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Variation in contraceptive prevalence rates in Tanzania: A multilevel analysis of individual and regional determinants

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ABSTRACT

Objective: The aim of this study was to answer two key questions: (1) what are the individual and regional determinants of contraceptive use; and (2) what are the effect(s) of individual and regional variables on regional differences in contraceptive use?

Data and method: Multilevel logistic regression was applied on data from the Tanzania Demographic and Health Survey (TDHS) 2010 that allowed us to investigate simultaneously the individual and the regional determinants of contraceptive use and its regional variation.

Results: There was significant variation in contraceptive use, both between population groups as well as between regions. A higher number of children ever born, urban residence, and a non-manual occupation are characteristics associated with higher odds of a woman using contraceptives. Women who talk about family planning with community-based distribution workers and clinic staff also have higher odds of using contraceptives. The regional differences in the shares of women with a secondary education or above explain a significant portion of the regional variance in contraceptive use. Having secondary education and above is related to lower contraceptive use.

Conclusion: This study constitutes a first step towards gaining a better understanding of the macro-level effects on decision-making processes regarding contraceptive use. The regional educational level explains a significant portion of the regional variance in contraceptive use.

Implication statement: An advantage of our study over other studies in Tanzania is that we extended the determinants of contraceptive use to include not only individual-level factors, but also regional-level factors.

Introduction

Contraceptive use is considered an important determinant of the worldwide fertility decline. In the past 50 years fertility has fallen by 50%, dropping from five children per woman in the early 1950s to 2.5 children per woman today [1]. The steepest declines over this period have been reported in East Asia, where the total fertility rate (TFR) decreased from 5.9 to 1.8 children per woman; and in Latin America, where the TFR fell from 6.0 to 1.8 births per woman. These declines were largely attributed to an increase in modern contraceptive use [2]. However, in other parts of the world, especially in Sub-Saharan African countries, population growth since the 1960s has been rapid, and fertility rates—along with infant, child, and maternal mortality rates—have remained high [3]. At the International Conference on Population and Development (ICPD) held in Cairo, Egypt in 1994, family

planning programmes were advocated as a means of reducing fertility rates [4,5].

Family planning helps to reduce maternal mortality by lowering the number of births, and thus the number of times a woman is exposed to the risk of dying during pregnancy and childbearing [6]. Moreover, contraceptive use is also shown to improve child survival, as it allows for optimal child spacing, longer birth intervals, and less sibling competition for scarce family and maternal resources [7]. Furthermore, the findings indicate that, compared to an interval of less than three years, a birth interval of more than three years cuts the risks of maternal and under-five child mortality in half [8].

Tanzania has been experiencing rapid population growth, with a doubling of the population every two decades over the past half-century: i.e., from 12.3 million in 1967 to 23.1 million in 1988; and from 17.5 million in 1978 to 34.4 million in 2002; with a fertility rate of 5.4

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births per woman [9]. The World Bank has suggested broadening the use of contraceptives as a means of slowing rapid population growth [10]. The National Population Policy was introduced in Tanzania in 1992 (and revised in 2006). The goals of this policy were to strengthen family planning services in order to promote the health and welfare of families, communities, and the nation as a whole; and to thereby reduce the rate of population growth [10]. Because a series of economic crises and structural adjustment reforms in the 1980s left Tanzania short of resources, the National Population Programme was mainly financed by multilateral and bilateral organisations [11].

Despite the implementation of the National Population Policy more than 20 years ago, Tanzania still has lower levels of contraceptive use than its neighbouring countries, lagging behind Kenya, Zimbabwe, Zambia, Malawi, and Rwanda (ICF International, 2012 <http://www.statcompiler.com>). According to the 2010 Demographic and Health Survey [9] only one-third of married women (34%) are currently using any family planning method: 27% use modern methods and 7% use natural (traditional) methods. The prevalence of contraceptive use is comparable to the prevalence levels in the other least developed countries, but is much lower than the worldwide average of 63% [12].

