal & Pervaiz, 2011). Furthermore, the religious convictions also discourage the contraceptive uses.

Table 4

Comparison of Null and Parsimonious Logistic Regression Model

Observed		Predicted (Null)		Predicted (Logistic Model)		Overall Correct (%)
		Family Size		Family Size		
		Small (≤ 2)	Large (>2)	Small (≤ 2)	Large (>2)	
Family Size	Small (≤ 2)	0	1477	1215	262	82.3%
	Large (>2)	0	1857 (100 %)	316	1541	83.0%
Overall Correct (%)		**55.7 %**		**82.7 %**		

Table 4 revealed that the null model overall correctly classified only 55.7% cases. It indicates that the null model has no practical significance in classifying the case. There is total 1477 women with small family and 1857 women with large family. The parsimonious logistic regression model correctly classified the small family and large family by 82.3% and 83% respectively. There are only 17.7% and 17% cases are misclassified. The overall correct classification by logistic model is 82.7% and may be considered to have a better fit to the data than the null model. Peng et al., (2002) demonstrated the model's strength and goodness of fit up to 27% correct prediction. In addition, Nagelkerke R^2 was also estimated i.e., 56.4% and concluded that the fitted model is parsimonious. Islam and Rahman (2010) also illustrated the significance of Nagelkerke R^2 for the goodness of fit of logistic regression model.

Conclusion and Recommendations

Poisson and logistic regression models were applied to study the substantial role of eight socio-economic and demographic variables regarding the children ever born and family size preferences. The most authentic and reliable secondary data were taken from Pakistan Demographic and Health Survey 2016-17 (NIPS, 2018) and analyzed. Poisson regression model illustrated that Age at marriage, wealth index, marriage duration, women's education and contraceptive are statistically significant in context to the CEB. Furthermore, the contraceptive and length of marriage were found to be positively correlated with CEB. On the other hand, the women education, age at marriage and wealth index showed an inverse relationship with children ever born. It may be assumed that contraceptives had been used to postpone the pregnancy or after the completion of desired family size, not to reduce the family size. The logistic regression model demonstrated that the factors age at marriage, length of marriage, women education and contraceptive disclosed significant impact on family size preference. In addition, it was observed the negative relation between the odds ratio and women education and age at marriage. However, family size and length of the marriage were found to be positively correlated. Consequently, the fitted parsimonious logistic regression model's correct classification for small family, large family and overall are 82.3%, 83% and 82.7% respectively. The findings, thus, have enormous implications for the Government and Population welfare Departments about policies formulations. The women education may

be encouraged to upsurge the age at marriage and lessening the childbearing years to limit the family size.

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