

# Decomposing the Effect of Women Educational Status on Fertility Across the Six Geo-political Zones in Nigeria: 2003-2018

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## Research article

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## Abstract

**Background:** High level of fertility has been consistently reported in Nigeria. Women education is often identified as one of the important factors that have contributed to reduction in fertility across countries. It is essential to identify the factors that explain the fertility variation in educational status and know the extent of association of these factors across the regions in Nigeria. Thus, this study aimed to examine the fertility differentials among uneducated and educated women in Nigeria.

**Methods:** A cross-sectional population-based design which involved secondary data analyses of the weighted sample of 2003 ( $n_1=7620$ ), 2008 ( $n_2=33385$ ), 2013 ( $n_3=38948$ ) and 2018 ( $n_4=41821$ ) Nigeria Demographic and Health Survey data sets was used. Fertility was measured from information on the full births history of women aged 15-49 years. Oaxaca-Blinder decomposition was used to identify factors that explain fertility differentials among educated and not educate women ( $\alpha=0.05$ ).

**Result:** Total fertility rate estimate was higher among uneducated women (6.7) than educated women (4.5) in 2018. The pattern was similar across the regions and survey periods. The mean children ever born among women aged 45-49 years was significantly higher among the uneducated than educated women in each of the survey year. Maternal age at first marriage, wealth index and age at first birth were contributory factors to the dissimilarities found in fertility between the educated and uneducated women. Risk difference (RD) of high fertility between uneducated-educated women was highest in South-East (RD=56.9; 95%CI=49.1-64.8) and least in North-East (RD=15.0; 95%CI=9.9-20.1).

**Conclusion:** The fertility level in Nigeria was high but more prominent among the uneducated than educated. Improving the level of educational enrolment of women of reproductive age will facilitate reduction in the fertility rate in Nigeria.

## Background

Fertility is the actual birth performance, and its measures play a major role in population planning, and evaluation of family planning and other public health programmes [1]. Measurement of fertility has become indispensable considering the shift in demographic parameters and its relevance to some of the themes of Sustainable Development Goals (SDGs) [2, 3]. The global fertility level declined from 5.3 children per woman in 1900 to about 2.5 children per woman in 2019 [4]. While several developed countries have completed their demographic transition, the developing countries are striving to shift from a stage of high mortality and fertility to the next where mortality has just begun to drop [5]. Fertility decline in sub-Saharan Africa has been considerably slower than the declines observed in Asia, Latin America and the Caribbean, and Northern Africa at comparable stages of the fertility transition [6]. United Nations report shows that the world population will increase from nearly 7.6 billion in mid-2017 to 8.6 billion in 2030 and further increase to about 9.8 billion by 2050. It is expected that more than half of this rise in human population will come from sub-Saharan Africa countries [7].

In sub-Saharan Africa, countries like South Africa, Ghana have progressed in the demographic transition process but Nigeria, the most populous country in the region struggles to achieve a little reduction in fertility despite measures and programmes instituted by the government and international agencies to check its persistent high fertility rate. Nigeria's population grew from 56 million in 1963 to above 200 million in 2019 [8], and the population is expected to grow to more than 400 million by 2050 if the current fertility and mortality schedules persist [5]. The rapid growth of Nigeria's population is facilitated by its high fertility rate amidst socio-cultural behaviours that drive the population growth rate. Therefore, if reduction in population growth rate and replacement level fertility are to be achieved globally in a few years ahead, the fertility situation of countries like Nigeria is imperative.

Fertility rate reduction in several countries like Bangladesh, Iran, South Korea, India, has been attributed to many factors; including women education [9]. Studies have also acknowledged the contributory role of an increasing women's education in fertility decline in developing countries [11]. The relationship between women education is indirect. It is indirect if women receive an interventional health education on fertility control measures including family planning [11]. Such information is often received through counseling, news media, social media, and schooling. These in turn can cause attitudinal and behavioural change in factor that directly influence fertility. Also time spent in acquiring education or attainment of a desired level of education can lead to postponement of marriage and thus reduce the period of exposure of the risks of childbearing [12]. Additionally, women's education affects fertility through reduction in the desired number of children, increase in uptake of contraceptive use to control fertility and improve knowledge of natural fertility control measures. Educational status was identified as one of the most important factors that have contributed to reduction in fertility in west Africa countries like Burkina Faso, Gambia and Nigeria [13, 14, 15, 16]. Studies conducted in other parts of Africa like Uganda, Kenya, Ethiopia have also established the strong relationship between education and fertility [17, 18, 19].

In explaining the influence of education on fertility, diffusion theory of fertility has been found useful [20]. Diffusion is defined as the way discovery of new things are spread from one place or person to other [21]. The movement of thoughts and innovations, as well as behaviors were associated with channel of communication established by socio-cultural and economic of a society [22]. There is a consensus that the educated women are likely to invest more in health care, contraception, health education, and indulge themselves in activities that are useful to fertility control. The reason is that the educated may be more exposed to different thoughts, innovation and cultures especially, the foreign cultures where smaller family size and female equality are embraced [20].

Despite the revealed impact of education on fertility reduction by studies conducted across countries where in most cases education was analysed at different levels, we feel it is worthwhile to find out if the dissimilarity in fertility can be established between those who have and those without formal

education. It is also essential to identify the factors that explain the fertility variation in educational status and know if these factors are the same across the regions in Nigeria a country of multi-ethnic group where the level of fertility at the national level may be inadequate to examine its fertility. This study aimed to fill the gap in knowledge about the fertility differentials among uneducated and educated women in Nigeria. The choice of decomposition approach in this study hinges on its ability to explain the specific components of demographic indicators that contributes to the association between education and fertility.

## Method And Data

Nigeria is made up of 36 states and a Federal Capital Territory, grouped into six geopolitical zones. It is the most populous country in Africa and yet the 14th largest in land mass [23]. An implication that the country has high population density. The 2006 Population and Housing Census conducted in Nigeria placed the country's population at 140,431,790, but the 2019 projection based on the 2006 census figure as the base year was above 200 million [24]. Nigeria is a multi-ethnic country with the three major ethnic groups being; Hausa/Fulani, Igbo and Yoruba. Cultural practices among all the ethnic groups in Nigeria favour childbearing. However, the magnitude of fertility varies due to cultural diversities and differential in some sociocultural factors that influence fertility. Polygamy is very common among the Muslims and early marriage is prevalent in the Northern part of Nigeria. Nigeria is being considered as developing nation characterized by high poverty rate and low literacy level.

### Study design and data

The study was cross-sectional in design and based on a nationally representative sample across all the six geopolitical zones in Nigeria. Data were analysed based on 2003, 2008, 2013 and 2018 rounds of Nigeria Demographic and Health Survey datasets. The 2003 NDHS programme made use of the sampling frame designed for the 1991 population census while the sampling frame designed for the 2006 population and housing census was used for 2008, 2013 and 2018 NDHS but with modification due to expansion in the number of households between the census period and the survey year. The primary sampling unit (PSU) as defined in all the survey rounds was a cluster tagged as the Enumeration Areas (EAs) from the 1991 and 2006 EA census sampling frames. Samples for the 2003 and 2008 surveys were selected using stratified two-stage cluster design consisting of 365 clusters in 2003 NDHS [25] and 888 clusters in 2008 NDHS [26]. While 2013 and 2018 NDHS was conducted at three and two stages respectively. For the 2013, at the first stage, 893 localities were selected with probability proportional to the size and with an independent selection from each sampling stratum. In the second stage, one EA was randomly selected from most of the selected localities. In a few larger localities, more than one EA was selected. In total, 904 EAs were selected. After the selection of the EAs and before the main survey, a household listing operation was carried out in all of the selected EAs [27]. For 2018 NDHS, at the first stage, 1400 EAs were selected; and a household listing which served as sampling frame was conducted in the selected EAs. In the second stage, 30 households were selected from each cluster by an equal probability of systematic sampling [23].

