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Contextual Determinants of Fertility Transitions among Black South African Women: A Multi-Level Analysis

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Abstract: Fertility declines (transitions) and their contextual determinants are concerns to the government and other stakeholders in South Africa. These are so, especially among the Black South African women of childbearing age. The South African Demographic Health Survey (SADHS) 2016 data was used to examine the role of three hierarchical layers of variables (individual, household and community level characteristics) in determining fertility transitions among Black South African women of childbearing age. Based on the Social-Ecological (SEM) and the Easterlin's micro-economic models, the chi-squared test and multilevel logistic regression were performed at the bi-variate and multivariate levels of analysis. The multilevel logistic regression was performed using the generalised linear and latent mixed model (GLLAMM) to obtain fixed and random effects. Findings suggest that close to half (48.1%) of these women had low fertility levels (1-2 children) in South Africa. Those in rural areas had a higher fertility level (4 plus children), compared to those in urban areas. Factors such as mother's age, employment and wealth status, owning a house with water and electricity, access and distance to health facilities and workers, etc., were strongly associated (significant) at different hierarchical model levels ($p<0.05$). Results of random effect revealed a non-existance (0.00%) of variations in their log odds of predicting fertility transitions across the communities (clusters/layers). The study recommends that these findings be considered in all programme and policy developments around the issue in South Africa.

Keywords: Fertility transitions, multilevel regression, association, contextual, Black South African, hierarchical layers

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Background

Studies in sub-Saharan Africa (Anderson 2003; Moultrie and Timaeus 2002; Sayi 2014/15; Garenne and Macro 2008; Bongaarts 2007/2008; Garenne 2008; Stats SA 2011) suggest a change in fertility patterns in the last five decades. Specifically, literature suggests that fertility levels are on the decline in South Africa, starting much earlier ahead of most of the other countries in the region (Anderson 2003; Moultrie and Timaeus 2003; Palamuleni *et al.* 2007; Stats SA 2011). Also, the country currently has the lowest fertility rate in sub-Saharan Africa (ibid). Fertility levels started declining in the 1950s and became more pronounced in the 1960s in South Africa (Rossouw *et al.* 2012; Stats SA 2011). The rate declined from 6.0 in the 1950s to 4.3 in the 1980s, dropping further to 3.3 in the 1990s (Rossouw *et al.* 2012; Moultrie and Timaeus (2003). In 2011 the rate was about 2.6 children dropping further to 2.4 children per woman in 2016. The rate currently stands at a 2.31 low in South Africa, according to the mid-year estimates (Stats SA 2021).

In addition, earlier results in the country point to variations in the fertility decline by demographics over the years, as fertility levels began to decline at different times and rates among different population groups in South Africa. Specifically, the rate declined more slowly for the Black African population when compared to any other population group in the country (Magagula 2009; Swartz 2003). For example, the fertility level of the Black African population group was at 3.0 children per woman in the 1980s, declining from 6.5 children per woman in the 1960s (ibid). The rate was at 2.8 in 2011 and during the same period, the white (1.7) and Indian/Asian (1.8) population group had already recorded a remarkable decline in fertility below replacement levels (Stats SA 2015). Therefore, at the rate of 2.8 in 2011, the level of fertility among Black African women remained the highest among all population groups in South Africa (ibid), with the provincial pattern differentials reflecting the unique provincial characteristics prevailing in each province (Stats SA 2015; Palamuleni *et al.* 2007).

In the light of these dynamics, early studies have revealed some of the background and socio-economic characteristics behind the fertility dynamics experienced in South Africa. For example, Rossouw *et al.* (2012) dwelled on fertility transitions in the country over the years, including the reasons for the decline since the 1960s. Among others, the study found factors such as improved education levels, lower prevalence of marriage, improved contraceptive use, the social role of women, etc., as being strongly associated (Rossouw *et al.* 2012). Although commendable, the study was done in the context of HIV/AIDS. Makgeledisa (2017) examined the socio-economic and demographic factors influncing fertility rates among selected women in the Northern Cape province of South Africa. The study confirmed factors such as level of education, type of place of residence and marital status as strong contributors to fertility among the study population.Other studies consistent with some of these findings in South Africa include that of Palamuleni *et al.* (2007), Anderson (2003), Moultrie and Timæus (2002), etc.

With these contexts in mind, much effort is therefore needed in exploring other contextual (distal) factors that also have a place in influencing fertility patterns (transitions) in recent times. These are mostly socio-cultural, structural and neighbourhood related factors also expected to influence fertility patterns in any social context. This is so, in a further effort of advancing existing knowledge beyond the understanding of fertility determinants at the background (individual) levels. More so, the need to explore these factors, especially among the Black South African women of childbearing age (15–49 years) in South Africa has become inevitable and as such a concern. Therefore, this study examined the contextual determinants of fertility transitions among Black South African women of childbearing age (15–49 years) in South Africa in a broader perspective. Specifically, the study examined the individual and contextual factors and determined the extent to which these characteristics explain hierarchical variations in fertility transitions (i.e. the extent to which these factors determine fertility transitions at different hierarchical model levels) among the study population in South Africa. Understanding these dynamics should bring about informed policies and programme development in the country.

Methods

Data, Design and Analysis

The South African Demographic Health Survey (SADHS) 2016 data was used to examine the role of three hierarchical layers of variables (individual, household and community characteristics) in determining fertility transitions among Black South African women of childbearing age in South Africa. The SADHS 2016 data is secondary cross-sectional data collected at a point in time (de facto), using study sample evenly distributed in the country and other methodology appropriate to the South African context. The data was collected at different levels, as such hierarchical in nature (cluster). Therefore, appropriate in carrying out multilevel analyses, in order to investigate the factors responsible for the observed fertility patterns, including existing variations at different hierarchical/operational (regional) model levels in the country, overall making the data suitable for a nationally representative study of this nature. The study employs an analytical cross-sectional study design, through the analysis of the secondary dataset referred to above. This design helped in creating a cross-sectional panel suitable enough to provide information appropriate in performing multilevel regression analyses i.e. allowing for a multilevel framework.

