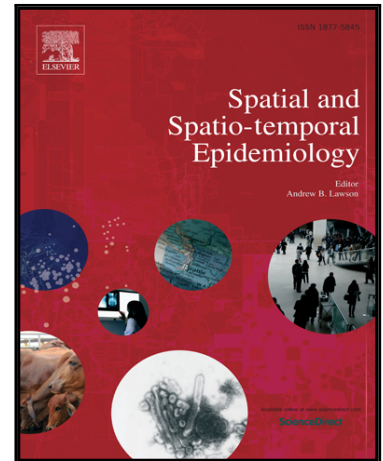


## Accepted Manuscript

Geography and correlates of attitude toward Female Genital Mutilation (FGM) in Sudan: what can we learn from successive Sudan opinion poll data?

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- Sudan is among Sub-Saharan Africa countries with high prevalence of FGM
- However, comparison of recent surveys shows a decrease in the practice.
- Pro-anti FGM rates vary between different states of the country
- We observed a decrease of pro-FGM with striking variation between states
- Local pro-FGM monitoring leads to design of interventions with local impact

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in Sudan: what can we learn from successive Sudan opinion poll data?

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In Sudan, prevalence of FGM is declining; likely as a result of changing attitude surrounding FGM, as more women believe the practice should be discontinued amid growing awareness about its health dangers.

DFID Sudan opinion poll data collected from 2012 to 2014 was used. Bayesian geo-additive mixed models were used to map the spatial distribution of the likelihood of pro-FGM attitude at the state-level accounting for associated risk factors.

During 2012 to 2014, the overall proportion of pro-FGM was 27.5% and 18.3% respectively with striking variations within states. People with pro-FGM attitude were more likely to be un-educated, living in rural settings with strong tribal identity. Individuals from Darfur were more likely to be pro-FGM when compared to the North state.

The decrease in the practice of cutting observed between the 2006 and 2010 Sudanese Household Surveys and the resulting shift in attitude make a compelling case for public health policy to eradicate the FGM practice.

**Keywords:** Sudan, epidemiology, geographic variation, FGM.

## Introduction

Female Genital Mutilation or cutting (FGM/C) procedure is considered a violation of human rights and has life-long implications for women, including ongoing infection, infertility, psychological trauma and complications during childbirth. Worldwide, at least an estimated 125 million women and girls are thought to have undergone FGM in 29 countries in Africa and the Middle East [1-3]. UNICEF reports that nearly nine out of 10 Sudanese women aged 15 to 49 have undergone some form of cutting in various degrees of severity. The procedure, also known as infibulation or 'pharaonic circumcision', is usually performed on underage girls by traditional practitioners, who have no medical training [1-3]. The procedure is irreversible and no modern medical procedures can fully repair the long-term psychological and physical complications due to FGM such as urinary and genital tract infection, pain and haemorrhage, complications in childbirth and social, psychological and sexual complications for mother or daughter mortality and ongoing morbidity concerns [4-7]. In other countries in the region, there have been some efforts by multilateral agencies such as the World Health Organization (WHO), United Nations Children's Fund (UNICEF) and Non Government Organisations (NGO's) advocating the abandonment of FGM and attitude change. In Ethiopia, some successful public health programmes have been documented by NGO's such

However, the comparison of the 2006 and 2010 Sudanese Household Surveys shows a notable decrease in the practice of cutting among for instance, the 5 to 9 age bracket, 34.5 per cent had been cut in 2010, compared to 41 per cent in 2006 with further decrease expected in the next Household Survey [1, 2]. The Eastern Sudan's Kassala state is most affected with 78.9 per cent of girls and women reported to have undergone the procedure – the third-highest prevalence in the country, according to the 2010 Sudan Household Health Survey [1-3]. The origin of the practice is steeped in traditional (especially in the north of the country) and societal ideals of beauty and cleanliness, religion and morality, and is also used as a method of stifling female libido. The Sudanese government has introduced stiff penalties for those who continue to perform the procedure, however, the practice, which is still not criminalised by law in Sudan, remains widespread, particularly in rural communities [1-3]. The eradication of FGM is further complicated by cultural and societal pressures, as well as religious sensitivities surrounding the issue. UNICEF is providing support for a national strategy to abolish FGM known as the Saleema initiative. Conceived in 2008, the campaign is being supervised by the National Council on Child Welfare [1-3]. However, despite the extensive media campaign by the Sudanese government, the strategy of changing the attitudes and tribal habits is not easy, nor that fast within the diverse population in Sudan it has been noted [2]. There is a scarcity of studies investigating attitude toward FGM in high prevalence FGM countries such as Sudan. The UNICEF study [1] is the most comprehensive study today about attitude toward FGM. However, this study was limited in scope and only did an exploratory analysis using descriptive data without examining many of the control variables that can confound the attitude toward FGM [1].