Data collected were highly comparable over time because of the standardization in sampling procedures, data collection methodologies and coding. The number of households interviewed in 2003, 2008, 2013, and 2018 was 7864, 34070, 40680 and 42000 respectively. The number of women aged 15-49 years interviewed for these year periods used in the study is given as 7620, 33385, 38948, 41821 respectively. Data analyses were based on this secondary data assessed on the web platform of the data originators. The analytical approach was used for further analyses in relation to the study objectives.

Sample weights were applied to each case to adjust for differences in the probability of selection. Weighting is important in to increase the extent of representativeness in the sample, and it reduces the errors associated with sample selection bias.

### Variable Description

The dependent variable was fertility measured by the total number of children ever born (CEB). CEB is the lifetime fertility were obtained from information provided by women aged 15-49 years on their full birth history. It is a discrete number in DHS data set. However, it was categorized into two in this study as low if a woman has less than 5 children and high if otherwise. The categorization was based on the 1988 population policy revised in 2004 which emphasized the need to maintain four children at family level [28].

The main explanatory variable was women education. We used literacy to denote women education in this study because it is essential in measuring a population's level of education. Literacy is defined as the ability to both read and write a short, simple statement about one's own life. We, therefore, categorized education as having no formal education (Illiterate) for those who cannot read and write and have not completed primary education while educated (if they can read and write and have a minimum of completed primary education - Literate). Other variables used were: maternal Age (15-19, 20-24..., 45-49), age at first birth, age at first marriage, place of residence (urban, rural), religion, modern contraceptive. The age at first marriage (v511) and age at first birth (v212) were count data in years. We re-categorized them as < 20 year (teenagers) and  $\geq$  20 year. Religion was categorized as Christian, Islam and others. Likewise, the wealth index was re-grouped as poor, middle and rich.

### Statistical analyses

Descriptive statistics were used to describe the distribution of respondents by explanatory variables. The difference in mean CEB between uneducated and educated women was examined using Mann-Whitney test due to the skewness of the CEB. We used direct method to produce the total fertility rates (TFR) by educational status. The method has been published elsewhere [29]. Also, we calculated parity progression ratio (PPR) as the proportion of women who move from one parity to the next higher parity for illiterate and literate women. We computed the risk difference in high fertility ( $\geq$ 5)

between women who were educated and those who were uneducated. A risk difference (RD) greater than 0 ( $RD > 0$ ) suggests that high fertility was more prevalent among women with no formal education (pro-illiterate inequality). Conversely, a negative risk difference indicates that high fertility was prevalent among educated women (pro-literate inequality). Finally, we used logistic regression method to conduct the Blinder-Oaxaca decomposition analysis [30, 31]. We chose this method because it allows quantification of the gap between the “advantaged” and the “disadvantaged” groups.

Blinder-Oaxaca decomposition assumed that  $y$  is explained by a vector of determinants,  $x$ , according to logistic regression model

$$y_i = \begin{cases} \beta^p x_i + \varepsilon_i^p \\ \beta^q x_i + \varepsilon_i^q \end{cases} \dots\dots(1)$$

Where the vectors of  $\beta$  parameters include intercepts.

The gap between the mean outcomes  $y^q$  and  $y^p$ , is

$$y^q - y^p = \beta^q x^q - \beta^p x^p \dots\dots(2)$$

Where  $x^q$  and  $x^p$  are the explanatory variables at the means for the  $p$  and  $q$ . In this study the explanatory variables were maternal age, educational status, religion, wealth index, place of residence, age at first marriage, age at first birth, ever used modern contraceptive.

If there are just two  $x$ 's,  $x_1$  and  $x_2$

It can be written as follows:

$$y^q - y^p = (\beta_0^q - \beta_0^p) + (\beta_1^q x_1^q - \beta_1^p x_1^p) + (\beta_2^q x_2^q - \beta_2^p x_2^p) = G_0 + G_1 + G_2 \dots\dots(3)$$

The gap in  $y$  between  $p$  and  $q$  can be said to be

- differences in the intercepts ( $G_0$ )
- differences in  $x_1$  and  $\beta_1$  ( $G_1$ )
- differences in  $x_2$  and  $\beta_2$  ( $G_2$ )

To estimate the overall gap or the gap specific to any one of the  $x$ 's is attributable to differences in the  $x$ 's

The gap between the two outcomes were expressed as:

$$y^q - y^p = \Delta x \beta^p + \Delta \beta x^q = E + (CE + C) \dots\dots(4)$$

Or

$$y^q - y^p = \Delta x \beta^q + \Delta \beta x^p = (E + CE) + C \dots\dots(5)$$

Where  $\Delta x = x^q - x^p$  and  $\Delta \beta = \beta^q - \beta^p$

The gap in the mean outcomes was from a gap in endowments ( $E$ ) (the part that is due to group differences in the magnitudes of the determinants of the outcome), a gap in coefficient ( $C$ ) (the part that is due to group differences in the effects of these determinants), and a gap arising from the interaction of endowments and coefficients ( $CE$ ).

## Results

Table 1 shows the percentage distribution of the women according to background characteristics across the survey rounds (2003-2018) Women who had no education were in the highest proportion of women in 2003 (41.6%), 2008 (35.8%) and 2013 (37.8%). However, the percentage of women with secondary education was highest in 2018 (39.7%). The percentage of women was higher in the rural areas than the urban areas in all the survey periods; although, those that were resident in the urban area increased from 34.5% in 2003 to 45.8% in 2018. The percentage of those who are poor remains unchanged between 2003 and 2013, but marginally decline to 36.5% in 2018 from about 37.4%. Modern contraceptive prevalence rate upwardly changed between 2003 and 2013 from 8.8 to 11.2; but decline to 10.51 in 2018.

**Table 1: Percentage distribution of respondents according to background characteristics 2003, 2008, 2013 and 2018**

Background Characteristics	2003		2008		2013		2018	
	No of Women		No of Women		No of Women		No of Women	
	%		%		%		%	
<b>Education</b>								
None	41.6	3171	35.8	11942	37.8	14729	34.9	14603
Primary	21.4	1628	19.7	6566	17.3	6734	14.4	6039
Secondary	31.1	2370	35.7	11904	35.8	13927	39.7	16583
Higher	5.9	451	8.9	2974	9.1	3558	11.0	4596
<b>Place of Residence</b>								
Urban	34.5	2629	35.8	11934	42.1	16414	45.8	19163
Rural	65.5	4991	64.2	21451	57.9	22534	54.2	22658
<b>Religion</b>								
Christian	48.0	3654	53.6	17907	46.8	18237	46.0	19217
Islam	50.7	3862	44.4	14826	51.7	20149	53.5	22372
Others	1.4	104	2.0	652	1.4	561	0.5	232
<b>Wealth Index</b>								
Poor	37.4	2853	37.2	12428	37.4	14560	36.5	15267
Middle	19.9	1513	19.0	6341	19.2	7486	19.6	8207
Rich	42.7	3254	43.8	14616	43.4	16902	43.9	18347
<b>Modern Contraceptive Use</b>								
No	91.2	6940	89.5	29884	88.9	34606	89.5	37424
Yes	8.8	680	10.5	3501	11.1	4342	10.5	4397
<b>Age at First Marriage</b>								
<20 years	78.7	4484	69.9	17455	71.1	21056	65.6	20515
20 years and above	21.3	1211	30.2	7533	28.9	8566	34.4	10756
<b>Age at First birth</b>								
<20 years	66.7	3510	57.9	13558	59.4	16393	56.2	16840
20 years and above	33.23	1747	42.1	9846	40.6	11222	43.8	13109