Based on the Social-ecological (SEM) and the Easterlin's micro-economic models, the study adopted a quantitative method of analysis and this was carried out at the bivariate and multivariate levels. The Chi-squared test was employed to obtain the relationship existing between each explanatory and outcome variable at the bivariate level, while the multilevel logistics regression model was employed at the multivariate levels. The multilevel logistics regression model analysis was performed using the generalised linear and latent mixed model (GLLAMM) to obtain the fixed and random effects (test of associations/goodness of fit and variations), existing in the relationship at the various operational/model levels (i.e. individual, household and community hierarchical model levels) during the study period. Data was analysed using Stata software (version 14) and findings expressed in proportion and odds ratio.

Outcome and Explanatory Variables

The number of children ever born (CEB) variable was used as a measure of the outcome variable in the study. The CEB is a continuous fertility variable with 0-17 count responses, capturing the total number of children ever born to a woman (lifetime fertility). To obtain this variable, a question was asked on how many children a woman has ever given birth to. This variable was recoded into no child (0 child), low (1-2 children), moderate (3 children) and high (4 plus children) fertility levels (transitions) at the the bivariate levels and recoded appropriately at the multilevel analysis to achieve the set objectives of the study. Selected individual and contextual (socio-structural/distal) characteristics in the data were identified and used as explanatory variables in the study. Also known as individual and neighbourhood level characteristics, these variables were appropriatly defined (classified) to fit the five regression models of the multilevel analysis. They were carefully selected, extracted and recoded where necessary to suit the study objectives. The selection of all explanatory variables was guided by the variable being statistically significant ($p<0.05$) at the bivariate level, reviewed literature and established theoretical foundations of the study.

Results

Distribution of Fertility Levels by Selected Individual and Contextual Level Characteristics

Table 1 presents the percentage distribution of fertility levels (low, moderate and high) by selected individual level characteristics of the study sample, 2016. The overall results showed that a majority proportion (48.1%) of these women were in the low fertility category (1–2 children) in South Africa. The proportion of those with high fertility levels (4 plus children) increased with age, while the proportion of those with no children decreased with age. There were significant proportions of those having low fertility levels (62.1%) among those in the age group of 30–34 years, as compared to any other level in the age group. Those in the age group of 15–19 years (89.2%) had the highest proportion among those with no children. This proportion indicates that above two-thirds of women in this age group had no children. Also, a significant proportion of those living together (56.0%) had low fertility (1–2 children), compared to other marital status incidences. An insignificant proportion of these women divorced/separated (4.9%) had no children. Those with low fertility (1–2 children) had the highest proportion (65.6%) of female children. More so, the sex of a child was not associated with fertility transitions ($p<0.05$).

The results show that the higher the levels of education, the higher the proportion of those with low fertility (1–2 children) and the lower the proportion of those with high fertility levels (4 plus children). Also, women with higher levels of education (59.9%) had the highest proportion among those with low fertility levels (1–2 children). About two in every ten (18.1%) of those with primary education had moderate fertility (3 children) among the study sample. A high proportion of the women with low fertility levels (1–2 children) spoke African (62.5%), followed by IsiNdebele (57.1%) and English (52.3%). The least proportion of those with no children spoke Tshivenda (21.5%) and Afrikaans (21.9%). The results also show that 34.6% of those with no children were not working. Those not working (11.4%) also had the lowest proportion among those with moderate fertility levels (3 children). Above two-thirds of those in informal employment (65.9%) had low fertility levels (1-2 children). Overall, the results show that with the exception of the sex of child variable, all tested individual level characteristics were found to be associated with fertility transitions among these women at this level of analysis in South Africa ($p<0.05$).

Table 1: Percentage distribution of fertility levels (low, moderate and high) by selected individual level characteristics of the study sample, 2016

	Fertility levels (Total children ever born)				
Variable	*0 child (No child) (%)*	*1–2 children (Low fertility levels) (%)*	*3 children (Moderate fertility levels) (%)*	*4 plus children (High fertility levels) (%)*	*P>|z|/ p-value*
Overall	26.9	48.1	13.8	11.2	
Mother's age (Years)					0.000
15-19	86.2	13.8	0.0	0.0	
20-24	40.5	57.0	2.1	0.5	
25-29	12.3	71.5	13.2	2.9	
30-34	7.5	62.1	19.4	10.9	
35-39	5.6	49.4	24.6	20.4	
40-44	5.6	38.4	24.6	31.4	
45-49	5.2	32.2	23.7	39.0	
Sex of child					
Male	-				
Female		65.6	18.0	16.4	0.432
H/level of education					0.000
No schooling	11.1	27.2	16.1	45.7	
Primary	17.3	32.0	18.1	32.6	
Secondary	29.9	48.0	13.1	9.0	
Higher	22.6	59.9	11.4	6.1	
Language					0.000
English	32.1	52.3	8.8	6.8	
Afrikaans	21.9	62.5	12.5	3.1	
IsiXhosa	26.4	46.6	14.1	12.9	
IsiZulu	28.6	45.6	13.4	12.3	
Sesotho	27.8	49.5	13.2	9.5	
Setswana	26.2	47.3	15.4	11.2	
Sepedi	29.8	43.7	13.6	13.0	
SiSwati	24.6	46.5	11.6	17.3	
Tshivenda	21.5	45.6	17.7	15.2	
Xitsonga	25.8	44.2	14.4	15.6	
IsiNdebele	33.3	57.1	4.8	4.8	

	Fertility levels (Total children ever born)				
Variable	*0 child (No child) (%)*	*1–2 children (Low fertility levels) (%)*	*3 children (Moderate fertility levels) (%)*	*4 plus children (High fertility levels) (%)*	*P>|z|/ p-value*
Respondent c/ working					0.000
No	34.6	42.9	11.4	11.1	
Yes	11.2	56.5	18.3	14.1	
Respondent occupation					0.000
Not working	35.9	41.8	11.3	10.9	
Formal employment	12.9	59.6	16.1	11.5	
Informal employment	7.0	65.9	16.3	10.9	
Manual	9.9	48.4	21.4	20.3	

