ISSN No:-2456-2165

Structural Equation Modeling of Factors Influencing Fertility among Married Women of Reproductive Age in Kaduna State, Nigeria

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Abstract:- The consistent high fertility rate in Kaduna state remains an issue of public health concern due to its effect on maternal and child mortality. This study developed a structural equation model of factors influencing fertility in Kaduna state, Nigeria. PMA2020 cross-sectional household survey of women of reproductive age 15-49 years were used. Descriptive statistics were used to describe the study participants and the structural equation model was built using AMOS statistical package at 5% level of significance. The mean age of respondents was 29 (SD=5.5) years. Age at first birth had direct negative influence on children ever born (β=-0.014) and it influences CEB indirectly through contraceptive use (β=0.005). The study has demonstrated that education and religion are fundamental factors influencing age at first birth, contraceptive use and fertility. Therefore, campaign aimed at encouraging contraceptive use and discouraging early marriage should be spread across various religious groups in Kaduna state.

Keywords*: Fertility, Contraceptive, Age at First Birth, Women of Reproductive Age, Structural Equation.*

I. INTRODUCTION

Fertility is being determined by the actual birth performance and or the demand for children. It is a measure of rate at which population increases by relating number of births to size of some selection of population such as number of married couples or number of women of child bearing age (Gupta 2001). The TFR of 6.7 estimated in 2013 DHS for North-West Nigeria where Kaduna is a stakeholder is high, even by the principles of developing countries which places high fertility on five children and above (Casterline 2010). High fertility poses health risks for mothers and their children, reduces from human capital investment, delays economic growth, and aggravates environmental threats (United Nations 2011). Previous studies have documented some of the factors that have contributed to sustained high levels of fertility in Kaduna state like other typical African society. These include early and universal marriage, child mortality, high social value attached to child bearing, low acceptance of contraception and early child bearing (Ozumba 2012, Adebowale et al 2011). A study on fertility in Nigeria observed a wide variation in fertility by socio-demographic characteristics and region. North Western and North Eastern part of the country were placed on the high spot compare to the observed level of fertility in the Southern part of the country (Okonofua and Ogu 2014). The findings of a study on fertility behaviour of men and women in three communities in Kaduna state reveal that the TFR for Kaduna state was 7.97, which was higher than TFR of 7.3 reported for the state in the 2008 NDHS (Adiri et al 2010). According to the report of NDHS series, early childbearing, particularly among teenagers has been consistently high in North western region in Nigeria. It was 54.7% in 1999, 45.2% 2003, 44.6% in 2008 and 35.7% in 2013. Perhaps, this has contributed to the consistent high level of maternal and childhood mortality recorded in the region over the years. The state is characterized by both less demand for and access to reproductive health services. The level of women's literacy is exceedingly low in Kaduna and in North West generally. About 90% of women have at least primary education in the southern region, but the level for women in the core-North was between 25% and 30%. Women's exposure to mass media and social activities are also lower in the core Northern part of Nigeria (DHS 2013).

The population of the country, Nigeria is tied to her fertility level, the sustained high levels of fertility observed for the North-west region where Kaduna is located and the resultant rapid population growth in the region constitute a serious threat to the socio-economic wellbeing and standard of living of its residents. This justifies the need to study factors responsible for the level of fertility in Kaduna, North West, Nigeria. The mechanism of factors influencing fertility is that intermediate variables influence fertility directly, while socioeconomic and demographic variables influence fertility through intermediate variables (Kassar et al 2013). However, most studies on fertility in Nigeria used approaches that assume direct factors rather than indirect factors (such as Chi-square, Weighted regression, Ordinary Lease Square and Logistic Regression etc.) to identify factors influencing fertility (Olatoregun 2014, Motlatso 2016, Alaba 2017). Therefore, this study sought to explore the interrelationship between background characteristics of women and fertility in Kaduna using the Structural Equation Model (SEM), as its use scarce in fertility literature in Nigeria.

ISSN No:-2456-2165

II. METHODS

Study Area

The study was conducted in Kaduna State, North-West, Nigeria. The state is located in the region where TFR has consistently reported to be the highest from 1991-2013 in Nigeria (Olatoregun 2014). The region is predominantly of people of Hausa/Fulani ethnic groups. However, Igbo and Yoruba people are also present in the region. Islam is the main religion of the people in the region but Christianity is also practiced, especially by the southerners living in the state. The government manages the public healthcare system in the state, as in other states in Nigeria, and the health system is characterized by poor equipment supply, lack of essential drugs and inadequate health workers which is the situation for any state in Nigeria but Kaduna is among the most affected state. In some situations, patients pay for certain services that are officially meant to be accessed free. Many people, particularly the poor have been prevented from accessing health facilities due to harsh economic conditions. In such situation, access to basic primary health care services like family planning, antenatal, maternal and child care services that can create an opportunity for women to learn more about the issues around family size is limited, particularly among women that live in the remote part of the state.