In table 2, data show that background characteristics of women were significantly different among uneducated and educated women. In 2018, about 84% of women living in urban area were educated, while only 53% of rural women were educated. More than 90 % of women who practice Christianity as religion were educated, but only 41% of Muslim women were educated. Women from poor and rich households who were educated was 35% and 91% respectively. This pattern was similar across the survey periods.

**Table 2: Distribution of respondents by Educational Status**

	2003		2008		2013		2018	
	Uneducated n (%)	Educated n (%)						
<b>Residence</b>								
<b>Location</b>								
Urban	697(26.53)	1932(73.47)	2369(19.85)	9565 (80.15)	2447(14.91)	13967(85.09)	3049(15.91)	16114(84.09)
Rural	2340(48.08)	2591 (51.92)	10455(48.74)	10996 (51.26)	10999(48.81)	11535 (51.19)	10670(47.09)	11988 (52.91)
<b>Religion</b>								
Christian	496(13.57)	3158 (86.43)	2169(12.11)	15738 (87.89)	1459(8.0)	16778(92.0)	1791(9.32)	17426 (90.68)
Islam	2558(66.23)	1304 (33.77)	10243(69.09)	4583 (30.91)	12883(63.94)	7266 (36.06)	13197(58.99)	9175 (41.01)
Others	72(68.89)	32 (31.11)	417(63.92)	235(36.08)	309(55.08)	252 (44.92)	80 (34.55)	152 (65.45)
<b>Wealth Index</b>								
Poor	1758(61.61)	1095(38.39)	8347(67.16)	4081 (32.84)	10349 (71.08)	4211 (28.92)	9893 (64.8)	5374 (35.2)
Middle	676(44.7)	837 (55.3)	2321(36.6)	4020 (63.4)	2202(29.42)	5284 (70.58)	2314 (28.19)	5893 (71.81)
Rich	561(17.23)	2693 (82.77)	1568(10.73)	13048(89.27)	1357 (8.03)	15545 (91.97)	1602(8.73)	16745 (91.27)
<b>Modern Contraceptive</b>								
No	2933(42.26)	4007 (57.74)	12743(42.64)	17141 (57.46)	13510 (39.04)	21096 (60.96)	13746 (36.73)	23678 (63.27)
Yes	78(11.46)	602 (88.54)	381(10.89)	3120 (89.11)	5.96 (259)	4083 (94.04)	626 (14.24)	3771 (85.76)
<b>Age at first marriage</b>								
< 20 years	4484(61.08)	1745 (38.92)	10707(61.34)	6748(38.66)	11930 (56.66)	9126 (43.34)	11531 (56.21)	8984 (43.79)
20 years	270(22.26)	941 (77.74)	1666(22.11)	5867 (77.89)	1478 (17.26)	7088 (82.71)	1835 (17.06)	8921 (82.94)
<b>Age at first birth</b>								
< 20 years	2076(59.14)	1434(40.86)	8017(59.13)	5541 (40.87)	8946(54.57)	7447 (45.43)	9304 (55.25)	7536 (44.75)
20 years	611(34.98)	1136 (65.02)	3366(34.19)	6480 (65.81)	3100(27.62)	8122 (72.38)	3106 (23.69)	10003 (76.31)

Figure 1 compares the mean CEB of illiterate and literate women aged 15-49 in 2003, 2008, 2013 and 2018 surveys. Across all the regions and the year periods, there is a significant difference in the mean CEB of illiterate and literate women. In South-East 2003, the gap between mean CEB of illiterate women (6.5) and literate women (1.8) was the widest. The trend in the mean CEB across the regions has not changed meaningfully in the two groups.

Figure 2 depicts the way women aged 40-49 years progressed from one birth order to the next higher birth order according to educational status. A similar pattern of PPR was observed in all the survey periods; however, the rate at which uneducated women move from one parity to the next higher parity is more intense than that of educated across the survey periods.

Figure 3 shows the estimated TFR by educational status across the six regions for the four survey periods. The data revealed that TFR was consistently higher among uneducated women compared to educated women. The pattern is similar across the regions in all the survey periods.

Figures 4 and 5 show the risk difference between women who were uneducated and educated in high fertility across the six regions in the year periods 2003, 2008, 2013 and 2018. The results quantify the gap between the uneducated and educated women with high fertility. A risk difference greater than 0 suggests that high fertility is prevalent among uneducated women. As revealed by the result, high fertility was more prevalent among women with no education across the regions and the periods. The result was statistically significant across the regions. As indicated in figure 4.39, the six regions at different periods were pro-uneducated inequality. Furthermore, as illustrated in the figures educated-uneducated risk difference was highest in South

East 2003 (56.92) and lowest in North East 2003 (14.99). Also, to be noted in the figures was the risk differences in South West 2003 (41.20), South-South 2003 (37.9), South East 2003 (56.92), and North Central (25.9) were higher than that of South West 2013 (27.3), South-South 2013 (30.5), South East 2013 (50.1), and North Central 2013 (22.8).

Figure 6 shows the scatter plot of the rate of high fertility and the risk difference between women who were uneducated and educated. Since high fertility and pro-illiterate inequality exist in all the regions and the year periods, the scatter plot was still divided into two based on the magnitude of the rate of high fertility. As depicted in the result, the prevalence of high fertility was more in North-West and North-East than other regions. Notably, the risk difference was higher in South-East in 2003, 2013 and 2008.

Figure 7 shows the detailed decomposition of the part of illiteracy inequality that was caused by compositional effects of the determinants of high fertility to the total gap between uneducated and educated women in high fertility by regions and periods. The important factors associated with the educational inequalities across the regions and periods were almost the same but at different degree. The educational differences were due to the "explained" (compositional effect) and the "unexplained" (structural effect), which are shown by colours red and blue respectively. As the percentage contribution of the "explained" part goes down, the brightness of the red colour becomes faded. The same applies to the blue colour that depicts the "unexplained" part. On average, the figures indicate that maternal age, wealth index, and age at first birth are important factors responsible for the inequality between the high fertility of uneducated and educated women across the regions and periods. In North East 2003, the highest contributions to the educational inequality in the prevalence of high fertility was by age at first birth, followed by religion, and then age at first marriage. In South West 2013, wealth index was the major factor responsible for the total gap in high fertility between uneducated and educated women; followed by age at first birth, then age at first marriage, place of residence and religion.

## Discussion

This study set out to decompose educational inequalities in the high fertility across the six geo-political zones of Nigeria due to the heterogeneous nature of the country. Considering the huge population of Nigeria and socio-cultural differences of the country, the regional analysis of fertility as it relates to maternal education is important. The relevance of childbearing behavior in the accomplishment of sustainable development goals (SDGs 1,3 and 5) underscores the need for this study in a high population growth rate country like Nigeria.