Table 2 presents the percentage distribution of fertility levels (low, moderate and high) by selected contextual level characteristics of the study sample, 2016. The results show that women staying with their husband (21.0%) and elsewhere (22.7%) had almost an equal proportion among those with moderate fertility level (3 children). However, almost half (48.2%) of these women with low fertility levels (1–2 children) did not own a house, with almost an equal proportion having electricity (47.3%) in their homes. The proportion of those with no electricity (18.2%) was slightly higher than those with electricity (11.5%) among those with high fertility levels (4 plus children). The distribution shows that less than one in every ten of these women with higher fertility levels (4 plus children) were from households with less than five (<5) members. A little above half (50.7%) of the women using flush toilet had low fertility (1–2 children), while only a proportion of 14.8% of those with high fertility (4 plus children) used pit latrine. Also, a little over half of these women who shared toilet facilities (55.1%) with other households had low fertility levels (1–2 children). The proportion of those who shared a toilet (21%) was lower than those who did not share (29.1%) a toilet, among those with no children.

The results also show that almost half of the women (47.8%) with low fertility levels (1–2 children) used piped water as their source of drinking water, suggesting a moderate proportion. Though, at a proportion of 19.3%, those using a river/stream as their source of drinking water were the highest among those with high fertility levels (4 plus children). The results show that the richest (52%) were higher among those with low fertility levels (1–2 children), while the poorest (17.6%) were higher among those with high fertility levels (4 plus children). Also, the proportion decreased as the wealth quintile increased among those with high fertility and increased among those with low fertility during the study period. The wealthier these women were, the lower the fertility and the poorer the women were, the higher the fertility. Therefore, wealth quintile was found to have a suppressing effect on fertility. A significant portion of those with low fertility levels (1–2 children) resided in the Northern Cape (54.2%), closely followed by Gauteng (50.7%). The North West province (23.4%) had the least proportions among those with no children. These distributions suggest that a little above two in every ten of these women in the North West province had no children, suggesting a low proportion. The low proportional level was also consistent in all the provinces of South Africa during the study period. The results also showed that a large proportion (50.2%) of these women who stayed in urban areas had low fertility levels. This proportion suggests that half of these women with low fertility levels (1–2 children) stayed in urban areas, although the proportion of those who resided in the rural areas (14.8%) was higher than those who resided in the urban areas (9.3%) among those with high fertility levels (4 plus children).

Two-thirds of those women with low fertility levels used a gynaecologist (66.2%) and a community health worker (66.5%) during prenatal care, suggesting a high proportion. Furthermore, those who saw the distance to a health facility as being a big problem (45.5%) had a slightly lower proportion compared to those who did not see it as a big problem (48%) among those with low fertility levels (1-2 children) during the study period. A high number of these women with low fertility (67.6%) used the health facility as their place of delivery; while an insignificant proportion (38.7%) of those with high fertility (4 plus children) used the home as their place of delivery. Overall, the results show that with the exception of prenatal care (gynaecologist and community health worker) variables, all tested contextual characteristics were found to be associated with fertility transitions among the study sample during the study period ($p<0.05$). Also, the results suggest that the majority of these women in South Africa had low fertility levels (1–2 children) and as such, were consistent with national patterns.

Table 2(a): Percentage distribution of fertility levels (low, moderate and high) by selected contextual level characteristics of the study sample, 2016

	Fertility transitions (Total children ever born)				
Variable	*0 child (No child) (%)*	*1–2 children (Low fertility levels) (%)*	*3 children (Moderate fertility levels) (%)*	*4 plus children (High fertility levels) (%)*	*P>|z|/ p-value*
Currently reside with husband/partner					0.000***
Staying with her	6.6	52.3	21.0	20.0	
Staying elsewhere	4.3	42.8	22.7	30.2	
Own house					0.000***
Does not own	34.1	48.2	10.3	7.4	
Alone only	8.8	42.6	24.2	24.4	
Jointly only	6.8	43.6	21.2	28.4	
Both alone & jointly	8.3	44.6	23.1	24.0	
H/hold has electricity					0.000***
No electricity	24.3	43.5	14.0	18.2	
Has electricity	27.8	47.3	13.5	11.5	
Family/household size					0.000***
<5	25.6	53.8	12.4	8.2	
5-6	29.9	36.0	17.3	16.9	
7+	28.7	45.0	12.0	14.4	
Type of toilet facility					0.000***
Flush toilet	27.9	50.7	12.6	8.7	
Pit latrine	27.6	43.5	14.1	14.8	
Other	24.1	48.1	13.4	14.4	
None	19.5	41.0	18.1	21.4	
Share toilet with other H/holds					0.000***
No	29.1	45.4	13.4	12.2	
Yes	21.0	55.1	13.3	10.6	
Source of drinking water					0.000***
Piped	27.2	47.8	13.7	11.3	
Well/borehole	29.1	42.4	12.8	15.7	
River/stream	27.0	36.3	17.4	19.3	
Other	28.3	46.3	9.6	15.8	
Wealth quintile					0.000***
Poorest	27.2	41.4	13.6	17.6	
Poorer	24.6	46.7	15.5	13.2	
Average/middle	26.6	49.1	12.4	11.9	
Richer	31.5	49.1	12.8	6.6	
Richest	30.1	52.0	12.0	5.9	

Table 2(b): Percentage distribution of fertility levels (low, moderate and high) by selected contextual level characteristics of the study sample, 2016 (concluded)