Study design/sampling technique

The study was retrospective cross-sectional in design. The data used for this study contained a sample of 2570 ever married women of reproductive age (15-49 years), were drawn from 2014 survey data set of PMA2020. In the main study, a two-stage cluster design with typically urban-rural and major regions as the strata was used for the survey sample. Ahead of data collection, key landmarks and households in each enumeration area were listed and mapped by resident data collectors. Systematic random selection procedure was used to sample households for inclusion in the survey. In each household, women of reproductive age (15-49 years) were asked questions about their background, their birth history and fertility preferences, their use of family planning methods, their reproductive health, and other information that is helpful to policymakers and program administrators in family and reproductive health improvement.

Study variables

In this study, the independent variables were: age, residence, education, marital status and religion as socioeconomic variables. And these have been used by previous authors (Mahsa et al. 2018, Islam et al., 2016). Due to limited number of variables available in the data set, only age at first birth and contraceptive use were considered as mediating variables. The dependent variable used was children ever born as a proxy for fertility.

Data collection procedures

In the main survey, female data collectors who hold minimum of a high school diploma and typically over 21 years of age were recruited not far away from respective EAs. They visited each of the selected household to collect data from each of the eligible women base on the already stated guidelines. The data collection took about six weeks to obtain the data from service delivery points, selected households and eligible women. Unlike DHS, PMA2020 used an open source software specially designed to facilitate data collection via the mobile-assisted platform. This enabled the transfer of the data from the smartphones into a central cloud server via mobile data network. Data were validated and aggregated in real-time.

Data processing and analysis

Data editing was accomplished using the Statistical Package for Social Sciences (SPSS) software version 21.0. Data were examined for set of missing values and outliers and the missing values were handled using maximum likelihood estimation method in AMOS program version 20.0 where SEM was conducted. Descriptive statistics of Socio-economic and Demographic characteristics, Contraceptive use and other selected variables were presented using frequency distribution, mean and standard deviation. Test of association was also carried out to determine the relationship between the respondents' background characteristics and fertility. Analysis of Moment Structures (AMOS) 20.0 program was used for structural equation modeling (SEM). Estimating coefficients in SEM was channeled through Maximum Likelihood Estimation (MLE) method. Maximum Likelihood Estimation is an iterative procedure that attempts to maximize the likelihood that obtained values of the criterion variable will be correctly predicted unlike Ordinary Least Square (OLS) that minimizes the squared deviations between values of the criterion variable and those predicted by the model (Ingram 1989). Model fitness was evaluated using the criteria in table 1.

Ethical consideration

The data originators received informed consent from the participants before interviewing them. The author obtained the approval from PMA2020 for permission to use the data before analysis.

III. RESULTS

Background characteristics of respondents

Table 2 shows the background characteristics of the respondents. The result reveals that mean age of respondents was 29.0 years, majority of the respondents (75.4%) were between the ages 25-34 and more than one-tenth (10.7%) were within the age group 35 and above. According to Education background of women, least proportion (7.6%) of the women attained the higher level of education while more than one-third (35.1%) had no formal education. About two-third (66.5%) of respondents were living in the rural area. Majority (73.9%) of the respondents were Muslims while others were either Catholic, Protestants or traditional worshipers. Also, small number (3.1%) of the women were not currently married, majority (62.6%) of them were Hausa. According to Wealth quintile, the percentages were close across all the groups. Respondents on lowest, middle and highest quintile were 20%, 19.9% and 19.4% respectively.

ISSN No:-2456-2165

Furthermore, nearly four out of every five (79.9%) respondents reported to have never used any method of contraceptive as at the time of survey. More than half (59.9%) of the women reported to have started having sex before age 20 and more than one out of twenty (5.4%) of respondents had first sex after age 25. Lastly, more than one-fifth (26.8%) of respondents claimed that they have not begun childbearing.