The present study investigates the geographical variation of attitude shifts toward the eradication of FGM, as well as a wide range of potential correlates towards the continuation of FGM using the successive DFID Sudan opinion poll (2012/13 to 2014 DFIDSOP) data, while accounting for a number of potential risk factors and socio-demographic correlates.

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This kind of data is valuable to inform public health policy from educating the younger generations to the prevention of avertable health conditions associated with FGM in Sudan and other settings [10].

## **METHODS**

### **Study Population**

As part of its commitment to better understand the context in which it operates, the United Kingdom (UK) Department of International Development (DFID) in Sudan has commissioned three rounds of polling (2012, 2013 and 2014) of the Sudanese public. These polls, which were very similar to each other, utilized a random stratified sampling methodology (of all parts of the country controlled by the government- so excluding rebel controlled and high conflict areas) and asked participants about a range of subjects mostly covering: (1) governance, (2) service delivery, (3) humanitarian and (4) social development areas.

The methods, objectives, organization, sample design, and questionnaires used in the 2012-2014 DFID Sudan opinion poll data sets (DFIDSOP) and an overview report have been described in detail elsewhere [10].

Briefly, the two rounds of polling data sets come from a public opinion survey conducted by DFID Sudan from July 2012 through February 2014, where the sample frame was based on the 2008 national census of Sudan.

The data for the household survey was gathered through personal interviews carried out by the Sudan Polling Statistics Centre (SPSC) at the national level for urban and rural areas, in 16 states including the Capital Khartoum. The survey used a two-stage cluster sampling design to collect data on a wide range of issues. Personal (face-to-face) interviews were conducted with a random adult member of a household after obtaining their consent. The questionnaire collected information on whether the participant would like the practice of FGM to be stopped or continued and, if so, why, on attitudes and beliefs about FGM, and the political, cultural and economic context of the participants. The survey procedures and instruments were validated by the Institutional Review Board at SPSC and quality assured by

the selected sample excluding people in Darfur and Khartoum that refused to be interviewed.

As part of the survey strategy, the replacement sampling and the successful application of the replacement protocol the total number of interviewees is consistent with the set number planned at the beginning of these surveys (1500 for the first survey and a little over 2000 in the second survey [10]).

According to a field report by the polling company, interviewers came across several challenges during the data collection process. For instance, a high number of households rejected interviews in several states (up to 40% in Khartoum and Darfur- although a replacement sampling protocol was used to mitigate the effects of refusal). At the same time however, the field report outlines that because interviewers were assigned to their respective hometowns or regions, local cultural, social and political conditions were sufficiently accounted for during data collection. For instance, in the 2013 data, a random sample of 2,365 households was selected across the 16 states of Sudan within 70 localities and 238 clusters. On average, the sample size for each sample state was 150 males and females between the ages of 18 and 100. The original sample comprised 1,181 women and 1,184 men [10]. Our analysis was based on 2,364 survey participants in 2012/13 and 2,376 participants from the 2014 survey.

### **Outcome variable**

We studied attitude shifts surrounding FGM as the main outcome in terms of “whether a participant, when asked, would like FGM practice to continue or to stop”. This question was converted into a binary variable, with two categories defined as 1 if the participant would like the practice to continue and 0 if the practice should stop, after excluding participants that did not respond to the question or were undecided.

### **Exposure variables**

The main exposure variable in the analysis was the “state of residence”, of which there are 15 including the capital city Khartoum as shown in **Figure 2** and defined by the Sudanese 2008

FGM attitudes [10]. Other cultural, political and geographic factors – sex, age, education level, income, marital status, family size, place of residence, trust in tribal leader, Imam, police, local and federal government, identity, decision making power (autonomy) and willingness to vote in general election – that may influence the outcome were also included as confounders. Age was recorded by the DFIDSOP as a continuous variable, and was re-coded into a categorical variable of four categories in the preliminary analysis, with a truncated first category for 18–24 year olds. Education level has been categorised as “None”, “Primary/interim”, “Secondary/diploma”, “Bsc” and “Higher: higher diploma, Msc, PhD” (Reference category), and income was pre-calculated in the DFIDSOP, categorised as “<100 STG”, “100-500 STG” (Reference category), “501-1000 STG”, “1001-2000 STG” and “2001-3000 STG” [10]. The variable for family size was re-coded into three categories of small size “1-4 children”, middle size “5-7 children” (Reference category) and large size “8+ children”, trust in tribal leader (little trust as reference category), in imam (not at all as reference category), in federal government (not at all as reference category), local government (not at all as reference category), in the police (some trust as reference category), in the judiciary (not at all as reference category) and having a choice about their future were pre-defined from “a lot”, little (as reference category) to “not at all”, the identity was recorded as “Sudanese” (reference category), “my state”, “Arab”, “African”, “my tribe” and “my religion”. The 16 Sudanese states were also re-coded into 15 states as per administrative divisions set up with the States in the 2008 census [10]. The category “Sudanese” in the identity variable and the category “North state” in the state variable were used as references, since both categories contained the least pro-FGM participants.