A number of factors undermine contraceptive use, including an undersupply of contraceptives in many areas, a limited number of service delivery points in certain geographic locations, economic conditions, lack of information, and psychosocial and administrative barriers [13,14]. Moreover, the use of contraceptives is influenced by women's knowledge of the methods available, their religious affiliation, [15–17], their wealth [18], and their ability to make decisions about contraceptive use [19]. Other factors include male involvement in decision-making regarding contraceptive use [20,21], fear of side effects, and educational levels [22,23,24].

However, these studies, particularly those conducted in Tanzania, analysed the country as whole, and did not address regional differences. Contraceptive use is dependent on education, religion, and socio-economic status, as well as other factors which are known to vary across districts in Tanzania [25]. For instance, in the Moshi Rural district, the level of education is very high, and the district has high per capita coverage of secondary schools relative to the rest of the country. The Chagga, an ethnic group who live in this district, have a clear system of gender income division in which men hold cash earned from coffee production, while women hold money earned from selling milk and bananas. Recent changes in economic and environmental conditions, together with changes in social roles and the effects of the adoption of western systems of health care, have altered the reproductive culture among the Chagga, leading to an increase in women's use of modern family planning methods [26]. In contrast, educational levels are generally low in Serengeti district. The main economic activities in this region are small-scale agricultural production and cattle raising, the proceeds of which are mainly held by men. Women can own cattle from a dowry paid for the marriages of their daughters. Moreover, in some of the polygamous families wives compete to win their husband's love by giving birth to many children. These are two examples which demonstrate how family and gender roles can vary significantly across the regions of Tanzania, and how these differences are linked to different approaches to family planning and contraceptive use.

In 2010, 35% of married women in mainland Tanzania and 18% of married women in Zanzibar reported using any contraceptive method. This figure varied considerably across Tanzania's (at that time) 26 administrative regions. Only 7% of married women in Pemba Island North and 11% in Pemba Island South and Zanzibar North were using contraceptives. In mainland Tanzania, contraceptive use was highest in the northwest, with 65% of married women using contraceptives in the Kilimanjaro region and 54% in the Tanga region; and was lowest in the north, with 12% of married women using contraceptives in the Mara region [9].

Previous research has focused on individual determinants of contraceptive use and decision-making processes, while assuming that the

whole country had the same economic and socio-cultural conditions. Thus, these studies failed to address the effects of macro-level data, i.e. regional differences on decision-making regarding contraceptive use. Our aim is to answer two key questions: (1) what are the individual and regional determinants of contraceptive use; and (2) what are the effect (s) of individual and regional variables on regional differences in contraceptive use?

Methods

Data

This study uses data from the Tanzania Demographic and Health Survey (TDHS) 2010, a population-representative survey. The survey collected information on the use and awareness of family planning methods, parity, marriage, and sexual activity [9]. The study is based on the TDHS couples' file, which provides information on 1148 women aged 15–49 years and their husbands. Regional variables were derived from the individual women's file, which contains information on 10,139 women aged 15–49 years. The data are organised hierarchically, with individuals (level 1) being clustered in 26 regions (level 2).

Variables

The variable of interest, contraceptive use, originally had four categories: non-user, user of natural methods, user of permanent methods, and user of temporary methods. This variable was recoded into two categories: non-user and user. The independent variables were divided into individual-level and regional-level variables (Table 1). The possible determinants of contraceptive use were chosen based on findings from previous studies which suggested that these variables were related to contraceptive use. Wealth was categorised into quintiles in the original

Table 1
Determinants of contraceptive use-independent variables.