Test of association between the selected independent variables and CEB

Table 3 shows the percentage distribution of number of children ever born by background characteristics of respondents and the test of association between respondents' background characteristics and number of children ever born. According to education background of respondents, the proportion of women who have born up to five children among those attained higher education was 10.3%, while those with no education had the highest proportion (28.4%). More than 50% of women below 35years of age had 2 children or less. The proportion of women in urban areas (25.2%) who have born 3 to 4 children was higher than the rural proportion (22.6%). About 43% of the currently married women gave birth to 3 children or more. The proportion of muslim women (56%) who born 2 children or less was lesser than the proportion (58.9%) among other faiths. Women in low wealth quintile had the highest proportion (23.0%) of 5 children or more, compare to 18.0% and 17.8% of those in the middle and high quintile respectively.

The chi square statistics (p value) shows the statistical significance between children ever born education (P=0.000), age (P=0.028), place of residence (P=0.05), marital status (P=0.032), religion (P=0.041), contraceptive use (P=0.000) and age at first birth (P=0.000). The associations between children ever born and the other three variables (ethnicity, wealth quintile and age at first sex) were not statistically significant.

Path Analysis

The test of association carried out on predictors of fertility revealed non-significant relationship between children ever born and age at first sex and ethnicity. Other variables having significant association with number of children ever born were considered in the model. Figure 1 shows the estimated path coefficients and residual path coefficients along with their arrows (paths) which represent the direct effect of independent variables on dependent variables. Eleven hypothesized paths were designed based on the recursive linear regression model. Three paths among them (Maternal education, Religion and Place of residence) assume direct effect on Age at first birth; six paths (Current age, Maternal education, Place of residence, Religion, Marital status and age at first birth) hypothesize direct effect on Contraceptive use; and finally two paths (Age at first birth and contraceptive use) have also hypothesized direct effect on fertility (CEB).

Standardized and unstandardized coefficients for the structural model by group of variables

The standardized and unstandardized weight for each of the relationships between variables and the proportion of variations in dependent variables explained by their predictors are presented in Table 4 below. The influence of Education and Religion on Age at first birth (AFB) were negative (β=-0.014; -0.022) while the relationship between Place of residence and Age at first birth was positive. Also, total effects of Education, Marital status and Age at first birth on Contraceptive use were positive but not significant (β=0.008; P>0.05, β=0.029; P>0.05 and β=0.034; P>0.05). Total effects of Current age, Religion and Place of residence were negative and not significant (β=-0.019; P>0.05, β=-0.005; P>0.05 and β=-0.006; P>0.05). Also, Age at first birth had negative influence on children ever born (β=-0.014). Total effect of contraceptive use on children ever born was negatively significant (β=-0.140; P=0.001). This implies that number of children ever born reduces with increase in contraceptive use.

The hypothesized model indicates that Women education explained to 63% of the variance in Age at first birth (R^2=0.625, Z<1.96). However, Religion and Place of residence insignificantly explained about 92% and 93% of variance in Age at first birth (R^2=0.915, Z<1.96; R^2=0.932, Z<1.96) respectively. Considering contraceptive use, the independent variables (Women education, Marital status, Age at first birth, Place of residence, Current age and Religion) insignificantly explained up to 99% of variation in Contraceptive use (R^2=0.998, 0.998, 0.999, 0.999, 0.999 and 0.999; Z<1.96). Furthermore, contraceptive use significantly explained about 99% (R^2=0.999; Z<1.96) while age at first birth insignificantly explained up to 99% (R^2=0.999; Z>1.96) of variation in children ever born.

Direct and indirect relationship between independent variables and CEB

The relationship between the selected socio-demographic characteristics and children ever born is presented in Table 5 below. Two variables (Education and Marital Status) hypothesized indirect positive relationship with Children ever born. This implies that a unit change in education and marital status indirectly brings about changes in number of children ever born by 0.001 and 0.004 respectively. Place of residence and Current age assume indirect negative relationship with Children ever born.

Goodness of Fit of the Model

As presented in Table 6 below, the fit indices imply a well acceptable model fit with the data, as evident in the following measures of goodness of fit: (χ2, 14.843; P=0.317); GFI=0.999; NFI=0.962; CFI=0.955 and RMSEA=0.007. As a result of these, the null hypothesis that the observed covariance matrix is equal to the hypothesized covariance matrix was retained.

IV. DISCUSSION

In this study, the mean age of respondents was twenty-nine years, more than one-third had no formal education, more than two-third were rural dwellers, less than five percent were not currently in union and about four out of five had never used contraceptive.