	Fertility transitions (Total children ever born)				
Variable	*0 child (No child) (%)*	*1–2 children (Low fertility levels) (%)*	*3 children (Moderate fertility levels) (%)*	*4 plus children (High fertility levels) (%)*	*P>|z|/ p-value*
Province/region					0.000***
Western Cape	30.7	47.3	14.9	7.1	
Eastern Cape	27.6	45.9	13.8	13.1	
Northern Cape	24.3	54.2	12.7	8.9	
Free State	29.8	49.6	12.7	8.0	
KwaZulu-Natal	31.1	46.1	11.9	11.0	
North West	23.4	46.8	16.5	13.3	
Gauteng	25.4	50.7	13.9	10.1	
Mpumalanga	26.0	47.1	11.8	15.2	
Limpopo	28.4	42.1	14.7	14.7	
Type of place of residence					0.000***
Urban	27.8	50.2	12.8	9.26	
Rural	27.2	43.8	14.2	14.8	
Prenatal care: Gynaecologist					0.597
No	-	66.18	18.61	15.2	
Yes		68.68	17.9	13.5	
Prenatal care: C/Health Officer					0.268
No	-	66.5	18.4	15.2	
Yes		66.7	28.6	4.8	
Distance from health facility					0.008**
Big problem	25.6	45.5	13.4	15.6	
Not a big problem	27.3	48.0	13.4	11.3	
Place of delivery					0.000***
Home	-	40.6	20.8	38.7	
Health facility		67.6	18.4	14.0	
Others		58.3	16.7	25.0	

Contextual Determinants: Multilevel Analysis

Table 3 presents the results of the multilevel logistic regression models showing the fixed and random effects of individual, household and community level factors associated with fertility transitions of the study sample, 2016. The results of fixed effects show that mother's age was significant during the study period, although the test at individual level (model 2) showed that the odds ratio of those in the age group 45–49 were 47% (OR=0.53; $p<0.05$) lower (i.e. less likely), compared to their reference category. Mother's education was significantly associated with fertility transitions, especially among those with a higher level of education at the individual level model test. The results also showed that as their levels of education increased, the odds ratio also increased in all models tested (models 2 and 5), therefore ascribing a strong effect to the variable. The results of the individual level model test (model 2) show that the odds ratio of those with a higher level of education experiencing fertility transitions was 25% higher (OR=1.25; $p<0.05$), compared to those with no education (reference category).

Language was not associated with fertility transitions, although significant with most languages at the individual level model test (model 2). The odds ratio of those women speaking IsiZulu was 0.92 (OR=0.92; $p<0.05$) times less likely, compared to those speaking English. Mother currently working was significantly associated with fertility transitions, especially at the individual level model test (model 2). The result showed that those currently working presented a 5% higher odds ratio (OR=1.05; $p<0.05$), suggesting a moderate but strong association, compared to those not working during the study period ($p<0.05$). With the exception of those in manual occupations, the results showed that mother's occupation was also significantly associated at both individual and full level model tests, especially among those in informal employment. The results of the full model level test (model 5) showed that those in both formal and informal employment occupations presented a 10% (OR=1.10; $p<0.05$) and 71% (OR=1.71; $p<0.05$) higher odds ratio, suggesting a strong association, compared to those in the reference category. The inclusion of a new class of variables (model 5) resulted in a significant change (increase) in odds ratio values, especially among those in the informal employment. The husband residing at home factor was associated at the full level grouping model (model 5) and was significant at the individual level model test (model 2). Though the results of the full model test (model 5) showed that those women whose husbands stayed elsewhere presented only a 2% association, compared to their reference category ($p<0.05$). With slight differences in odds ratio values, owning a house also maintained a consistent pattern. However, the results at the full model test (model 5) showed that those who own a house both alone and jointly presented only 2% higher odds ratio, thus indicating a 1.02 (OR=1.02; $p<0.05$) times association, compared to those in their reference category.

Household having electricity was associated at the full model test (model 5), but not at the individual level model test (model 2). The results at the full model test showed that those with electricity had a 15% higher odds ratio (OR=1.15; $p<0.05$), compared to those who did not have electricity. In addition, the results also showed that family size was highly significant to fertility transitions in all models tested (models 3 and 5). However, the test at household level (model 3) among those with seven and more household members (7+) indicated a 0.68 lower odds ratio (OR=68; $p<0.05$), compared to those in the reference category. This rate indicates a 32% less association during the study period. Type of toilet facility was also associated with fertility transitions, especially among those using pit latrines at the full level model test, with all other response categories presenting inconsistent odds ratio values. A Black South African woman of childbearing age using a pit latrine presented a 2% higher odds ratio (OR=1.02; $p<0.05$), compared to those using a flush toilet (model 5). Source of drinking water was also associated with fertility transitions among the study sample; however, with the exception of those using a river/stream in all model levels tested (models 3 and 5). The test at model 5 level revealed a 14% higher odds ratio (OR=1.14; $p<0.05$) among those using other sources of drinking water, compared to their reference category. The results also showed that the wealth quintile (status) of these women was statistically significant (associated) with fertility transitions, especially at the household level model test (model 3). The results at this level showed that the richest of these women presented a 25% higher odds ratio, suggesting a 1.25 higher association (OR=1.25; $p<0.05$), compared to those in the reference category (model 3). Also, the addition of a new level of variables (model 5) revealed a consistency in higher positive ratio, also reflecting the importance of the variable.

The province/region of residence was not associated with fertility transitions during the study period. Also, the addition of a new level of variables (model 5) presented insignificant odds ratio values. The results at the community regional level model test (model 4) suggested that those residing in KZN presented a 6% lower odds ratio (OR=0.94; $p<0.05$), indicating a 0.94 lower association ($p<0.05$), compared to that of the reference category (Western Cape). Similarly, with a slight difference in odds ratio values, type of place of residence was also not associated. Test at community regional level model (model 4) indicated that the odds ratio of those staying in rural areas was 4% less (OR=0.96; $p<0.05$), compared to those in urban areas, therefore suggesting a lower chance of fertility transitions in the rural areas. Having access to a gynaecologist and health care community worker during prenatal care presented strong odds ratio at the full model test (model 5). The odds ratio of those with access to a gynaecologist was 3% higher (OR=1.03; CI=0.92-

1.16), while the ratio for those with access to health care community worker was 26% higher (OR=1.26; CI=0.79-1.91) compared to the reference categories. The results also showed that distance to a health facility was associated, especially at the community regional level test (model 4), but not so at the full model test level (model 5). The test at model 4 suggests a 1.01 time odds ratio, suggesting a 1% higher association (OR=1.01; p<0.05), compared to those in the reference category. Place of delivery was significantly associated (statistically significant) among those using a health facility as their place of delivery. Also, the addition of a new level of variables (model 5) maintained a consistent higher predictive power. Test at community regional level model (model 4) indicates a 24% higher odds ratio (OR=1.24; p<0.05), compared to those using the home as a place of delivery.