### **Conceptual theoretical Framework**

The conceptual theoretical framework guiding this study is shown in Figure 1. We draw and adapt on the existing framework proposed by Nei-Ching Yeh (2007) [11], a model of culture and its relationship to information behaviour that can show us how to think about the relationship between culture and human information behaviour. We postulate that pro/anti-FGM attitude is directly influenced by the culture, exchange and information use is



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determined to a large extent by the culture of our environment and during the process of interacting with the environment (political, social or economic) or other people [11].

In previous research, culture and social norms have been suggested as influential factors of the continuation of the FGM practice. Chatman (2000) [12] argued that cultural and social norms do affect ways in which people choose to respond, are passive or ignore information. Therefore, all who consider the information seeking behaviour of FGM need to consider the essential characteristics in human information seeking, including a description of its cultural and social determinants [13] (Hjørland, 2000). The seeking and use of information in this context is not processed objectively but rather interpreted through expectations about life experience (interaction with, family members including parents, grand-parents, tribal and religious leaders). In the case of FGM practice, we postulate that culture has a direct effect on pro/anti-FGM attitude by influencing people's attitude. In this regard, the person characteristics such as education or wealth mediate the effect of culture on pro/anti-FGM attitude. The direct effect of culture on pro/anti-FGM attitude can therefore be said to be the net effect of environment and social determinants and can be referred to as the causal impact, if all confounding effects are eliminated. The interaction between culture, environment and social determinants specifies or shapes what the information is, what makes sense and what information is sought out or neglected. Thus, the pro/anti-FGM attitude should be considered as an information that is embedded in the fabric of people's lives and work and constructed through involvement in life's activities, problems, tasks and social and technological structures, as opposed to being independent and context free [14] (Solomon 2002: 229).

We believe that this information about the FGM practice is perpetuated from generation to generation based on Berger and Luckmann's theory (Berger and Luckmann 1966: 94) [15]. The authors argued that through externalization and internalization processes, cultures learn from significant others or other group members with tradition as the social norm and tradition normalizes people's behaviours imperceptibly and forms a society called a symbolic universe, which gives people a direction and lets individuals judge whether or not their behaviours are legal (Berger and Luckmann 1966: 94) [15]. This model, we believe is very true in the case of

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the Sudanese society and in the context of FGM, where the environment can include political, social or economic factors with the person's life experience on FGM attitude including the interaction with family members, parents, grand-parents, tribal and religious leaders).

[INSERT FIGURE 1 ABOUT HERE]

## STATISTICAL ANALYSIS

Survey datasets, such as the 2012 to 2014 of the Sudanese Opinion polls, include geographical information that could identify spatial patterns in pro-FGM attitudes towards the continuation of the practice to target FGM abandonment programmes. This new information must also be incorporated when the analyses of such data are undertaken.

In the analysis of survey data, the commonly adopted models are logistic or probit, and the standard measure of effect is the odds ratio [4-7]. In the present study, however, since the DFIDSOP data contains geographic or spatial information, such as the state of residence for individuals in the study and the presence of non-linear effects for some covariates such as age of the individual, means that strictly linear predictors cannot be assumed. Analysing and modelling geographical patterns for attitude shifts towards the eradication of FGM, in addition to the impact of the cultural and political environment where the individual lives, is of obvious interest in programming and public health interventions.

In this study, we use a well-grounded advanced statistical methodology to explore various dynamics influencing pro-FGM attitude. In the context of Sudan, the spatial patterns of pro-FGM attitudes, socio-cultural, state factors and the possibly non-linear effects of other factors are explored within a simultaneous, coherent regression framework, using a geo-additive, semi-parametric mixed model that simultaneously controls spatial dependence and possibly nonlinear or time effects of covariates and the complex sampling design. The methodologies are able to identify key drivers of pro-FGM factors associated with high risk groups who can be targeted for rapid intervention at state level to assess the potential impact of abandonment programmes and upholding laws banning FGM [4-7].

extend classical geo-statistical methods such as kriging to allow, amongst other features, formal incorporation of: (i) sampling error in the observed data; (ii) relationships with covariates (and the uncertainty in the form of these relationships); (iii) uncertainty in the spatial autocorrelation structure of the outcome variable.