The findings of this study revealed that female education, place of residence, religion, marital status and age were socio-demographic characteristics of respondents which have significant relationship with fertility. This result is not far from the findings of previous studies in Nigeria. For instance, Skirbekk 2008 who found significant relationship between fertility trends and socio status of women in Nigeria; Onipede 2012 reported significant relationship between women education and fertility and Westoff & Kristin 2015 found a significant relationship between religion and women reproductive behaviour.

It has been established that religion is a fundamental factor to consider in terms of contraceptive use, age at first birth and fertility. Muslim women marry early, have low prevalence of contraceptive use and have higher number of children ever born than their counterparts who are not Muslims. Also, women who are currently living with their spouses had relatively more children than others who are either divorced or widowed. The result also shows that age at first birth had direct impact on contraceptive and also had direct and indirect influence on fertility. This implies that the chance of using contraceptive increases by an increase in age at first birth and the chance of having high number of children reduces by an increase in age at first birth. These outcomes are similar to the findings of a previous study on fertility locally and international (Alaba et al 2017, Gbolahan and James 2015, Osuafor and Mturi 2013, Snopkowski et al 2016 and Islam et al 2016).

Furthermore, this study found direct positive significant relationship between marital status and contraceptive use and indirect positive relationship between marital status and fertility. This is aligned with the finding of a previous study in Nigeria which reported that women who were currently married were about twice likely to have high fertility against low level fertility as compared to the formerly married (Fagbamigbe et al 2015). It was also established in the study that the pattern of fertility which reduces with increase in contraceptive use is normal and logical. The gaps urgently need a proactive policy and intervention to deal with this worrying observations. Improvements in the prevalence of contraceptive use, which is essential in reducing fertility should be given serious attention.

V. CONCLUSION

This study has demonstrated that age at first birth and contraceptive use have direct negative influence on fertility. More educated women and those living in urban area have fewer children ever born to them and both factors have indirect influence on fertility through age at first birth and contraceptive use. In this study, about four-fifth of women have never use contraceptive, average age at first sex and age at first birth were 17.9 years and 21.1 years respectively. The exogenous variables (education, place of residence, marital status, age at first birth and contraceptive use) have negative influence on fertility. The study shows that the generated model is statistically significant based on the set criteria and can be described as acceptable.

LIMITATIONS

The cross-sectional nature of the data used may influence some of the results found in this study since verbal reporting of historical events such as the time of first sexual activity, pregnancy and birth information and consistent use of contraceptive are often susceptible to recall bias. Also, the use of secondary data in the study limits the choice of variables included in the analysis.

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ISSN No:-2456-2165

Table 1: Selected fit indices in SEM	
Fit Index	**Acceptable threshold levels**
$\chi 2$	Low chi-square relative to degrees of freedom with an insignificant P-value [P > 0.05] (Tabachnick and Fidell 2007)
$\chi 2/df$	
GFI	Values greater than 0.90 (Meyers et al 2013)
NFI	Values greater than 0.95 (Meyers et al 2013)
CFI	Values greater than 0.95 (Hu and Bentler 1999)
RMSEA	Values less than 0.05 (Schumacker and Lomax 2010, Steiger 2007)

Table 2: Respondent's Background Characteristics							
Background Characteristic	n=2570	Percent (%)	Mean & S.D	Background Characteristic	n=2570	Percent (%)	Mean & S.D
Age (in years)			29.5, 5.5	**Ethnicity**			
15-24	355	13.8		Hausa/Fulani	1610	62.6	
25-34	1939	75.4		Others	960	37.4	
35+	276	10.7		**Religion**			
Education				Christianity	498	19.4	
None	901	35.1		Islam	1900	73.9	
Primary	619	24.1		Others	172	6.7	
Secondary	855	33.3		**Age at first sex**			17.9, 4.5
Higher	195	7.6		10-19	1529	59.5	
Place of Residence				20-24	902	35.1	
Urban	862	33.5		25+	139	5.4	
Rural	1708	66.5		**Age at first birth**			21.1, 5.8
Marital Status				10-19	938	36.5	
Currently married	2491	96.9		20-24	1016	39.5	
Previously married	79	3.1		25+	616	24.0	
Wealth Quintile				**Ever use of contraceptive**			
Lowest	514	20.0		No	2054	79.9	
Lower	501	19.5		Yes	516	20.1	
Middle	512	19.9					
Higher	545	21.2					
Highest	498	19.4					