The results of the random effects model are shown in Table 8.2 (including empty Model 1). The results show that the variation in the log odds of predicting low fertility transitions among these women across the communities (clusters) within the last twelve months to the time of the survey does not exist at 0.00. The variation remained 0.00% even after controlling for individual, household and community level variables. The results show that 0.00% of the variance in the experience of lower fertility could be attributed to community/cluster-level variables, according to the intra-cluster correlation coefficient implied by the estimated intercept component variance (VPC). Also, as judged by the proportional change in variance (PCV), -89.28% of the variance in log odds of experiencing lower fertility by the respondents across the community clusters was explained by individual compositional factors (Model 2), -117.48% by household factors, -104.8% by community factors and -61.69%, when all the variables were combined (Model 5). The median odds ratio (MOR) of 1.00 (in all the models) showed that in the median case, the residual heterogeneity between areas increased by 1.00 times the individual odds of experiencing lower fertility by the respondents within the last twelve months to the time of the survey, when randomly picking out two persons in different areas. This therefore indicates or means that, if a person moved to another area (cluster) with a higher probability of experiencing lower fertility, their risk of experiencing the same will (in median) increase by 1.00 times. In addition, the residual heterogeneity between areas (i.e. MOR=1.00) showed that there was no real difference (variability) between areas/clusters in the probability of experiencing lower fertility by the respondents. Also, the low (insignificant) values observed and the decrease in the value of AIC and BIC from one model to the next is an indication of good model fitness (Uthman 2008). Therefore, suggesting that the models applied in the study correctly predict the outcomes of the study during the study period.

Table 3 (a): Results of the multilevel logistics regression models showing the fixed and random effects of individual, household and community level factors associated with fertility transitions (low fertility levels) of the study sample, 2016

	Model 1 Emptymodel	*Model 2 Individual level*		*Model 3 Household level*		*Model 4 Community level*		*Model 5 Full model (Empty, Individual, H/hold and Community)*	
Fixed effects	*OR*	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*
Individual level characteristics									
Mother's age									
15-19		RC						RC	
20-24		0.95**	0.93-0.98					0.84	0.57-1.24
25-29		0.82***	0.80-0.85					0.60**	0.41-0.87
30-34		0.71***	0.69-0.73					0.52**	0.35-0.76
35-39		0.61***	0.59-0.63					0.42***	0.29-0.63
40-44		0.55***	0.53-0.57					0.38***	0.26-0.56
45-49		0.53***	0.51-0.55					0.32***	0.20-0.51
Highest level of education									
No schooling		RC						RC	
Primary		1.00	0.94-1.06					0.81	0.64-1.02
Secondary		1.14***	1.08-1.21					0.96	0.77-1.19
Higher		1.25***	1.17-1.34					1.04	0.81-1.33
Language									
English		RC						RC	
Afrikaans		1.04	0.92-1.19					1.22	0.70-2.13
IsiXhosa		0.93**	0.90-0.97					0.92	0.73-1.15
IsiZulu		0.92***	0.89-0.96					0.88	0.73-1.07
Sesotho		0.98	0.94-1.02					1.05	0.86-1.28
Setswana		0.95**	0.91-0.99					0.99	0.78-1.27
Sepedi		0.92***	0.87-0.96					0.99	0.80-1.23
SiSwati		0.90***	0.85-0.96					1.04	0.79-1.36
Tshivenda		0.88***	0.83-0.93					0.91	0.70-1.17
Xitsonga		0.91***	0.86-0.95					1.00	0.80-1.25
IsiNdebele		1.04	0.96-1.13					1.25	0.88-1.79
Mother currently working									
No		RC						RC	
Yes		1.05**	0.99-1.10					1.00	0.83-1.20

Table 3 (b): Results of the multilevel logistic regression models showing the fixed and random effects of individual, household and community level factors associated with fertility transitions (low fertility levels) of the study sample, 2016 (continued)

Variable	*Model 1 Empty model*	*Model 2 Individual level*		*Model 3 Household level*		*Model 4 Community level*		*Model 5 Full model (Empty, Individual, H/hold and Community)*	
Fixed effects	*OR*	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*
Mother's occupation									
Not working		RC						RC	
Formal employment		1.05**	1.00-1.10					1.10	0.91-1.32
Informal employment		1.08**	1.00-1.16					1.71**	1.22-2.38
Manual		0.97	0.92-1.02					0.95	0.78-1.15
Household level characteristics									
Husband resides at home									
Living with her				RC				RC	
Staying elsewhere				0.94**	0.89-0.98			1.02	0.92-1.12
Own house (tenure)									
Does not own				RC				RC	
Alone only				0.88**	0.81-0.96			1.04	0.85-1.26
Jointly only				0.88***	0.83-0.92			1.09	0.98-1.21
Both alone and jointly				0.90***	0.85-0.94			1.02	0.92-1.12
Has electricity									
No electricity				RC				RC	
Has electricity				0.99	0.92-1.08			1.15	0.98-1.35
Household/family size									
<5				RC				RC	
5-6				0.66***	0.63-0.69			0.80***	0.73-0.88
7+				0.68***	0.64-0.72			0.86**	0.77-0.97
Type of toilet facility									
Flush toilet				RC				RC	
Pit latrine				1.00	0.95-1.05			1.02	0.90-1.15
Others				0.98	0.87-1.09			1.04	0.84-1.28
None				1.00	0.89-1.13			0.87	0.70-1.07