In brief, the strictly linear predictor:

$$\eta_i = x_i' \beta + w_i' \gamma + \varepsilon_i \quad (1)$$

is replaced with a logit link function with dynamic and spatial effects,

$\Pr(y_i=1|\eta_i)=e^{\eta_i}/(1+e^{\eta_i})$ , and a geo-additive semi-parametric predictor  $\mu_i=h(\eta_i)$ :

$$\eta_i = f_1(x_{i1}) + \dots + f_p(x_{ip}) + f_{spat}(s_i) + w_i' \gamma + \varepsilon_i \quad (2)$$

where  $h$  is a known response function with a logit link function,  $f_1, \dots, f_p$  are non-linear smoothed effects of the metrical covariates (respondent's age), and  $f_{spat}(s_i)$  is the effect of the spatial covariate  $s_i \in \{1, \dots, S\}$  labelling the state in Sudan. Covariates in  $w_i'$  are categorical variables such as education and urban–rural residence. Regression models with predictors such as those in Equation 2 are sometimes referred to as geo-additive models.

In a further step we may split up the spatial effect  $f_{spat}$  into a spatially correlated (structured) and an uncorrelated (unstructured) effect:  $f_{spat}(s_i) = f_{str}(s_i) + f_{unstr}(s_i)$ . The rationale is that a spatial effect is usually a surrogate of many unobserved influences, some of them may obey a strong spatial structure and others may be present only locally.

To estimate smooth effect functions and model parameters, we use a fully Bayesian approach, as developed by Fahrmeir and Lang, 2001 [16]. For all parameters and functions we have to assign appropriate priors. The non-linear effects in (2) of  $f_1, \dots, f_p$  are modelled by cubic penalized splines (P-splines) with second order random walk penalty. For the structured spatial effect  $f_{spat}(s_i)$ , we experimented with different prior assumptions (two-dimensional P-splines or Gaussian random field (GRF) priors based on radial basis functions or Markov random field priors (MRF)) common in spatial statistics. In the final model, P-spline priors were assigned to the functions  $f_1, \dots, f_p$ , while a Markov random field prior was used for  $f_{spat}(s_i)$  since they outperformed the other priors [7, 16-17]. The standard measure of effect was the posterior odds ratio (POR) and 95% credible region (CR). Although the estimation process

with this model is complex, the estimated POR that were produced could be interpreted as similar to those of ordinary logistic models.

The analysis was carried out using version 2.0.1 of the BayesX software package [17], which permits Bayesian inference based on Markov chain Monte Carlo (MCMC) simulation techniques. The statistical significance of associations between potential risk factors and pro-FGM attitude were explored in chi-square and Mann–Whitney *U*-tests, as appropriate.

Multivariate Bayesian geo-additive regression models were used to evaluate the significance of the POR determined for the fixed effects and spatial effects between pro-FGM attitudes in Sudan. Each factor was looked at separately in unadjusted models using conventional logistic regression model. Next, fully adjusted multivariate Bayesian geo-additive regressions analyses were performed to look again for a statistically significant correlation between these variables, but this time further controlling for any influence from individual (age), cultural (identity), political (trust in government etc...) and state factors (see **Table 1**). A *P*-value of  $<0.05$  was considered indicative of a statistically significant difference.

## Results

### Descriptive results

Baseline socio-demographic and state characteristics are shown in **Table 1** and intentions to stop or continue the FGM practice are presented in **Table 2**. The overall proportion of pro-FGM attitude was different between the two surveys (27.6% in 2012/2013 and 18.3% in 2014). However, the two survey populations are comparable for the selected variables in terms of higher proportion of pro-FGM among rural residents, and similar proportions in both female and male. The mean age for men was slightly higher than that for women in both the 2012/13 (36.2 vs. 32.7 years) and the 2014 survey (38.0 vs. 33.5 years) as expected from the sample strategy.

Overall, the mean ages of the two samples were comparable (age range: 18–75 in 2012/13 and 18-97 for 2014) [ for 2012/13 the mean age was 34.8 years, with a standard deviation of  $\pm 12.5$  years and in 2014 the mean age of the sample was 35.8 years, with a standard deviation of  $\pm 12.9$  years]. Most of the population sampled lived in rural settings (64.6%) and 63.7% were married.

23.8% of individuals in the 2014 population had a secondary education, while only 7.2% had no education compared to 37.2% (secondary education) and 14.1% no education in 2012/13. When asked the reason why FGM should continue, in 2012/13, 51.6% of participants cited the requirement for a good marriage and 34.4% cited the importance of tradition compared with 2.1% that cited it as part of Islam instruction and in 2014, 28.7% cited the requirement for good marriage, 30.8% of the population cited the importance of tradition compared with 20.2% that cited it as part of Islam instruction.

