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Abstract

This paper aims to investigate for an evidence of fertility decline reversal in Sudan through analyzing fertility levels and trends and to examine the fertility decline reversal by identifying factors associated with fertility. Primary and secondary sources of data were used. Demographic and Health Survey 1989 (SDHS 1989) and Safe Motherhood Survey 1999 (SMS 1999) reports were the secondary sources while the raw data of Sudan Multiple Indicator Cluster Survey 2014 (MICS 2014) constitutes the primary source. Multiple regression technique has been applied to estimate factors associated with fertility in 2014. Results revealed that the fertility of women increased by 13% during 1993-2014 after it has been declined by 24% between year 1979 and 1993. The group with the largest contribution to fertility increase is 15-19 women years old; which is 70.6%. The statistical analysis results indicated that early age at first marriage before 18 years old and women education were important factors associated with the fertility decline reversal, where one-year increase in the variable of age at first marriage less than 18 represents an increase in fertility by 0.724 and none educated women and those with primary education level increase fertility by 2.417and 1.468 respectively.

Keywords: Decline Reversal, Determinants, Evidence, Multiple Regression.

Introduction

Fertility is a significant element of population dynamics affecting population size and structure. Fertility defined as the actual reproductive performance of a woman and usually measured by total fertility rate (TFR), which means the average number of children a woman could give birth to through her reproductive span if she experienced the prevailing age specific fertility rate. Fertility has fallen substantially in developing countries, even so high fertility –defined as five or more births per woman over the reproductive career- characterizes twenty-nine sub –Saharan ones (World Bank, 2010).Poverty, low level of education, economic status, less autonomy of women and traditional barriers were usually mentioned as reasons for the persistent of high fertility rate in sub-Saharan Africa (Dana2018). High fertility has potentials adverse effects in development efforts and poses health risks for children and their mothers, slow economic growth, investment, and environmental threats (World Bank, 2010).

Recently fertility decline in Africa is thought to have considerably slowed in the second part of 1990s and early 2000s, and with the slow pace of fertility decline in many sub-Saharan countries there is growing evidence of stall in high fertility levels of more than five children per woman in a third of the countries (Bongaarts, 2008). Declines in contraceptive use, increases in unmet needs for family planning, increases preferences for larger families and increases in adolescent fertility were consistently associated with stall in fertility in some African countries (Ezch et al., 2009).

In Sudan, which is one of high fertility countries, it is observed that fertility has been declining gradually over last decades and causes of this decline are investigated through examining proximate and socio-economic determinants of fertility in different studies. The main determinants of fertility during 1979-1989 were breastfeeding and the proportion of married women followed by contraceptive use (Adam, 2007), while the rapid decline in TFR specifically during periods 1979-1993

attributed mainly due to changes in marriage patterns (Eltigani, 2000). In a recent study it was found that post–partum infecundability had the largest effects in reducing fertility by 30% followed by the contribution of marriage by 27.5% and contraceptive use7.8% (Hassan et al., 2018).

Also, among the socio-economic factors, the women education was the indirect factor which has great contribution in changing fertility levels. Despite the declining fertility in Sudan over decades; the last estimate of TFR was 5.2 births per woman (MICS2014). Hence, questions to be raised are Sudan witnessing a fertility decline reversal, if so, what factors caused this reversal trend. This paper is an attempt to answer the above questions, by analyzing fertility levels and trend to estimate the magnitude of increase in fertility and identifying factors associated with it.

Objectives

This paper specifically aims:

- To estimate the magnitude of fertility decline reversal.

- To identifying factors associated with fertility increase.

Data sources

Primary and secondary sources of data were used. National reports: Sudan Demographic and Health Survey 1989 (SDHS 1989), Safe Motherhood Survey 1999 (SMS, 1999) and Sudan Multiple Indicator Cluster Survey 2014 (MICS, 2014) were the secondary sources of data of fertility levels and trend. Data of fertility from Sudan Fertility Survey conducted in 1979 (SFS, 1979) and that of Sudan Maternal and Child Health Survey conducted in 1993 (SMCHS, 1993) was obtained from the above-mentioned reports.