Table 3 (c) : Results of the multilevel logistic regression models showing the fixed and random effects of individual, household and community level factors associated with fertility transitions (low fertility levels) of the study sample, 2016 (continued)

Variable	*Model 1 Empty model*	*Model 2 Individual level*		*Model 3 Household level*		*Model 4 Community level*		*Model 5 Full model (Empty, Individual, H/hold and Community)*	
Fixed effects	*OR*	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*	*OR*	*(95% CI)*
Household level characteristics									
Source of drinking water									
Piped				RC				RC	
Well/borehole				1.03	0.95-1.11			1.02	0.87-1.21
River/stream				0.97	0.87-1.09			0.82	0.65-1.04
Other				1.04	0.96-1.12			1.14	0.98-1.33
Wealth quintile									
Poorest				RC				RC	
Poorer				1.07	0.99-1.14			0.98	0.85-1.13
Average				1.12**	1.04-1.21			1.03	0.88-1.20
Richer				1.15**	1.06-1.26			1.03	0.87-1.22
Richest				1.25***	1.13-1.37			1.04	0.85-1.28
Community level characteristics									
Province/region									
Western Cape						RC		RC	
Eastern Cape						0.95	0.80-1.12	0.99	0.78-1.27
Northern Cape						0.98	0.81-1.19	0.88	0.63-1.20
Free State						0.95	0.80-1.12	0.90	0.69-1.18
KwaZulu-Natal						0.94	0.80-1.11	0.86	0.66-1.16
North West						0.91	0.77-1.08	0.79	0.59-1.06
Gauteng						0.93	0.79-1.10	0.93	0.72-1.18
Mpumalanga						0.93	0.79-1.11	0.90	0.68-1.17
Limpopo						0.93	0.79-1.10	0.90	0.68-1.20

Variable	*Model 1 Empty model*	*Model 2 Individual level*		*Model 3 Household level*		*Model 4 Community level*		*Model 5 Full model (Empty, Individual, H/hold and Community)*	
Type of place of residence									
Urban						RC		RC	
Rural						0.96	0.90-1.02	0.96	0.85-1.07
Prenatal care: Gynaecologist									
No						RC		RC	
Yes						0.99	0.91-1.07	1.03	0.92-1.16

Table 3(d): Results of the multilevel logistic regression models showing the fixed and random effects of individual, household and community level factors associated with fertility transitions (low fertility levels) of the study sample, 2016 (concluded)

Variable	*Model 1 Empty model*	*Model 2 Individual level*		*Model 3 Household level*		*Model 4 Community level*		*Model 5 Full model (Empty, Individual, H/hold and Community)*	
Fixed effects	OR	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Prenatal care: H/Comm worker									
No						RC		RC	
Yes						0.91	0.66-1.27	1.26	0.79-1.91
Distance from health facility									
Big problem						RC			
Not a problem						1.01	0.94-1.07	0.98	0.89-1.07
Place of delivery									
Home						RC		RC	
Health facility						1.24**	1.09-1.42	1.23**	1.02-1.48
Others						1.22	0.82-1.80	1.12	0.64-1.97
Measure of variations (variance)									
Random effects									
Community level variance (SE)	**0.00 (0.00)**	**0.00 (0.00)**		0.00 (0.00)		0.00 (0.01)		0.00 (0.01)	
PCV (explained variation) (%)	**Reference**	**-89.28**		-117.48		-104.80		-61.69	
MOR	**1.00**	**1.00**		1.00		1.00		1.00	
ICC/VPC (%)	**0.00**	**0.00**		0.00		0.00		0.00	
Model fit statistics									
AIC	**8655.75**	5685.81		2688.25		1656.31		477.78	
BIC	**8676.46**	**5864.15**		2802.01		1748.70		710.60	
Sample size									
Level 1	**641**	**619**		586		502		286	
Level 2	**7,359**	**5,052**		2,182		1,252		439	

Discussion

In applying the bivariate and multivariate multilevel analysis, the study examined the contextual determinants of fertility transitions among Black South African women in South Africa. Results at the bivariate level revealed that the level of association was higher among those with low fertility levels (1–2 children) during the study period. This pattern suggests that the majority of these women in South Africa have low fertility levels, and as such is consistent with national patterns. The multivariate multilevel analysis carried out revealed the fixed (association) and random (variance) effects of all tested variables on fertility transitions at different hierarchical layers (grouping). The results of fixed effects show that mother's age was statistically significant to fertility transitions at all levels tested (models 2 and 5). Also, as the age of the mother increases, the lower the odds ratio of contributing, suggesting a lower chance of association due to age increase in all model level tests. These patterns are consistent, keeping in mind that the older a woman is, the lesser her chance and contribution to fertility. The role of a mother's age on fertility is well documented by earlier studies in South Africa. Mother's educational level is also significantly associated, especially among those with secondary and higher levels of education at the household level (model 2). The study revealed that the odds ratio of those with higher levels of education was 25% higher. Consistent with expectations, the odds ratio values also increase as the levels of education increase among these women, suggesting a direct relationship and ascribing a strong importance to the variable, especially among those with higher levels of education. Women with higher levels of education are more likely to experience fertility decline, compared to those with lower levels of education. This finding goes to further support the notion that education is strongly associated with fertility decline. Studies such as Makgeledisa (2017), Mturi and Hinde (2001), etc. in South Africa and Tanzania found education to be strongly associated to fertility. Also, in carrying out a retrospective panel data analysis in South Africa, Rossouw *et al.* (2012) found education to be strongly associated to fertility.