Pro-FGM people were mostly married ( 29.7% vs 19.3% ) with no education or primary education (68.8% vs 50%), had a “low” income (32.1% vs 28.1%), a big family size ( 26.4% vs 27.0%), lived in rural areas (30.0% vs 20.2%), had relatively more trust in tribal leaders (29.5% vs 23.1%) and had a lot of trust in Imam (30.3% vs 16.5%), a lot of trust in federal government (34.9% vs 19.0%), some trust in local government as well (29.3% vs 15.7%), had the state as their identity (43.7% vs 31.2%), a lot able to hold decision makers to account (36.6% vs 19.1%) and were living in White Nile (49.3% vs 49.3%) and South Darfur (20.1% vs 55.3%) in 2012/13 and 2014 respectively. What is interesting about the distribution of support amongst the states is that the areas historically associated with FGM (the North) are now less likely to support the practice. While it is beyond the scope of this paper to speculate as to why this is, it is possible that this is associated with the fact that these areas are politically powerful and therefore enjoy higher socio-economic development (factors associated with a decreasing rate of FGM support). [Table 2 and Figure 2].

(Table 1 & 2 here)

Unadjusted and adjusted marginal odds ratios are presented in Table 3. Factors that helped explain individually (unadjusted analysis) a positive attitude for the continuation of FGM (pro-FGM) in 2012/13 were: being married (OR=1.31, 95%CI=1.09–1.59) compared with people not married; having no education (OR=2.06, 95%CI=1.26–3.37) compared with people with higher education (Msc and PhD); household income [(OR=1.60, 95%CI=1.27–2.02) for people with a household income of <100 STG vs people with household income 501-1000STG], family size [(OR=1.32, 95%CI=1.07–1.64) for small size family of 1-4 children, (OR=1.46, 95%CI=1.20–1.79) for large family size of 8+ children vs middle size family of 5-7 children], place of residence [(OR=1.46, 95%CI=1.20–1.79) for people living in the rural area vs urban area], having trust in Imam, trust in Federal government, be able to make a choice about own future, trust in local government, trust in the judiciary system, the identity, able to hold decision makers to account and the state of residence. After adjusting for all other factors (adjusted model), the likelihood of being pro-FGM in people with only primary/interim education became statistically insignificant. The effect disappeared also for large family size; the statistically significant effect remains only for people with some trust in local government. They were 1.64 times more likely to be pro-FGM than people with no trust at all (95%CI=1.05–2.57); people with a lot of trust in the police were 1.70 more likely to be pro-FGM (95%CI=1.12–2.57) than people with some trust in the police; People who identify themselves as African were 2.91 times more likely to be associated with pro-FGM than people that identify themselves as Sudanese (95%CI=1.17–7.26).

In the same year of 2012/2013, pro-FGM were least likely to be in North state and most likely in White Nile (OR=7.14, 95%CI=3.04–16.8), in Sinnar OR=6.00, 95%CI=2.56–14.1) and in Red Sea (OR=6.00, 95%CI=2.05–17.6).

**In the following year of 2014**, factors associated with pro-FGM attitude in the unadjusted analysis were: education (OR=1.55, 95%CI=1.00–2.39) for the category “no education”, (OR=2.54, 95%CI=1.86–3.47) for primary/interim education and (OR=1.53, 95%CI=1.15–2.02) for secondary/Diploma vs people with Msc and PhD], household income [(OR=2.78, 95%CI=2.00–3.86) for people with a household income of <100 STG vs people

with household income 501-1000STG], family size [(OR=1.29, 95%CI=1.01–1.65) for middle size family of 5-7 children, (OR=2.02, 95%CI=1.51–2.70) and for large family size of 8+ children vs people with a small size family of 1-4 children], place of residence [(OR=1.43, 95%CI=1.13–1.81) for people living in the rural area vs urban area], having trust in the tribal leader, having trust in Imam, trust in Federal government, trust in local government, trust in the judiciary system, the identity, able to hold decision makers to account and the state of residence. After adjusting for all other factors, the likelihood of being pro-FGM in people with only primary/interim education was almost twice that of people with a Bsc (aOR=1.95, 95%CI=1.18–3.22). People from large families (8 children and above) were 1.61 times more likely to be pro-FGM than people from small families (1-4 children) (aOR=1.61, 95%CI=1.00–2.61); people with little trust in local government were 2.07 times more likely to be pro-FGM than people with no trust at all (95%CI=1.17–3.65); People who identify themselves with their tribe were 3.10 times more likely to be associated with pro-FGM than people that identify themselves as Sudanese (95%CI=1.57–6.14).