We found high fertility rate in Nigeria and the mean children ever born of above six by women in age group 40-49 years who are expected to have completed childbearing irrespective of their literacy status is an indicator of high childbearing practices in Nigeria. The finding is similar to what was reported by Gerland and colleagues (2017) in their study conducted in sub-Saharan Africa [32]. However, the fertility level found in the current study was higher than estimates obtained in other countries like South Africa, Kenya, and Ghana. Several factors can explain the higher fertility situation in Nigeria. The persistent passive population policy, high poverty rate, sociocultural norms and poor health system are possible explanation for our finding.

We found that the prevalence of high fertility was significantly more among women who were uneducated compared to their counterpart who were educated across the regions. The high fertility pattern observed among uneducated and educated women was similar between 2003 and 2018. The greatest pro-illiterate inequality was observed in South East and the least was in North East. This is because uneducated women are likely to commence childbearing early which will increase the number of years at risk of childbearing during the reproductive years [12]. Also, educated women may be more exposed to ideas that promote smaller family size and female equality [20], and they are more empowered to take decision about the reproductive health. Educated women, in most cases, have the ability to decide the number, timing and spacing of their children [33].

In the decomposition analysis, maternal age, wealth index, and age at first birth are important factors explaining inequality in high fertility among women who were educated and those that were uneducated across the regions in Nigeria and survey periods. This finding aligns with previous studies which had established a relationship among women education, maternal age, wealth index, age at first birth and fertility [33, 34, 35, 36]. These results can serve as a vital guide for formulating programmes that will facilitate fertility reduction across the regions of Nigeria.

Female education is imperative in accomplishment of sustainable development. Educated women are likely to be more empowered economically, marry at a later age, delay onset of childbearing, have small family size and have ability to make decision about their own health [20, 33]. The combination of these factors is key to achieving a rapid reduction in fertility. Explaining the fertility differentials among educated and uneducated women has important implications on population policy and programmes. Fertility, as indicated in this study, is still high and more prevalent among uneducated women across the six geo-political zones of Nigeria. In 1990, Nigeria population figure was 80 million and in 30 years later, the population is above 200 million. This growing size of Nigeria population is a critical issue. The unrestraint population growth of Nigeria can lead to population explosion which might constitute a challenge to the health of the populace, environment, and infrastructural development. To avoid the crises, immediate actions to reduce fertility drastically should be put in place across the region in Nigeria especially among uneducated women. Public health interventions such as health education and promotion should be more frequent among uneducated women. Also, programmes that focus on increasing educational opportunities for girls should be more robust across Nigeria. In the pursuit of fertility level reduction in Nigeria, research that focuses on the perception of uneducated populace about fertility and population will be important.

## Limitation and Strength

The study was based on cross-sectional study design; and high rates of error particularly non-sampling errors are associated with this type of study design. More so that the information collected were self-reported, some cultural beliefs and practices might affect the information on fertility behavior. There are tendencies of underreporting of births due to omission and displacement which could lead to under-estimation of fertility. Also, there are could be misclassification of timing of births because of recall bias. Establishing causality using survey data is difficult. Nonetheless, the utilization of nationally representative data and regional based analysis is a major strength of this study. Also, with the use of Blinder-Oaxaca decomposition analysis our study was able to measure the magnitude of the explained and unexplained factors associated with high fertility across the region in Nigeria.

## Conclusion

The fertility level in Nigeria was high but more prominent among the uneducated than educated. This was also the pattern observed across the six geopolitical zones in Nigeria. In all the regions, the prevalence of high fertility was more among uneducated women. The magnitude of inequalities observed in literate-illiterate high fertility across the regions underscores the importance of women education in reducing fertility in Nigeria. Maternal age at first marriage, wealth index and age at first birth were contributory factors to the dissimilarities found in fertility between the educated and uneducated women. Improving the level of educational enrolment among Nigeria women of reproductive age will facilitate reduction in the fertility rate in Nigeria. Through this effort, the age at first marriage and age at first birth are likely to increase and socioeconomic advancement of women will be assured.

## Abbreviations

CEB: Children Ever Born; NDHS: Nigeria Demographic Health Survey; RD: Risk Difference; PPR: Parity Progression Ratio; SDGs: Sustainable Development Goals; TFR: Total Fertility Rate;

## Declarations

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### Ethical Consideration

Proper approval to download and use NDHS data was obtained from ORC Macro International, the agency responsible for Demographic and Health survey globally. The National Health Research Ethics Committee of Nigeria (NHREC) and the ICF institutional Reviewed and approved the survey protocols of each round since 2008. Before then committee was yet to constituted. The assigned number for the survey round was NHREC/01/01/2007. The same number applied for other survey rounds. At the point of data collection, the data originators sought informed consents from the respondents and they were assured of confidentiality and anonymity of the information they provide. There was no identifier in the raw data that could be used to link a particular respondent to the information she provides.

### Authors' contributions

OTA and ASA conceived and designed the study; OTA and FFA analysed the data, drew the Figures and wrote the results; OTA and OOC reviewed the literatures and wrote of the manuscript. ASA FFA and OOC reviewed and edited the manuscript. All authors read and consented to the final version of the manuscript.

### Consent for publication

Not Applicable.

### Competing interests

The authors declare that they have no competing interests

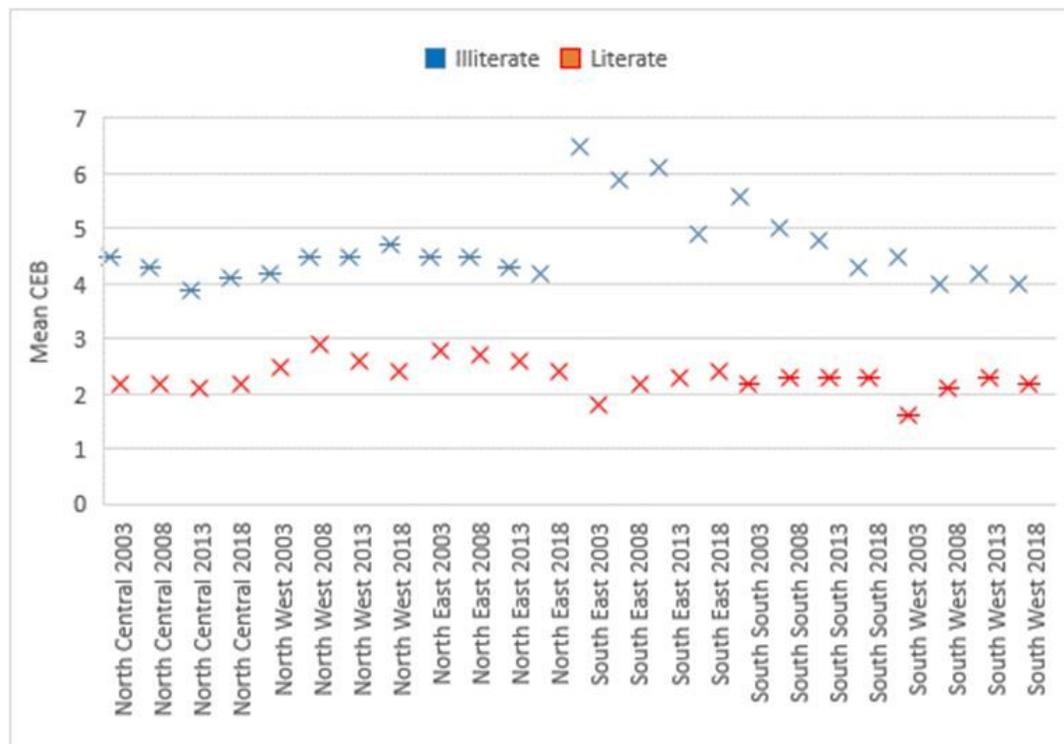
## References

1. Sullivan, J. N. O. 2013. Revisiting demographic transition : correlation and causation in the rate of development and fertility decline. pp. 1–12.
2. Wietzke, F. 2020. Poverty, Inequality, and Fertility: The Contribution of Demographic Change to Global Poverty Reduction. *Population and Development Review*, 46(1): 65–99.