Individual-level variables
<u>Demographic factors</u>
Current age of respondent
Total children ever born (parity)
Maternal age at first birth
Age at first marriage
Current age of husband
Type of place of residence
<u>Socio-economic status</u>
Woman's educational level
Woman's occupation
Household wealth index
Literacy level
Partner's educational level
Partner's occupation
<u>Attitudes</u>
Ideal number of children
<u>Perceived behavioural control</u>
Sex of household head
<u>Subjective norms</u>
Final say on own health
Person to talk to most about family planning
<u>Regional-level variables</u>
<u>Demographic factors</u>
Proportion of women who leave in rural area
Proportion of women who are Muslim
Proportion of women who are Roman Catholic
Proportion of women who are Protestant
<u>Socio-economic factors</u>
Proportion of women with poor wealth index
Proportion of women with richer wealth index
Proportion of women without education
Proportion of women with secondary education and above

Source: TDHS 2005 & 2010.

data, with the quintiles based on information on household ownership of consumer items. For this study, wealth was recoded into three categories: poorest and poor became poor; middle stayed the same, and richer and richest became rich.

The variables describing the demographic and socioeconomic conditions in the Tanzanian regions were obtained by aggregating the individual-level variables on place of residence, religion, women's education, and household wealth by regions. The religion variable was obtained from TDHS 2004/2005 after been removed from DHS and census questionnaires. The numerical relationship between Christian and Muslim is regarded as political sensitive issue in Tanzania and been removed from all national surveys and census. These variables represent the proportion of women who live in rural areas; proportion of women who are Muslim; proportion of women who are Roman Catholic, proportion of women who are Protestant; proportion of women who were poor or rich; and proportion of women who had no education or secondary education and above.

Data analysis

A multilevel logit regression model with contraceptive use as the outcome variable (use versus non-use) was fitted to determine individual- and regional-level variables related to contraceptive use. The dichotomous dependent variable (use and non-use of contraceptives) was used in all models deploying non-user as a reference group. Modelling was done in Stata version 13. Results from random-intercept models are presented. These models estimate the effects of individual- and regional-level variables on contraceptive use whereby all regression coefficients other than the intercept are constrained to be fixed across regions; i.e. we assume that the effects of the explanatory variables does not differ between regions [27,28]. We first ran a regression model with only individual-level effects (Table 3) and then subsequently added regional-level variables one by one to explain contraceptive use (Table 4). Multilevel random-coefficient models and cross-level interactions whereby effects of the explanatory variables are allowed to differ between the regions were perfumed but did not significantly improve the model fit, and were therefore not shown. Thus, we have used the median odds ratio (MOR) with the intention to measure the extent to which an individual probability of contraceptive use is determined by regional differences [29]. The study started to build models based on theoretical considerations and data availability. The Pearson residual, deviance residual and Pregibon leverage diagnostic statistical test was done and suggests that the model is correct and no significant incorporation of potential outliers.

Before running regression models, we first checked the independent variables for high correlations between them (Pearson's $r \geq 0.6$). As the study focuses on women, and a woman's age tends to be highly correlated with that of her husband, the woman's age was retained. The total number of children ever born was also highly correlated with a woman's age, and was excluded from further analyses. The variable age at first birth was dropped as it was highly correlated with the age at marriage, and contained 76 missing values. Literacy level was dropped due to a high correlation with educational level, and because research indicates that the role of education is more complex. The final selection of independent variables included in the analyses is shown in Table 1.

Ethical consideration

Permission to use the Tanzania Demographic and Health Survey 2004/2005 and 2010 datasets was obtained from DHS Measure after assuring that the data would be analysed according to the Integrity Code for research as formulated by the University of Groningen.

Results

The demographics of the women in the study, both in total and by

Table 3

Regression coefficients for individual-level characteristics (model I).