Pro-FGM were least likely to be in the North state and most likely in West Darfur (OR=35.9, 95%CI=6.79–190.1), in White Nile OR=32.6, 95%CI=6.11–173.9) and in North Darfur (OR=28.4, 95%CI=5.11–157.3)- possibly reflecting the relative deprivation of these states.

(Table 3 about here)

### **Results of the shift in the pro-FGM attitude at the state level during the 3 years period**

Monitoring pro-FGM attitudes using national proportions can mask within-country variability and thereby lead to the design and implementation of generic policies and interventions that may have limited impact at the local level.

An interesting case is looking at these consecutive DFID Sudan opinion poll data sets, where national pro-FGM percentage conceals important spatial variation at the state level within the three year period. For example, in the 2014 DFIDSOP, the national percentage of pro-FGM was 18.3% but ranged from 1.3% (North State) to 55.3% (South Darfur). Also, between 2012/13 and 2014, while the national percentage of pro-FGM decreased

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dramatically, South Darfur state went from a lower prevalence area in 2012-2013 (20.4%) to a higher prevalence area in 2014 (55.3%). Sinnar went from the highest prevalence area in 2012-2013 (45.9%) to a lower prevalence area in 2014 (9.4%). The proportion of pro-FGM remains stable at a lower level during the same period in states such as Kassala and Khartoum.

Unadjusted marginal odds ratios indicate that in 2012/2013 the highest pro-FGM attitude was in White Nile [OR & 95% CI: 9.36 (4.85, 18.0)], Red Sea [OR & 95% CI: 8.19 (4.25, 15.8)] and Sinnar [OR & 95% CI: 8.15 (4.23, 15.7)], followed by North Darfur, Blue Nile, South Kordofan, River Nile, Al Gedarif, South Darfur, North Kordofan and West Darfur, with the lowest percentages in Kassala, Kharthoum and Al Gezira. In 2014, the highest percentages were in South Darfur [OR & 95% CI: 12.3 (6.33, 23.8)] and White Nile [OR & 95% CI: 4.61 (2.31, 9.18)], followed by North Kordofan, West Darfur, North Kordofan, Blue Nile and Red Sea, and the lowest percentage was again in Kassala, Al Gedarif and Al Gezira. Kharthoum state, a highly urbanised area, was among the lowest probability states both in 2012/2013 and 2014. Surprisingly, South Darfur, which had a lower proportion of pro-FGM (20.1%) in 2012/2013, was among the highest proportion of pro-FGM (55.3%) in 2014.

[INSERT TABLE 1 ABOUT HERE]

[INSERT FIGURE 2 ABOUT HERE]

The pattern of shifts in pro-FGM attitude by state differed markedly between the two surveys, though there was consistently a higher proportion of pro-FGM attitude in Darfur and lower proportion in Khartoum (**Figure 3 and 4**). The observed proportion of pro-FGM attitude at the state level shown in **Table 2** indicates that the states in which the proportion of pro-FGM attitude is lowest and below the national average in both surveys are Kassala, North state and Khartoum. In 2012/13, states in which the proportion of pro-FGM attitude are higher than the



Kordofan and White Nile. In 2014, the states with a higher proportion of pro-FGM than the national average are North Darfur, South Darfur North Kordofan, South Kordofan, West Darfur and White Nile. White Nile and Sinnar are no longer among the states with the highest marginal odds ratios in 2014, only South Darfur is.

[INSERT FIGURE 1 ABOUT HERE]

### Bayesian Spatial regression analysis results

In multivariable Bayesian geo-additive regression analyses, factors that were consistently associated with higher pro-FGM attitude in both samples are: **education** (no education) [POR & 95% Credible Region (CR): 2.15(1.03, 3.80) in 2012/13 and primary/interim education [POR & 95% CR: 2.07(1.29, 3.18) in 2014], **trust in local government** (people with some trust [POR & 95% CR: 1.59(1.05, 2.64); in 2014] or people with little trust [POR & 95% CR: 1.47(1.03, 2.03) in 2012/13] and people with little trust in 2014 [POR & 95% CR: 2.10(1.03, 4.04)]), **identity** (African identity) [POR & 95% CR: 3.16(1.24, 6.48) in 2012/13] and tribal identity [POR & 95% CR: 3.23(1.75, 6.34) in 2014] and **the state of residence** ( living in Sinnar, Red sea and White Nile in 2012/13 and living in South Darfur, West Darfur and White Nile in 2014).