Mothers currently working in a formal and informal occupation (mother's occupation) were statistically/strongly associated with fertility transitions, especially at the individual model test (model 2). Empirical evidence suggests that being currently employed results in economic independence, enabling a woman to take far-reaching decisions around her childbearing attitude. Swartz (2003) identified employment of women as a general influencer of fertility in South Africa. The study further revealed that women whose husbands stayed elsewhere were significantly associated, although presenting only a 2% higher odds ratio, suggesting a not too strong association at the full model level test (model 5). The impact of an absentee husband on low fertility levels has been alluded to by earlier studies and therefore cannot be over-emphasised. The thinking is that husbands staying elsewhere present lesser chance of pregnancy to women, especially in a normal African society where the community frowns at pregnancy out of marriage. Also, owning a house jointly and the household having electricity also maintained consistent associated patterns in the full model test (model 5) during the study period. Specifically, the study revealed that the odds ratio of households who own a house jointly and with electricity were 9% and 15% higher, indicating strong associations. Swartz (2003) identified similar factors such as owning land as a possible factor associated to fertility in South Africa. Also, Curtis and Waldfogel (2009) associated issues around housing availability to the variations in fertility (births) in the US. It can be argued that not having electricity removes comfort from the household, which can indirectly encourage low fertility levels. Anderson (2003) also found that access to electricity was consistent with fertility transitions in South Africa. In addition, the study revealed that having a large family size was highly significant to fertility transitions at the household and full models tests (models 3 and 5). Being a part of or coming from a large family may sometimes discourage a woman from having more children, due to negative experiences, cost and other challenges associated with keeping large families. These are especially so, among the Black South Africans. Krutul (2005) found this factor to be significantly associated in his study in Africa.

Using a traditional pit latrine was moderately associated at the full model test (model 5), with other types presenting inconsistency odds ratio patterns. Also, with the exception of those using a river/stream, the study found that other sources of drinking water were strongly associated fertility during the study period. The odds ratio was 14% higher among those using other sources of drinking water (model 5). Anderson (2003) and Swartz (2003) identified socio-structural (intervening) factors such as sanitation as possible determinants of fertility. Also, the authors linked safe drinking water and water management to fertility levels in South Africa. With the exception of poorer women, the study revealed that all wealth quintiles (status) were significantly associated, especially at the household model test (model 3). The odds ratio of the richest was 25% higher, suggesting a stronger association and the importance of the variable. These findings are consistent with that of earlier studies in South Africa, and support the notion that rich women of the study sample have a higher chance of lower fertility, compared to the poorest.

Study such as Rossouw *et al.* (2012) found factors such as women's wealth and economic status as strong factors associated with fertility levels in Southern Africa. The province/region in which these women reside was not associated to fertility transitions in South Africa. With slight differences in odds ratio, the results also showed that this finding was consistent with the type of place of residence. However, the test at community regional level model indicates that women staying in rural areas were 4% less likely, compared to those in urban areas (model 4). This indicates that women in the urban areas had a greater chance of experiencing lower fertility levels (transitions), compared to those in the rural areas. Magagula (2009) found this factor to be consistent in her study among South African women in the country. With a strong odds ratio, the study found that having access to gynaecologists and community health workers was strongly associated with fertility transitions at the full model test (model 5). The results also revealed that distance to a health facility was fairly associated, especially at the community regional level test (model 4), although with a 1% higher odds ratio among those who perceived it as not being a problem. More so, the study found that place of delivery was significantly associated, especially among those using a health facility as their place of delivery. Specifically, the test at community regional level model indicates a 24% higher odds ratio, suggesting a stronger association to fertility transitions (model 4). These findings also ascribed strong importance to these variables. The importance of community health related factors are well documented by earlier studies in South Africa. For example, in examining fertility declines, studies such as Moultrie and Timæus (2002), Anderson (2003), etc., found these variables to be consistent in South Africa.

The results of random effect revealed that the variation in the log odds of predicting lower fertility transitions among these women across the communities (clusters) within the last twelve months to the time of the survey was non-existent at 0.00 value. This is so, as implied by the estimated intercept component variance (VPC). The variation remained 0.00% even after controlling for individual and household level variables. The study also revealed that the residual heterogeneity between areas (i.e. MOR=1.00) showed that there was no significant difference (variability) between areas/clusters in the probability of experiencing lower fertility by the respondents. Also, the insignificant value of the AIC and BIC and their decreasing pattern from one model to the next as observed in the study was an indication of a good model fit. Thus, suggesting that the applied models correctly predict the outcomes of the study during the study period (Oyedokun 2013; Uthman 2008).

Conclusion

Findings from the study highlight the importance of looking beyond the influence of individual-level factors in the enquiries of associated factors of fertility transitions, especially at different hierarchical levels among Black South African women. In achieving this, the study revealed that factors such as mother's age, employment and wealth status, owning a house with water and electricity, access and distance to health workers and facilities, etc., were strongly associated (significant) at different hierarchical model levels ($p<0.05$). As such, unpacked and underscored their significance in explaining the dynamics existing in fertility transitions there-off. The study concludes that these factors be considered in all programme and policy developments around the issue in South Africa.

Ethical Issues

The study used secondary data already collected, processed and available on request. Also, the study design is quantitative in nature and as such, has no risk of undue disclosure and other ethical considerations. Consequently, ethics clearance was granted for the study by the Basic and Social Sciences Research Ethics Committee (BaSSREC) of the North West University. Also, permission to use the SADHS 2016 data for this study was obtained from ICF Macro Inc. accordingly.

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References

Anderson, B. (2003). 'Fertility in South Africa: Current issues and prospects for the future'. *PSC Research Report at the Institute of Social Research*, University of Michigan. Report No. 03, 532.

Bongaarts, J., & Casterline, J. (2013). 'Fertility transition: Is sub-Saharan Africa different?' *Population and Development Review* 38(Suppl.): 153–168.

Bongaarts, J. (2007/8). 'Fertility transition in developing countries: Progress or stagnant'. *Studies in Family Planning*, 39 (2), 105-110

Bongaarts, J. (2017). 'Africa's unique fertility transition'. *Population and Development Review*, 43 (Suppl.): 39–58.

Chemhaka, G.B. (2017). 'Multilevel determinants of fertility behaviour in Swaziland'. Thesis submitted to the faculty of humanities, University of Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Doctor of Philosophy in Population Studies.

Curtis A., & Waldfogel, J. (2009). 'Fertility timing of unmarried and married mothers: Evidence on variation across U.S. cities from fragile families and child bearing study'. *Population Research and Policy Review*, 28 (5) 569-588.