3. Starbird, E., Norton, M. and Marcus, R. 2016. Investing in family planning: key to achieving the sustainable development goals. *Global Health Science Practice*,4(2):191–210. <http://dx.doi.org/10.9745/GHSP-D-15-00374>.
4. Ghosh, I. 2019. Visualizing over a Century of Global Fertility. Available at <https://www.visualcapitalist.com/over-a-century-of-global-fertility/>.
5. United Nations, Department of Economic and Social Affairs, Population Division. World Population Prospects 2019: Highlights (ST/ESA/SER.A/423). Available at <https://population.un.org/wpp/>.
6. Shapiro, D. and Hinde, A. 2017. On the pace of fertility decline in sub-Saharan Africa. *Demographic Research*: Volume 37, Article 40, Pages 1327- DOI: 10.4054/DemRes.2017.37.40.
7. United Nations, Department of Economic and Social Affairs, Population Division World population prospects: The 2017 revision [Data set]. New York, NY: United Nations, Department of Economic and Social Affairs. Retrieved from <https://esa.un.org/unpd/wpp/>
8. Population Reference Bureau. 2019. *World Population Data Sheet*. Washington, DC: PRB.
9. Mehrass, A. A. O., Ahmed, I. A., Ali, A. D., and Al-Adhroey, A.H. Early marriage and less education as independent predictors for high fertility in Yemen. *Annals of Medical and Health Sciences Research*; 7:251-255.
10. Shapiro, D. 2012. Women's education and fertility transition in sub-Saharan Africa. *Vienna Yearbook of Population Research*, Vol 10: 9-30.
11. Bongaarts, J. The causes of educational differences in fertility in Sub-Saharan Africa. *Vienna Yearbook of Population Research*, (1), 31–50. <https://doi.org/10.1553/populationyearbook2010s31>.
12. Shapiro, D. and Tenikue, M. 2017. Women's education, infant and child mortality, and fertility decline in urban and rural sub-Saharan Africa. *Demographic Research*: Volume 37, Article 21, Pages 669- DOI: 10.4054/DemRes.2017.37.21.
13. Chandio, K., Mondal, P. R., Mahajan, C. and Saraswathy, K. N. Biological and Social Determinants of Fertility Behaviour among the Jat Women of Haryana State, India. *Journal of Anthropology*; pp.6. <http://dx.doi.org/10.1155/2016/5463168>
14. Oyinloye, B. O., Bamiwuye, O. S., Kupoluyi, J. A. and Solanke, B. L. 2017. Family type and ethnic differences in lifetime fertility in selected west African. *African Population Studies*. Vol. 31, No. 1, (Supp. 2)
15. Adebowale, A. S., Yusuf, O. B., Gbadebo, B. M. and Dahiru, T. 2017. Level and determinants of high fertility in two contrasting populations in Nigeria. *African Population Studies* Vol. 31, No. 1, (Supp.).
16. Ariho, P., Kabagenyi, A. and Nzabona, A. 2018. Determinants of change in fertility pattern among women in Uganda during the period 2006–2011. *Fertility Research and Practice*, 4:4 <https://doi.org/10.1186/s40738-018-0049-1>.
17. Mutwiri, R. M. 2019. An Analysis of the Determinants of Fertility Differentials Amongst the Poorest Women Population in Kenya. *International Journal of Statistical Distributions and Applications*. Vol.5, No.3, pp. 60-66. doi: 10.11648/j.ijstd.20190503.13
18. Tegegne, M. A., Fekadu, A. A. and Negassa, G. M. 2019. Determinants of fertility status among reproductive age women in rural Ethiopia: evidence from 2016 Ethiopian demographic health survey. *Mathematical Theory and Modeling*, Vol.9, No.10. DOI: 10.7176/MTM/9-10-01
19. Adebowale, A. S., Tinuoya, A.F., Olowolafe, T.A., Gbadebo, M.T., and Onwusaka, O.C. 2019. Unintended Pregnancy and Childbearing among Out-of-School Unmarried Young Women Living in Metropolitan City. *Public Health Research*, 9(4): 87-98 DOI: 10.5923/j.phr
20. National Research Council. (2001). *Diffusion Processes and Fertility Transition: Selected Perspectives*. Committee on Population. John B. Casterline, Ed. Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press
21. Retherford, R. D. and Palmore J. A., 1983. Diffusion processes affecting fertility regulation, in: Rodolfo A. Bulatao and Ronald D. Lee (eds.), *Determinants of fertility in developing countries*, vol. 2, p. 295–339. *New York, Academic Press*, 846 p.
22. Kirk, D. 1996. Demographic Transition Theory. *Population Studies*. 50 (2), pp. 361–387. DOI: 1080/0032472031000149536
23. National Population Commission (NPC) [Nigeria] and ICF International. (2019). *Nigeria Demographic and Health Survey 2018*. Abuja, Nigeria: National Population Commission and ICF International.
24. Population Reference Bureau. 2019. *World Population Data Sheet*. Washington, DC: PRB.
25. National Population Commission (NPC) [Nigeria] and ORC Macro. (2004). *Nigeria Demographic and Health Survey 2003*. Calverton, Maryland: National Population Commission and ORC Macro.
26. National Population Commission (NPC) [Nigeria] and ICF Macro. (2009). *Nigeria Demographic and Health Survey 2008*. Abuja, Nigeria: National Population Commission and ICF Macro.
27. National Population Commission (NPC) [Nigeria] and ICF International. (2014). *Nigeria Demographic and Health Survey 2013*. Abuja, Nigeria: National Population Commission and ICF International.
28. Shofoye, A. D. 2014. An Appraisal of the 2004 National Policy on Population for Sustainable Development. *Mediterranean Journal of Social Sciences*; Vol 5 No 23. Doi:10.5901/mjss.2014.v5n23p2520.
29. Moultrie, T. A., Dorrington, R. E., Hill A. G., Hill, K., Timæus, I. M., Zaba, B., editors. 2013. Tools for demographic estimation. Paris: International Union for the Scientific Study of Population. [demographicestimation.iussp.org](http://demographicestimation.iussp.org)
30. Oaxaca, R. Male-female wage differentials in urban labor markets. *International economic review*. 14:693–709. <https://doi.org/10.2307/2525981>.
31. Blinder, Alan S. 1973. Wage Discrimination: Reduced Form and Structural Variables. *Journal of Human Resources*, 8, 436-455.