ISSN No:-2456-2165

Table 3:Test of Association between the selected variables and CEB							
Background Characteristics	**Children Ever Born**				**Total Women**	**χ2-value**	**P-value**
	0	**1-2**	**3-4**	**5+**			
Education							
None	135 (15.0)	269 (29.9)	241 (26.7)	256 (28.4)	901 (100)	279.1	0.000
Primary	105 (17.0)	205 (33.1)	165 (26.7)	144 (23.3)	619 (100)		
Secondary	376 (44.0)	240 (28.1)	148 (17.3)	91 (10.6)	855 (100)		
Higher	74 (37.9)	52 (26.7)	49 (25.1)	20 (10.3)	195 (100)		
Age							
15-24	93 (26.2)	94 (26.5)	93 (26.2)	75 (21.1)	355 (100)	74.45	0.028
25-34	511 (26.4)	598 (30.8)	452 (23.3)	378 (19.5)	1939 (100)		
35+	86 (31.2)	74 (26.8)	58 (21.0)	58 (21.0)	276 (100)		
Place of Residence							
Urban	225 (26.1)	251 (29.1)	217 (25.2)	169 (19.6)	862(100)	21.43	0.050
Rural	465 (27.2)	515 (30.2)	386 (22.6)	342 (20.0)	1708 (100)		
Marital Status							
Currently married	672 (27.0)	743 (29.1)	587 (23.6)	489 (19.6)	2491 (100)	34.73	0.032
Previously married	18 (22.0)	23 (29.8)	16 (20.3)	22 (27.8)	79 (100)		
Religion							
Islam	516 (26.3)	584 (29.7)	475 (24.2)	390 (19.8)	1965 (100)	28.97	0.041
Others	174 (28.8)	182 (30.1)	128 (21.2)	121 (20.0)	605 (100)		
Ethnicity							
Hausa/Fulani	425 (26.4)	483 (30.0)	385 (22.9)	317 (19.7)	1610 (100)	0.834	0.841
Others	265 (27.6)	283 (29.5)	218 (22.7)	194 (20.2)	960 (100)		
Wealth Quintile							
Low	219 (21.6)	314 (30.9)	249 (24.5)	233 (23.0)	1015 (100)	36.56	0.000
Middle	131 (25.6)	166 (32.4)	123 (24.0)	92 (18.0)	512 (100)		
High	340 (32.6)	286 (27.4)	231 (22.1)	186 (17.8)	1043 (100)		
Age at first birth							
10-19	261 (27.8)	274 (29.2)	212 (22.6)	191 (20.4)	938 (100)	97.37	0.000
20-24	270 (26.6)	320 (31.5)	235 (23.1)	191 (18.8)	1016 (100)		
25+	159 (25.8)	172 (27.9)	156 (25.3)	129 (20.9)	616 (100)		
Age at first sex							
10-19	265 (17.3)	519 (33.9)	413 (27.0)	332 (21.7)	1529 (100)	17.79	0.578
20-24	375 (41.6)	212 (23.5)	160 (17.7)	155 (17.2)	902 (100)		
25+	50 (36.0)	35 (25.2)	30 (21.6)	24 (17.3)	139 (100)		
Contraceptive use							
Never use	647 (31.5)	623 (30.3)	433 (21.1)	351 (17.1)	2054 (100)	148.3	0.000
Ever use	43 (8.3)	143 (27.7)	170 (32.9)	160 (31.0)	516 (100)		

Table 4: Path Coefficients for the Structural Model by group of variables								
			Unstandardized estimate	**Standardized estimate**	**S. E**	**Z**	**P**	**R^2**
Age at first birth	<---	Education	-0.442	-0.014	0.612	-0.722	0.470	0.625
Age at first birth	<---	Religion	-0.318	-0.022	0.291	-1.095	0.274	0.915
Age at first birth	<---	Place of residence	0.168	0.013	0.261	0.644	0.520	0.932
Contraceptive use	<---	Education	0.016	0.008	0.042	0.385	0.700	0.998
Contraceptive use	<---	Current Age	-0.018	-0.019	0.020	-0.912	0.362	0.999
Contraceptive use	<---	Age at first birth	0.002	0.034	0.001	1.722	0.085	0.999
Contraceptive use	<---	Religion	-0.004	-0.005	0.019	-0.231	0.817	0.999
Contraceptive use	<---	Place of residence	-0.005	-0.006	0.017	-0.307	0.759	0.999
Contraceptive use	<---	Marital status	0.068	0.029	0.046	1.491	0.136	0.998
CEB	<---	Age at first birth	-0.001	-0.014	0.001	-0.702	0.483	0.999
CEB	<---	Contraceptive use	0.140	0.140	0.019	7.171	0.000	0.999