Other factors associated with a higher pro-FGM attitude in each sample were in 2012/13: Household income (501-1000STG) [POR & 95% CR: 1.43(1.03, 2.36), having a lot of trust in the police [POR & 95% CR: 1.71(1.11, 2.47) or not at all [POR & 95% CR: 1.67(1.00, 2.89)]. In 2014 these factors were: Large family size [POR & 95% CR: 1.72(1.19, 2.78)] and having a little trust in the tribal leader [POR & 95% CR: 1.73(1.05, 2.80)]. People willing to vote in a general election were associated with a reduced likelihood of being pro-FGM [POR & 95% CR: 0.65(0.46, 0.89)] in 2012/13.

Results of both multivariate standard logistic regression and multivariate Bayesian geo-additive analyses displayed in **Table 4** support the role of lack of education, family size, trust in the local government, identity, willingness to vote in a general election and living in certain

states as associated risk factors for pro-FGM attitude in both samples. The associations of urban/rural residence with pro-FGM attitude risk were not statistically significant.

Moreover, age of the respondent at the time of interview (as a continuous variable using a flexible nonlinear curve in **Figure 2**) and state of residence (as a spatial variable in **Figure 3 and 4**) remained significant risk factors in both surveys. Overall, results of the 2012/13 DFIDSOP (**Figure 3**) show that after accounting for (i) sampling error in the observed data; (ii) relationships with covariates and the uncertainty in the form of these relationships; (iii) uncertainty in the spatial autocorrelation structure of the outcome variable, the states with the highest pro-FGM risk included White Nile, Sinnar and Red Sea, while South Kordofan and North Darfur no longer ranked among the highest prevalence states as suggested by the marginal OR (**Table 3**). One year later in 2014 (**Figure 4**), the highest risk states included South Darfur, West Darfur and White Nile but not Sinnar.

[INSERT FIGURE 1 ABOUT HERE]

**Figure 2** shows an inverse U-shape association and a bell shaped non-linear relationship between the probability of pro-FGM attitude and respondent's age at the interview. The nonlinear association between age and the probability of pro-FGM at age 18 do not differ in the two samples starting at zero, the lowest probability of pro-FGM attitude with a gradual increase in both years. At all other ages, the two surveys also show agreement in the pattern of the probability of pro-FGM attitude until age 60. A watershed is present between 30-35 years of age, when both samples have the highest observed probability of pro-FGM attitude. Before age 30, this probability rises quickly as age increases. Beyond age 34 there is a declining probability of pro-FGM attitude, although the variation in probability increases rapidly at the same time as age continues to increase. For age above 60, there are wide confidence intervals suggesting few observations in both samples that make it difficult to discern a consistent upward increase in the pro-FGM attitude (instability of the estimates) in

However, a careful examination of the two figures reveals that in both figures the age's effects start at an estimate of 0 with a gradual increase thereafter. However, the two figures have a problem of scaling in the y-axis. This is an estimation problem and a difficult one to resolve now.

[INSERT FIGURE 3 & 4 ABOUT HERE]

With regard to pro-FGM attitude by states, in both samples, the spatial analysis has captured the striking variation in pro-FGM risk across states observed in the marginal regression analyses. **Figure 3 and 4** show results for covariate-adjusted state pro-FGM attitude spatial variation captured by **the global total residual state effects (i.e. the sum of the unstructured and structured spatial effect)**. There is a clear pattern of states with higher risk of pro-FGM attitude, mostly the south-eastern states of Sinnar and White Nile, including the eastern state of Red Sea in 2012/13 (Figure 2) and the southern state of South Darfur in 2014, which were associated with a higher risk of pro-FGM attitude, while states such as Kassala in 2012/13 and Northern, River Nile, Kassala and Al Gedarif in 2014 were associated with a lower pro-FGM attitude. These spatial patterns confirm the observed marginal model findings shown in Table 3.

Specifically, the left-hand map in Figure 2 shows estimated posterior total residual state odds of pro-FGM attitude for each state in 2012/13, ranging from a lower POR of 0.50 (0.24, 0.80) in Kassala State to a higher POR of 2.56 (1.64, 4.59) in White Nile and in 2014 the POR ranges as low as 0.16(0.04, 0.48) to a higher POR of 9.82(5.39, 21.4) in South Darfur, with red colour indicating the higher risk recorded and green colour denoting lower risk. The right-hand map shows the 95% posterior probability map of pro-FGM attitude, which indicates the statistical significance associated with the total excess risk. White indicates a negative spatial effect (associated with reduced risk of pro-FGM attitude), black a positive effect (an increased risk) and grey a non-significant effect. However, the total spatial residuals in **Figure 3 and 4** in both surveys show that much of the variation in pro-FGM attitude remains to be explained.

multiple adjustments of other risk factors indicating that perhaps the higher number of pro-FGM attitude participants living in the state was inflated by other factors such as identity, income and education.