Garenne, M. (2008). 'Fertility changes in sub-Saharan Africa'. *DHS Comparative Reports* 18: 111.

Garenne, M. (2008). 'Situations of fertility stall in sub-Saharan Africa'. *African Population Studies* 23(2):173-188.

Garenne, M., & Macro, I. (2008). *Fertility changes in sub-Saharan Africa*. Calverton, Md.: Marco International.

Krutul, L. (2005). 'Factors influencing total fertility rates (TFR) in Africa'. *Ginekologia Polska*; 76(9):699-703. PMID: 16417081.

Lerch, M., & Spoorenberg, T. (2020). 'The emergence of birth limitation as a new stage in the fertility transition in sub-Saharan Africa'. *Demographic Research:* Volume 42, Article 30, Pages 827-858; https://www.demographicresearch.org/Volumes/Vol42/30/

Magagula, T.K. (2009). 'Examining the effect of changing marriage patterns on fertility among African South African women'. Being a thesis submitted in partial fulfilment of the requirements for the degree of Masters of Population Studies, Faculty of Humanities, Development and Social Sciences, University of KwaZulu-Natal Durban.

Makgeledisa. (2017). 'Selected socio-economic and demographic factors influencing fertility rate among women in the Northern Cape Province, South Africa'. Being a Dissertation submitted in fulfilment of the requirements for the degree of Master of Social Sciences in Population Studies and Demography, Faculty of Human Social Sciences at the Mafikeng Campus of the North-West University.

Moultrie, T.A., & Dorrington, R.E. (2004). 'Estimation of fertility from the 2001 South Africa Census data'. *Centre for Actuarial Research*, University of Cape Town.

Moultrie, T.A., & Dorrington, R.E. (2008). 'Sources of error and bias in methods of fertility estimation contingent on the P/F ratio in a time of declining fertility and rising mortality'. *Demographic Research*, 19 (46), 1635-62.

Moultrie, T.A., & Timaeus, I.M. (2002). '*Trends in South African fertility between 1970 and 1998: An analysis of the 1996 Census and the 1998 Demographic and Health Survey'. Burden of Disease Unit Technical Report*. Medical Research Council, South Africa.

Moultrie, T.A., & Timaeus, I.M. (2003). 'The South African fertility decline: Evidence from two censuses and a demographic and health survey'. *Population Studies*, 57(3): 265-283.

Moultrie, T.A., & Timaeus, I.M. (2012). 'Birth intervals, postponement and fertility decline in Africa: A new type of transition?' *Population Studies* (Camb), 66(3), 241-258.

Moultrie, T.A., Dorrington, R.E., Hill, A.G., Hill, K.H., Timæus, I.M. & Zaba, B. (Eds.) (2012). 'Tools for Demographic Estimation'. Paris: *International Union for the Scientific Study of Population*.

Mturi & Hinde. (2001). 'Fertility levels and differentials in Tanzania'. Workshop on the prospects for fertility decline in high fertility countries. Population Division, Department of Economic and Social Affairs, *United Nation Secretariat*, New York, 9-11.

National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF (2019). 'South Africa Demographic and Health Survey 2016: Key Indicators'. Pretoria, South Africa, and Rockville, Maryland, USA: *NDoH, Stats SA, SAMRC, and ICF.*

Oyedokun, A.O. (2013). 'Sexuality in the Cape area of South Africa: Dynamics and contexts'. Unpublished Doctor of Philosophy (PhD) dissertation, Johannesburg: University of the Witwatersrand.

Palamuleni, M.E., Kalule-Sabiti, I., & Makiwane, M. (2007).'Fertility and childbearing in South Africa families and households in post-Apartheid South Africa'. *Human Science Research Council (HSRC)*, HSRC Press.

Rossouw, L., Burger, R., & Burger, R. (2012). 'The fertility transition in South Africa: A retrospective panel data analysis'. Stellenbosch. *Department of Economics and Bureau for Economic Research,* Stellenbosch University.

Sayi, T.S. (2015). 'Stall in fertility decline in Zimbabwe. Paper presented at the 2016 Population Association of America Conference. Extended Abstract.

Sayi, T.S. (2014). Relationships between marriage and fertility transitions in sub-Saharan Africa'. *Decomposing Fertility Trends*. 143000 (princeton.edu).

Statistics South Africa. (2010). 'Estimation of fertility from the 2007 community survey of South Africa'. (Report No. 03-00-04). Pretoria*: Statistics South Africa*.

Statistics South Africa. (2015). 'Census 2011: Fertility in South Africa'. (Report No. 03-01–63). Pretoria: *Statistics South Africa.*

Statistics South Africa. (2015). 'Exploring childlessness and delayed childbearing in South Africa, 2001-2011'. (Report No. 03-06–02). Pretoria: *Statistics South Africa.*

Statistics South Africa. (2017). 'South Africa demographic and health survey 2016: Key Indicator Report'. (RP: 03-00-09), 74pp.Pretoria: *Statistics South Africa*.

Statistics South Africa. (2019). 'Cohort fertility in South Africa: Exploring fertility behaviour in birth cohorts'. (Report No. 03-00-03), Pretoria: *Statistics South Africa*.

Statistics South Africa. (2019). 'Mid-year population estimates, 2019'. Statistical Release P0302. Pretoria: *Statistics South Africa*.

Statistics South Africa. (2021). 'Mid-year population estimates, 2021'. Statistical Release P0302. Pretoria: *Statistics South Africa*.

Swartz, L. (2003). Fertility transition in South Africa and its implications on the four major groups'. *Department of Economics and Social Affairs*, 539-553.

United Nations. (2019/20). Department of Economic and Social Affairs, Population Division. *Monitoring Global Population Trends and Development*.

Uthman, O.A. (2008). 'Geographical variations and contextual effects on age of initiation of sexual intercourse among women in Nigeria: A multi-level and spatial analysis'. *International Journal of Health Geographics 2008*, 7:27.