Variables	Beta	P-value.
Current age of respondent	-0.005	0.729
Total children ever born	0.147	0.001
Type of place of residence		
Urban (Ref)		
Rural	-0.474	0.030
Woman's educational level		
No education (Ref)		
Primary education	-0.011	0.956
Secondary education & above	0.038	0.901
Woman's occupation		
Not working, unskilled manual (Ref)		
Professor technician, manager, clerical, services	0.828	0.011
Agricultural self employed, household & domestic	0.111	0.586
Agricultural employee, skilled manual	0.481	0.158
Household wealth index		
Poorer (Ref)		
Middle	0.343	0.093
Richer	0.768	0.000
Ideal number of children	-0.012	0.104
Sex of household head		
Male (Ref)		
Female	0.191	0.544
Final say on own health		
Alone (Ref)		
Respondent and husband/partner	0.018	0.936
Husband/partner alone/someone else	-0.070	0.755
Person to talk to most about family planning		
Husband/partner alone (Ref)		
Community-based distribution worker & clinic staff	0.350	0.072
Friend, relative & religious leaders	0.171	0.716
Partner's (husband's) education		
No education (Ref)		
Primary education	0.396	0.110
Secondary education & above	0.514	0.118
Partner's (husband's) occupation		
Not working, Unskilled manual (Ref)		
Professor technician, manager, clerical, services	-0.361	0.228
Agricultural self employed, household & domestic	-0.269	0.278
Agricultural employee, skilled manual	-0.171	0.543

contraceptive use, are presented in Table 2.

The multilevel models with random intercepts clustered by region were estimated first by including all of the individual-level variables (model I, Table 3), and subsequently by including the regional-level variables one at a time (models II-VIII, Table 4). Model I shows that a woman's place of residence, her household wealth, her total number children ever born, the person she consulted about family planning, and her occupation have significant effects ($p < 0.05$) on her contraceptive use. Talking mostly to a community-based distributor or clinic staff about family planning is borderline significant ($p < 0.1$). For example, the women living in rural area had lower likelihood of 0.624 to use contraceptive significantly, relative to women living in urban areas. The women who are richer, had high likelihood of 2.156 to use contraceptive relative to poorer women. When the model controls for all of the other variables, no significant association can be observed between contraceptive use and a woman's current age, her educational level, whether she has a final say on her own health, whether she is the household head, or her husband's education or occupation.

The MOR between the individual in the region with higher contraceptive use and the individual in the region with lower contraceptive use was estimated. This allows unexplained region to region variability to be directly compared with individual level and regional-level determinates factor effects. From the multilevel model it was estimated that if an individual moved to another region with a higher probability of contraceptive use, the median increase in their odds of contraceptive use would be 2 - 2.28 folds (MOR = 2 - 2.28). see Table 4.

The results indicate that there is significant variation in

Table 4
Regression coefficients for regional coefficients for regional-level characteristics.

Variables name	Odds Ratio	P-value	Confidence Interval		Variance	MOR*
Individual Level (Null Model)					0.556	2.27
Regional variables						
Place of residence						
Proportion of women who live in rural area (Model II)	0.9216252	0.928	0.158	5.360	0.748	2.28
Religion						
Proportion of women who are Muslim (Model III)	0.693962	0.493	0.244	1.971	0.744	2.28
Proportion of women who are Roman Catholic (Model IV)	2.542059	0.386	0.308	20.958	0.734	2.26
Proportion of women who are Protestant (Model V)	3.386514	0.361	0.409	28.030	0.718	2.24
Household wealth index						
Proportion of women with poor wealth index (Model VI)	2.431354	0.361	0.362	16.350	0.727	2.24
Proportion of women with richer wealth index (Model VII)	0.5640264	0.497	0.108	2.944	0.738	2.25
Women education						
Proportion of women without education (Model VIII)	1.159773	0.941	0.023	59.394	0.748	2.28
Proportion of women with secondary education and above (Model IX)	0.0677666	0.007	0.010	0.472	0.56	2

Note: Model II-IX are controlled for the Individual-level characteristics, as detailed in Table 3.

Key *Median Odds Ratio (MOR).

contraceptive use, both between population groups as well as between regions. In addition to the number of children ever born and urban vs. rural residence, socioeconomic factors turn out to have a strong influence on women's contraceptive use. Indicators of women's socioeconomic status appear to have a stronger influence than their husbands' status; in particular, women in non-manual occupations have higher odds of using contraceptives.