ISSN No:-2456-2165

Table 5: Direct and indirect relationship between respondents background and CEB							
Dependent variable	**Independent variable**	**Unstandardized effect**			**Standardized effect**		
		Direct	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
CEB	Education	0.000	0.002	0.002	0.000	0.001	0.001
	Religion	0.000	0.000	0.000	0.000	0.000	0.000
	Place of residence	0.000	-0.001	-0.001	0.000	-0.001	-0.001
	Age	0.000	-0.003	-0.003	0.000	-0.003	-0.003
	Marital status	0.000	0.010	0.010	0.000	0.004	0.004
	Age at first birth	-0.001	0.000	-0.001	-0.014	0.005	-0.009

Table 6: Fit Indices of the Observed Model (N = 2570)		
Fit Index	**Observed Model**	**Recommended Level**
$\chi 2$	14.843; P=0.317	0.05
GFI	0.999	≥0.90
NFI	0.962	>0.95
CFI	0.995	>0.95
RMSEA	0.007	≤0.05

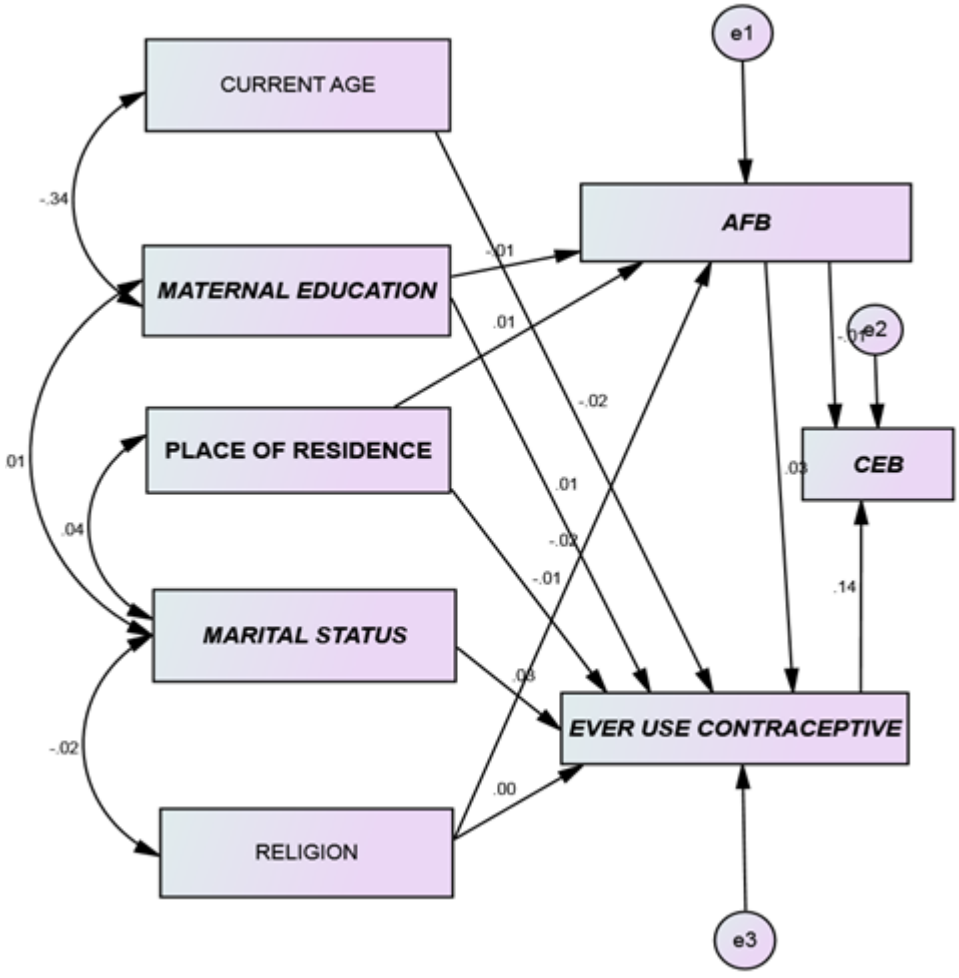

Figure 1: Path Diagram