Sudan Multiple Indicator Cluster Survey conducted in 2014 (MICS, 2014), where 18,302 women aged 15-49 were successfully interviewed, was the primary source of the raw data used to identify factors associated with fertility. In this survey a full birth history was collected from each woman, a series of questions about live births was asked to obtain data on

fertility, including the name, sex and date (year and month) of each live birth, age at death for children who died, and for living children, whether or not they were residing with their mother. The sequence of the questions was designed so as to reduce errors commonly found in such survey.

Methodology

Linear multiple regression model has been estimated to identify factors associated with fertility in 2014 as:

$$y = a + b1x1 + b2x2 + \cdots \ldots + bkxk + e$$

Where

y : The dependent variable.

$x1, x2, \ldots \ldots . xk.\, are\, the\, independents\, variables$

$a: constsnt$

$b's: coficints$

e : error term

Measurement of variables:

The dependent variable is the fertility; which is measured by the continuous variable; total number of children ever born for a woman.

Independent or explanatory variables represent a set of demographic and socio-economic variables related to fertility; Education level of women, Age at first marriage, Place of residence (urban/rural), States/ Regions and Ever use of contraception.

In order to estimate regression coefficients all categorical explanatory variables must be transformed to dummy variables with values of '0' or '1'; where '0' value for the reference category. The transformation done as follows:

Education level of women has 4 categories: illiterate, primary, secondary, and higher level of education; this variable transform

to 3 dummy variables with the reference category is higher educational level of women as follows:

Illiterate/None educated: The value '1' for illiterate/none educated and '0' for other levels of education.

Primary education: The value '1' for primary level of education and '0' for other levels of education.

Secondary education: The value '1' for secondary level of education and '0' for other levels of education.

States/ Regions this variable constitutes the 18 states of Sudan. First, we summarized it into a variable of 6 categories, some representing different geographic directions; North (Northern and River Nile), Centre (Gezira, White Nile, Sinnar and Blue Nile), East (Red sea, Kassala and Gadarif) and the West represented by the 3 states of Kordofan and the 5 states of Darfour and Khartoum. Secondly using the dummy variable method with the reference category is Khartoum, then 5 dummy variables are considered in the regression model.

Age at first marriage this variable recoded into two categories '1' for women whose age at first marriage before 18 years of old and '0" to represent age at first marriage at 18+ years old.

Ever use of contraception is a variable of two categories, '1' for women never user of contraception and '0' for women ever user of contraception.

Place of residence (urban/rural) is a variable of two categories, '1' for women who reside in rural areas and '0' for women live in urban areas.

Results

Fertility decline reversal

Table (1) below reflects fertility levels and trend during 1979-2014, estimatesshowas in most developing countries pattern of fertility did not change over times, age specific fertility rates (ASFRs) rise sharply with ages, reach peaks at age 25-29 and gradually fall after age 30-34.

The decline in fertility is most pronounced during 1979 to 1993; where TFR decreased from 6.02 to 4.6 births per woman estimated by 23.6% and this is consistent with the findings of Bongaarts and Casterline (2013) of fertility transition in Africa that did not begin until the late 1980s.

All age groups of women contributed to this decline, except the age groups 35-39 years and 45-49 years. Younger women age groups plus age group 40-44 experienced largest decline in fertility, age group 15-19 (55%), age group 20-24 (36%) and age group 40-44 (39%).