32. Gerland, P., Biddlecom, A., & Kantorová, V. 2017. Patterns of fertility decline and the impact of alternative scenarios of future fertility change in Sub-Saharan. *Population and Development Review*, 43, 21–38. <https://doi.org/10.1111/padr.12011> 2018
33. Solanke, B. L. 2015. Marriage Age, Fertility Behavior, and Women's Empowerment in Nigeria. *SAGE Open*, October-December 2015: 1–9. DOI: 10.1177/2158244015617989
34. Haloi, A. 2014. Fertility differentials by incidence of marriage and their reproductive wastage in a Muslim population from rural North-East India. *Human Biology Review*, 3(1), 1-14.
35. Colleran, H. and Snopkowski, K. 2018. Variation in wealth and educational drivers of fertility decline across 45 countries. *Population Ecology* 60:155–169. <https://doi.org/10.1007/s10144-018-0626-5>
36. Ferré, C. 2009. Age at First Child Does Education Delay Fertility Timing? The Case of Kenya. *Policy Research Working Paper 4833*. The World Bank South Asia Region Human Development Division

## Figures



**Figure 1**  
 Mean number of children ever born (CEB) to Illiterate and Literate women aged 15-49 across the region in Nigeria. Note: All are significant at 0.05 in Mann-Whitney test

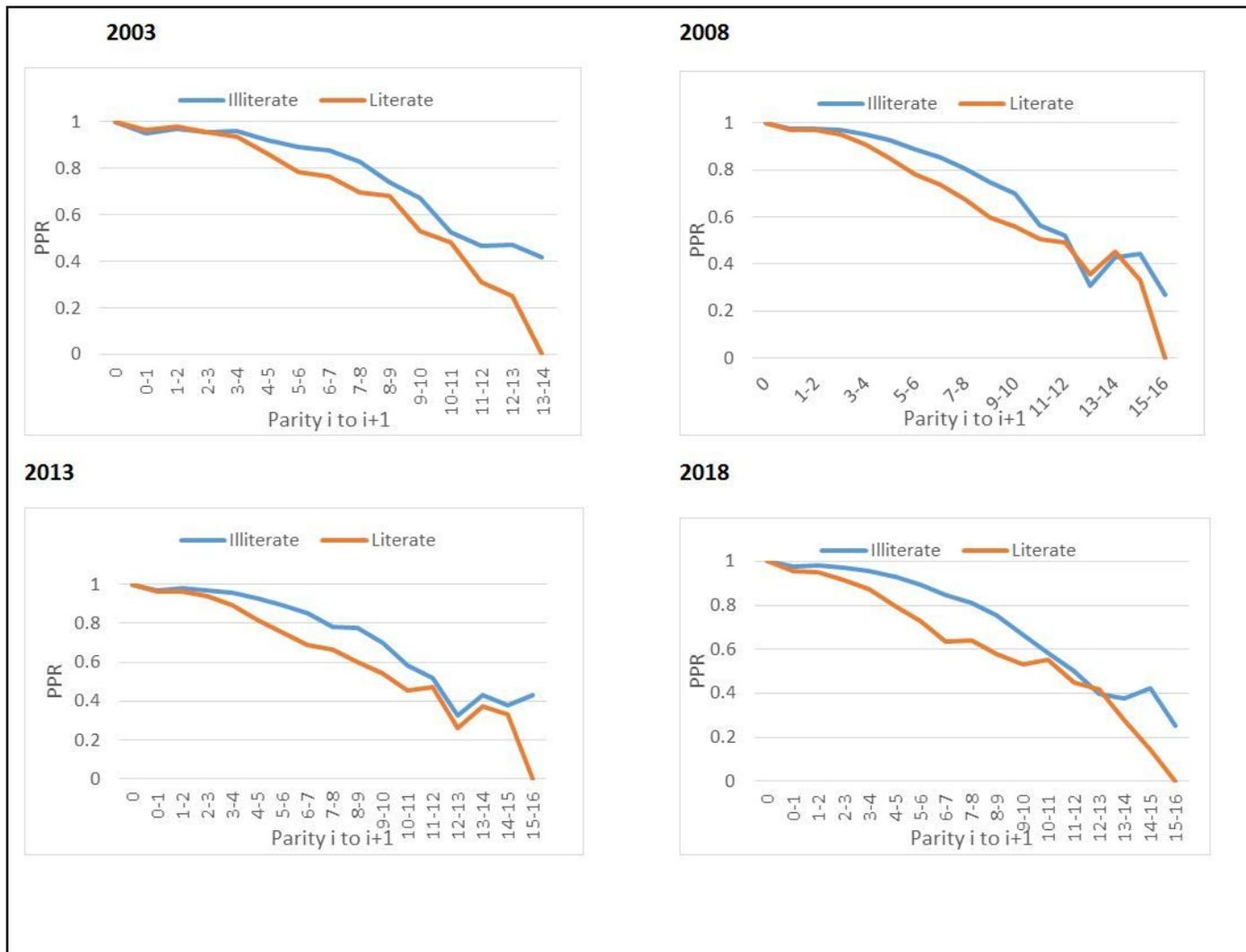


Figure 2

Parity Progression Ratio for women aged 40-49 years by Educated and Uneducated.

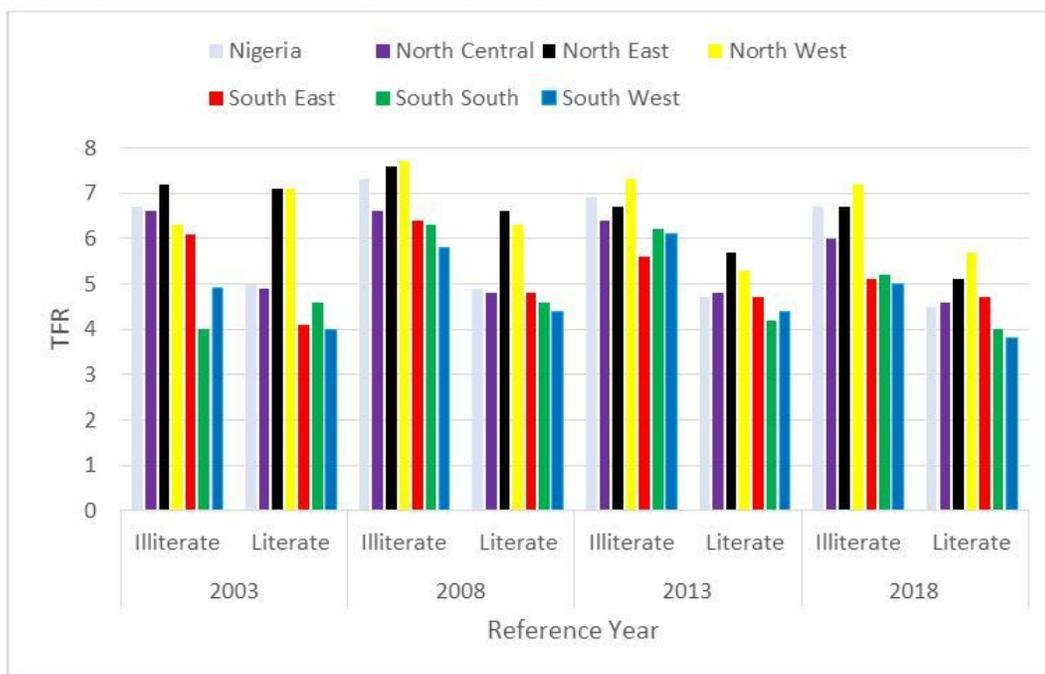


Figure 3

Estimated total fertility rate by educational status across regions in Nigeria.