When regional-level variables (place of residence, religion, household wealth index and the woman's education) are included, the model fit is significantly improved relative to the model fit with all of the individual-level variables (Table 4). However, most of the effects of regional-level variables are not statistically significant and hence regional variation in contraceptive use is hardly explained by regional-level conditions. In model I, the between-region variance for individual variables is 0.748, the MOR is 2.28. Significant changes can be observed in model VIII, which includes the proportion of women with secondary education and above, as the between-region variance, MOR decrease. A higher share of better educated women is significantly related to a lower use of contraceptives.

Discussion and conclusion

In this study, our aim was to determine the effects of individual and regional variables on regional differences in contraceptive use in Tanzania. Our findings suggest that improvements in both women's and regional socioeconomic conditions could help to raise the prevalence of contraceptive use. Contraceptive use increases with household wealth, and with an increasing number of children ever born. The results further indicate that women who live in urban areas, and who see community-based distribution workers and clinic staff as the primary people to talk to about family planning, are more likely than other women to use contraceptives. Some of the regional variability is explained by adding education as a regional-level variable. However, a significant portion of regional variation in contraceptive use still remains unexplained, even when both individual- and regional-level variables are included in the multilevel model. A higher share of women with secondary education and above is related to lower contraceptive use. This is contrary to our expectation that is higher education is related with high use of contraceptives [15–17]. Perhaps higher educated women engage later in a relationship, and start their reproductive career at a later age resulting in lower contraceptive use.

Some of the regional variability has been explained by adding the education as regional-level variable whereby primary education is related to a significant increase in contraceptive use and secondary education and above is related to a decrease (not significant). However, a large portion of regional variation in contraceptive use still remains

unexplained even when both individual as well as regional-level variables are included into the multilevel model. The unexpected results and insignificant regional-level effects on contraceptive use are possibly caused by the sample size. In some of the regions in DHS data set the proportion of women with secondary education and above is non-existent or very low, this may be why it is insignificant conflicting to what we expect.

Most of our findings are in line with the results of other studies which reported that factors associated with higher contraceptive use often reflect women's socioeconomic status. The fact that women who predominantly talk to community-based distribution workers and clinic staff about family planning issues are more likely to use contraceptives than women who predominantly consult their partner or other people may be seen as a policy success [30]. This finding highlights the need for professional family planning consultants. Moreover, other studies on contraceptive use conducted in other settings that have used multilevel models have found significant effects either at lower levels (clustered by household) or at the middle level (clustered by district). For instance, a study done in Bangladesh [31] with three levels of analysis found significant variation in contraceptive use at the lower level only (block). Another study [32] found effects at both the higher level (Division) and the lower level. Moreover, a study by Wang et al. [33] of four East African countries (Rwanda, Kenya, Uganda, and Tanzania) revealed that there are important regional or provincial variations in the provision of various family planning service components. They suggested that regional-level factors significantly contribute to the between-region variations in contraceptive use.

Our research has some strengths and some limitations. An advantage of our study over other studies in Tanzania is that we extended the determinants of contraceptive use to include not only individual-level factors, but also regional-level factors. Other studies have reported that the effect of regional variables on health outcomes may depend on the operationalisation of the regional variables [31,32,34]. We have therefore operationalised the regional variables in different ways. Still, some of the regions in the DHS data set have very few women with secondary education and above. As the delivery of programme services occurs mainly at the district level, this study could have produced more precise results if the analysis had included district-level as well as regional-level variables. However, the DHS data set does not have information about district-level characteristics.

The analyses were based on the Tanzanian Demographic and Health Survey, which is considered a nationally and regionally representative sample of the Tanzanian population [9]. Data on the regional conditions had to be aggregated from the TDHS dataset, as regional data on socioeconomic and structural conditions is not available from other sources. Other studies have reported that the effect of regional variables

Table 2
Cross-tabulation of dependent variables and categorical independent variables (N 1,148).