Table (1) ASFRS (per 1000 woman) and TFRs per woman according to SFS 1979, SDHS 1989, SMCHS-1993, SMS 1999 and MICS 2014

Age Group	1979	1989	1993	1999	2014	% 0f Decline During 1979-1993	% of increase during 1993-2014
15-19	114	69	51	72	87	-55.3	70.6
20-24	264	183	169	187	207	-35.9	22.5
25-29	283	240	213	233	259	-24.7	21.5
30-34	251	236	212	227	226	-15.5	6.6
35-39	149	157	161	158	160	+8.1	-.62
40-44	108	82	66	77	71	-38.9	7.6
45-49	35	25	37	31	23	5.7+	-37.8
TFRs	6.02	4.96	4.6	4.9	5.2	-23.6	13.0

Source: National reports; SFS 1979, SDHS 1989, SMCHS-1993, SMS 1999 and MICS 2014

It is obvious that the period 1993 to2014 witnessed a fertility decline reversal, where TFR increased by 13%,with high noticeable contribution of younger age group of women 15-19 years by70.6%, indicating early childbearing in Sudan. This large increase is balanced by the large decline in proportion of births to older group of women 45-49 year's i.e.38%.

Factors associated with fertility in 2014.

In order to investigate the increase in fertility level, a multiple regression model have been estimated for the recent period and the statistical results are displayed in table (2) below.

Table (2) Result of multiple regression analysis

Variables	p-values	Standard Errors	Level of Significance
Constant	3.047	.178	.000
Age at first marriage< 18 years	.724	.055	.000
	2.417	.141	.000
	1.468	.140	.000
Illiterate/None educated.	.970	.145	.000
	.092	.160	.567
Primary education	-.502	.147	.001
	.286	.143	.046
Secondary education	.215	.147	.143
	.355	.142	.012
North	-.560	.085	.000
East	-.419	.065	.000
Centre			
Kordofan			
Darfur			
Never use of contraception			
Rural Residence			

At 5% level of significance all variables contribute to the explanation of the linear regression model, except North and Kordofan regions. One-year age at first marriage less than 18 represent an increase in fertility, on average, by 0.724. The adverse effect of women education in fertility is highly noticeable; none educated women and those with primary education level increase fertility by 2.417and 1.468 respectively.

All states/regions contribute to the increase in fertility level except the East, where fertility reduced by 0.502, a result which is consistent with the documented levels of fertility below the national level in Eastern states of Red Sea and Kassala; 3.2 and 4.8 respectively (MICS 2014). Darfur region is the highest contributor to the increase in fertility level compared to other regions; by 0.355. The unexpected, contradicted result is the effect of rural residence and never using of contraception, as these two factors associated with a reduction in fertility by 0.419 and 0.560 respectively. The opposite effect of these two variables may be due to multicolonearity between variables, and this confirmed by examining relations between the variables of place of residence and using of contraception and all other variables using chi-square tests and all relations were highly statistically significant (results not shown).

Discussions and Conclusion

-The analysis of fertility levels and trend during 1993 -2014 reflects a fertility decline   reversal where TFR increased by 13% after it has been declined by 23.6% during 1979- 1993, most of this decline reversal is due the Increase in early age at marriage and childbearing

- High noticeable contribution of younger age group of women to fertility, Births for age group 15-19 increased by 70.6%. This finding consistent with the fact that decrease in age at first marriage and increase in percentages of women who were married before age 18 is the deterministic factor for the fertility increase; if age at childbearing starts earlier the mother can have many children through her reproductive span even with long birth interval and this result can be supported by argument of Bongaart and Casterline (2013) that the potential for fertility decline due to lengthening of inter-birth interval is less in Africa than in Asia and Latin America. Also this finding confirmed by data of MICS 2014where results showed that 38 % of women ages 20-49 years were married before age 18.

- The importance of women's education in changing fertility levels is obvious, where the adverse effect of women education in fertility is highly noticeable; none educated women and those with primary education level increase fertility by 2.417and 1.468 respectively.

- All states/regions contribute to the increase in fertility level except the East, where fertility reduced by .502, a result which is consistent with the documented levels of fertility below the national level in Eastern states of Red Sea and Kassala; 3.2 and 4.8 respectively (MICS 2014).

- We conclude that Sudan is witnessing a fertility decline reversal; as its level of TFR increased by 13%, and this could be stopped by avoiding conditions of high fertility and the most effected early age of childbearing as documented by Onour (2018) that if adolescent births eliminated TFR (5.2) will reduce by 8.0%, through raising socio- economic characteristics of women like education and knowledge and accessibility of contraception.

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