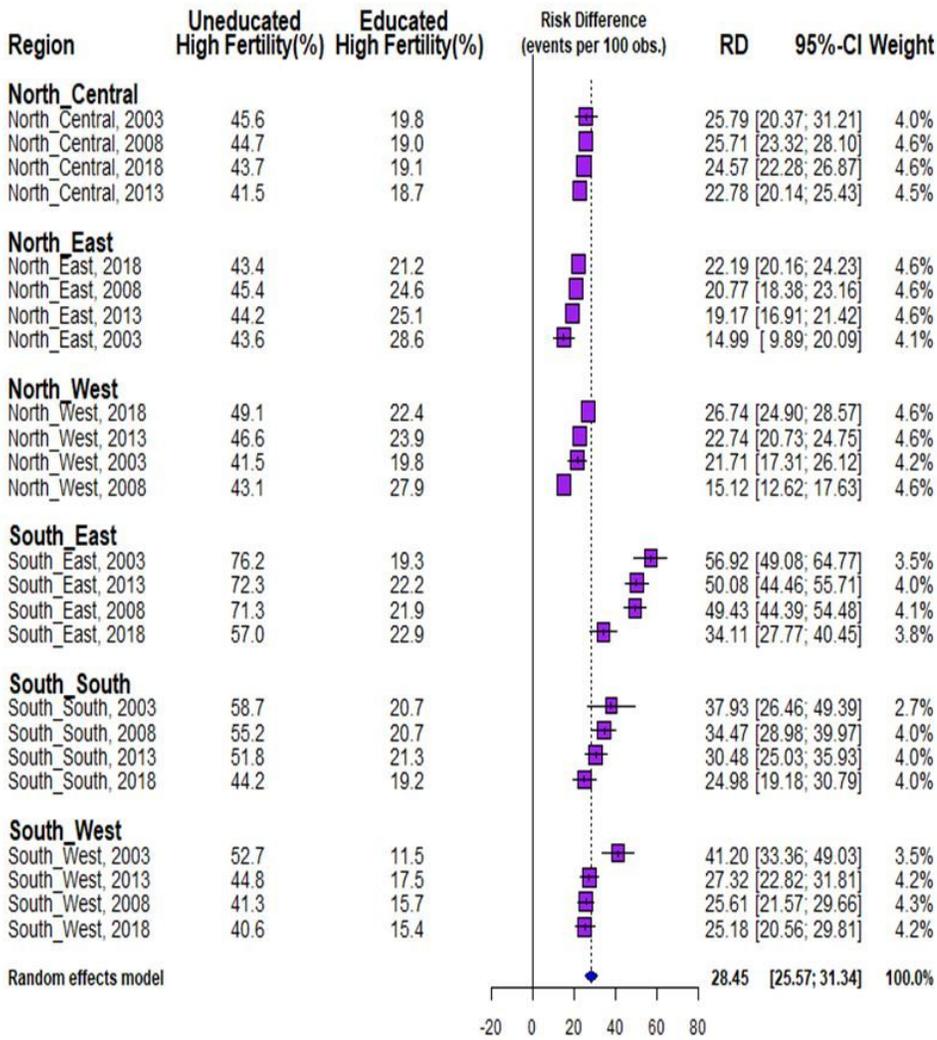
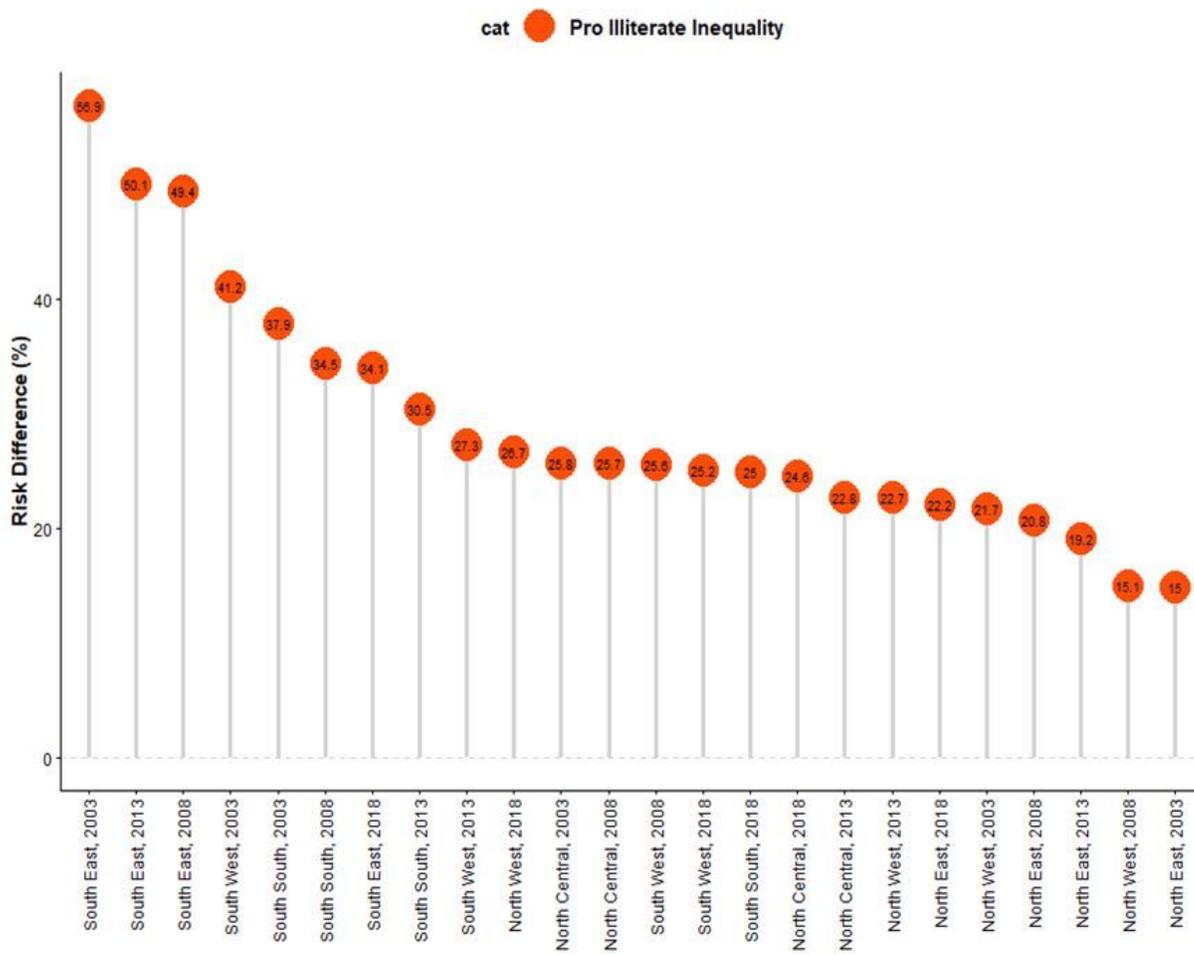


Figure 4

Risk Difference between women who are Uneducated and Educated in High Fertility by Regions between 2003 and 2018.



**Figure 5**

Graph showing the Risk Difference between women who are Uneducated and Educated in High Fertility by Regions.