Variables	Non-use		Use		Total		Chi-Square Tests		
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Value	df	Sig. (2-sided)
Current age of respondent									
15–24 years	230	73	83	27	313	27	15.419	2	0.000
25–34 years	320	61	200	39	520	45			
35–49 years	190	60	125	40	315	27			
Type of place of residence									
Urban	121	50	123	50	244	21	29.9	1	0.000
Rural	619	68	285	32	904	79			
Women education level									
No education	180	71	72	29	252	22	7.017	2	0.030
Primary education	466	63	276	37	742	65			
Secondary education & above	94	61	60	39	154	13			
Women Occupation									
Not working, unskilled manual	203	63	120	37	323	28	21.635	3	0.000
Prof. technician, manager, clerical, services	28	42	39	58	67	6			
Agricultural self-employed, household, domestic	480	68	225	32	705	61			
Agricultural employee, skilled manual	29	55	24	45	53	5			
Household wealth index									
Poor	327	73	123	27	450	39	30.252	2	0.000
Middle	143	67	70	33	213	19			
Richer	270	56	215	44	485	42			
Literacy Level									
Cannot read at all, Blind/visually impaired	280	71	109	29	369	32	9.048	2	0.011
Read parts of sentence	49	65	26	35	75	7			
Read whole sentence	431	61	273	39	704	61			
Partner's education									
No education	109	76	34	24	143	12	10.311	2	0.006
Primary education	520	63	302	37	822	72			
Secondary education & above	111	61	72	39	183	16			
Partner's occupation									
Not working, unskilled manual	72	57	55	43	127	11	12.884	3	0.005
Prof. technician, manager, clerical, services	78	59	54	41	132	11			
Agricultural self-employed, household, domestic	504	68	235	32	739	64			
Agricultural employee, skilled manual	86	57	64	43	150	13			
Ideal number of children									
1–3	84	58	60	42	144	13	19.51	2	0.000
4–5	310	59	212	41	522	45			
6 & above	346	72	136	28	482	42			
Sex of household head									
Male	700	64	387	36	1087	95	0.035	1	0.852
Female	40	66	21	34	61	5			
Final say on own health									
Respondent alone	100	64	56	36	156	14	6.432	2	0.040
Respondent and husband/partner	308	61	199	39	507	44			
Husband/partner alone/someone else	332	69	153	31	485	42			
Person to talk to most about family planning									
Community-based distributor, clinic staff	560	62	336	38	896	78	7.186	2	0.028
Husband/partner alone	152	71	63	29	215	19			
Friend, relative, religious leader	28	76	9	24	37	3			

on health outcomes may depend on the operationalization of the regional variables [32–34]. Insignificant effects of regional variables may therefore be related to the derivation from TDHS.

This study constitutes a first step towards gaining a better understanding of the macro-level effects on decision-making processes regarding contraceptive use; an area, which, to our knowledge, has remained largely, unexplored. Our findings confirm that the regional educational level explains a significant portion of the regional variance in contraceptive use. Policy-makers designing national-, regional-, and district-level programmes to encourage contraceptive use should also consider the issue of education. However, the findings indicate that there are other factors which contribute to the regional differences, but which we were unable to capture with DHS data set. Further investigations, which take into account district-level characteristics, are

clearly warranted. In addition, such data would enable us to examine more fully the implementation process of family planning at the district and the regional levels, and they would allow us to make more rigorous estimates of the district and the regional differences in contraceptive use. These data are needed to design appropriate interventions which might increase the use of contraceptives among women in Tanzania.

Study design

Multilevel logistic regression was applied on data from the Tanzania Demographic and Health Survey (TDHS) 2010 that allowed us to investigate simultaneously the individual and the regional determinants of contraceptive use and its regional variation.

Declaration

We declare that the work submitted to this journal has not been published previously and is not under consideration for publication elsewhere. All authors approve its publication. If accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

Declaration of Competing Interest

The authors declare they have no conflicting interests.

Authors' contributions

Mackfallen Anasel conceived and designed the study, requested data from MEASURE DHS, analysed the data and wrote the manuscript in consultation with the other author. Hinke Haisma played a role in the interpretation of the data, and drafted and edited the manuscript.

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