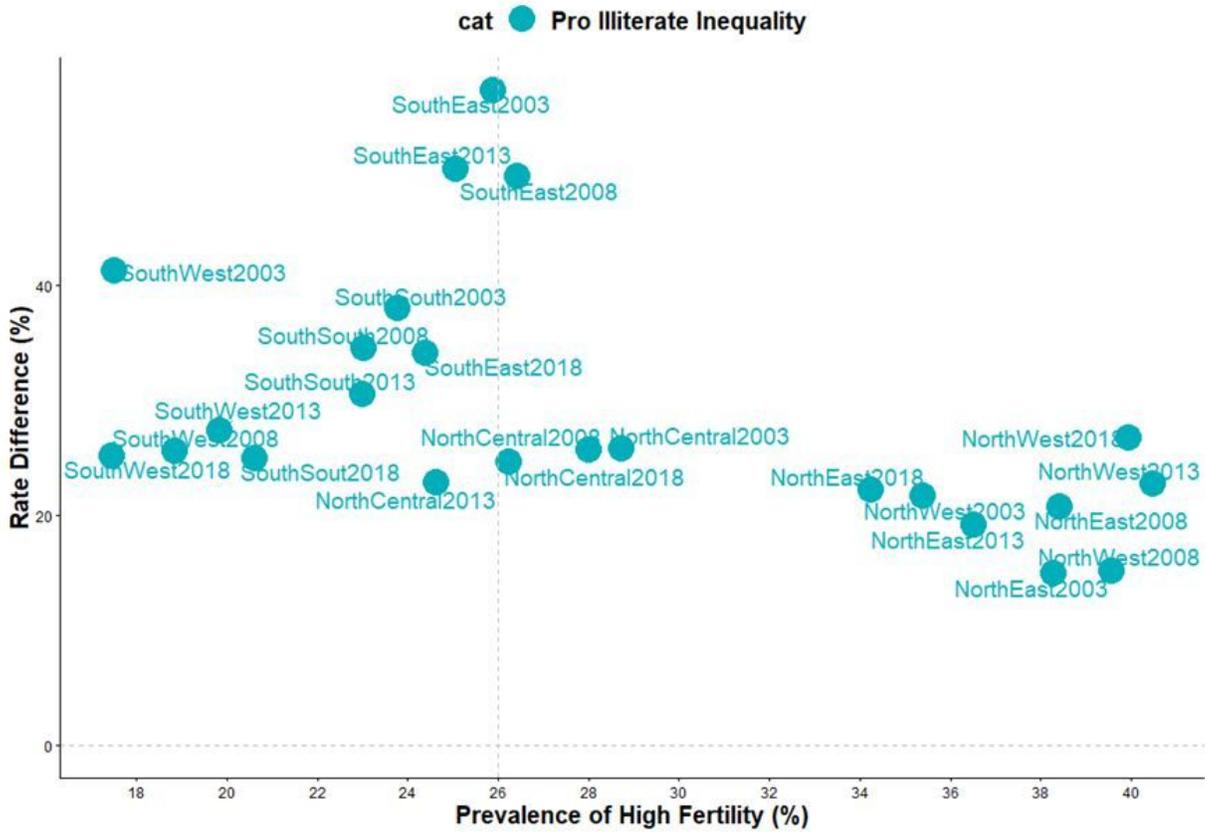


Figure 6

Scatter plot of rate of High Fertility and Risk Difference between women who were Uneducated and Educated in High Fertility.

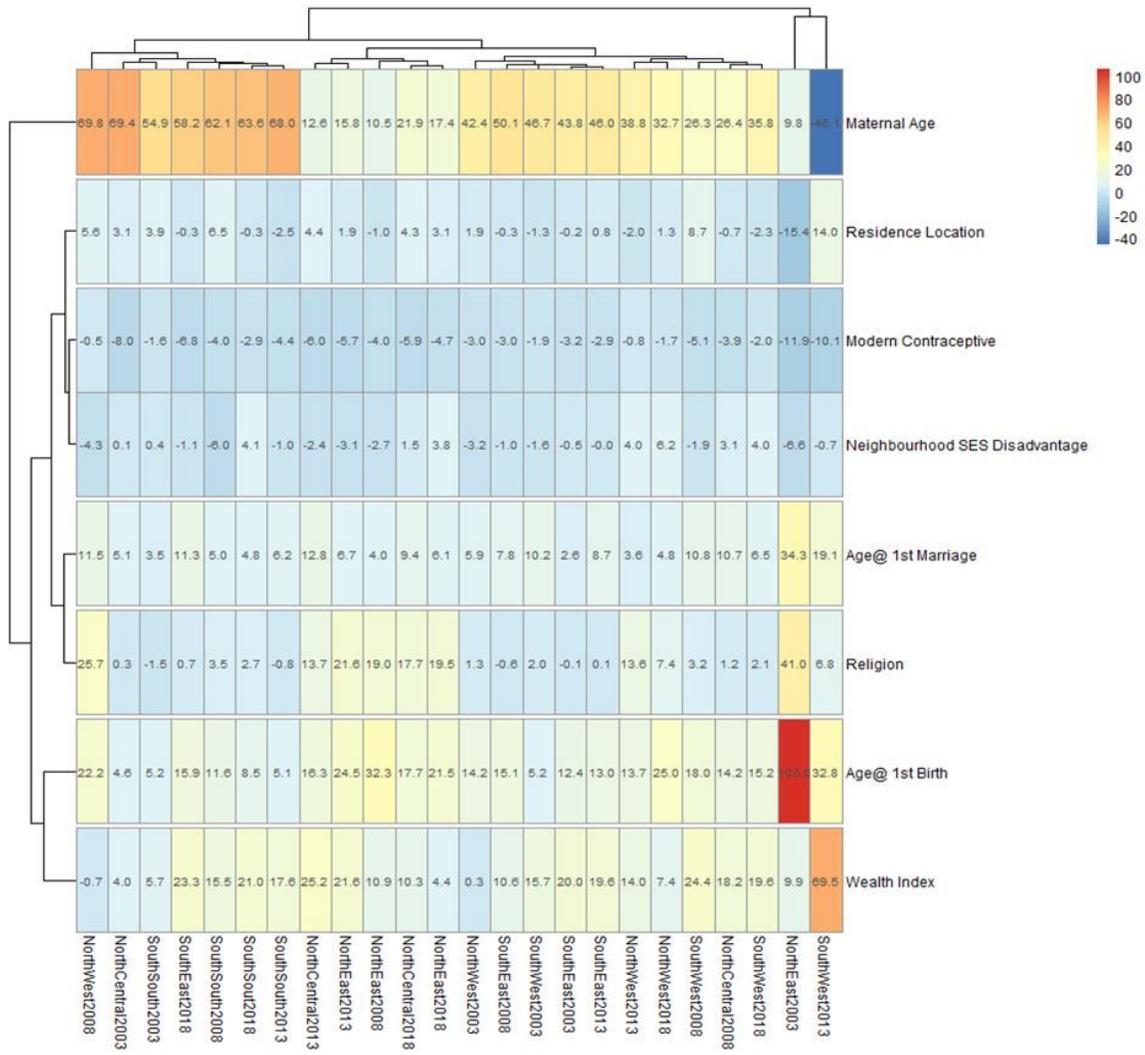


Figure 7

Detailed Decomposition of the part inequality that was caused by compositional effects of the determinants by regions and year periods.