## Discussion

To our knowledge, this is the first and largest epidemiological study, which examined the geographic variation at the state-level, of an attitude shift surrounding the FGM practice in an adult population from a higher FGM prevalence country in Sub-Saharan Africa. We used nationally representative data from the 2012 to 2014 Sudan DFIDSOP on a large, nationwide sample of women and men across the country's 16 states. Overall, the proportion of pro-FGM was 18.3% in 2014 compared with 27.6% in the two previous years (2012/13), with a striking variation across self perceived Sudanese cultural identity groups and states of residence, ranging from 1.3% in North State to 55.3% in South Darfur in 2014. Findings also point to the crucial role of demographic, socio-economic, political and cultural environmental factors surrounding the practice of FGM in these higher FGM prevalence settings. In fact, we found that people with a lack of education, low income, with a big family size, living in rural areas, who have some trust in local government and with a strong tribal identity, were more likely to be associated with a positive attitude for the continuation of FGM. Individuals from Darfur were more likely to have a positive attitude towards the continuation of FGM when compared to the North state in 2014- a somewhat surprising result given the North's historical association with FGM but possibly a product of the fact that these peripheral states suffer from the lowest levels of development in Sudan (associated with individual characteristics more likely to increase support for FGM). Also, between 2012/13 and 2014, while the national percentage of pro-FGM decreased dramatically, South Darfur state went from a lower prevalence area in 2012-2013 (20.4%) to a higher prevalence area in 2014 (55.3%). Sinnar went from the highest prevalence area in 2012-2013 (45.9%) to a lower prevalence area in 2014 (9.4%). The proportion of pro-FGM remains stable on a low level during the same period in states such as Kassala and Khartoum.

Looking at these sudden shifts of attitude at the state level provides more evidence that monitoring attitude shifts of pro-FGM using national proportions can mask within-country variability and thereby lead to the design and implementation of generic policies and interventions that may have limited impact at the local level.

These findings provide novel evidence to support the notion of a rapidly shifting attitude surrounding the abandonment of FGM. The notable decrease in the practice of cutting observed between the 2006 and 2010 Sudanese Household Surveys and the resulting shift in attitude make a compelling case for public health policy on FGM abandonment to avert a growing burden of health dangers [2]. Several factors are likely to contribute to the changing attitude in the practice of FGM in these higher FGM prevalence countries for both pro-FGM and anti-FGM groups. For pro-FGM groups, it is primarily the reason they cite why the practice should continue such as the importance attached to the practice as a prerequisite for a good marriage, as an important requirement for the continuation of tradition or it's part of the culture and part of the Islamic instruction. For the anti-FGM groups, there has been an extensive education by the government and non-government organisations about the awareness on health dangers associated with the practice [2, 10]. The rapidly changing role of women in these societies, with their education and their increasing involvement in the democratic process and labour force especially in urban areas, might also contribute to the changes in the FGM perception to eradicate the practice [19-24]. In countries where FGM/C is higher such as Sudan, the attitudes of pro-FGM and anti-FGM practising populations can be leveraged to promote its elimination. To do so, it is essential to explore what people think about the practice. Does support vary across groups with different social and economic backgrounds? Do women and men share the same opinions? What are the perceived benefits of FGM/C and the reasons why women and men believe it should continue?

All these questions were examined extensively in our study going even further by controlling many confounding factors that might intermingle with each other in a complex modelling that extend the exploratory analysis done by UNICEF on this subject [1].

helping to reduce the prevalence of the practice. According to UNICEF, more than 50 per cent of Sudanese women believe the practice should be discontinued amid growing awareness about its health dangers. The comparison of the 2006 and 2010 Sudanese Household Surveys shows a notable decrease in the practice of cutting, which UNICEF expects to lead to a further decrease. It is interesting to note that states such as Kassala with the highest prevalence in the country, according to the 2010 Sudan Household Health Survey is associated with a lower proportion of pro-FGM [1-2]. A possible explanation of this finding is that women in higher prevalence FGM areas might want the practice to be discontinued.

Our study found that Kassala state was among the states with the lowest pro-FGM attitude despite the fact that it is among the highest FGM practising states. These novel findings have great policy implications. The support of this practice is decreasing and this is an opportunity for the abandonment of the practice.

The Sudanese government has introduced stiff penalties for those who continue to perform the procedure, however, the practice, which is still not criminalised by law in Sudan, remains widespread, particularly in rural communities [1]. The eradication of FGM is further complicated by cultural and societal pressures, as well as religious sensitivities surrounding the issue. UNICEF is providing support for a national strategy to abolish FGM known as the Saleema initiative [1, 3]. In other countries in the region, there are some successful public health policy programmes by multilateral agencies such as the WHO, UNICEF and different NGOs advocating the abandonment of FGM. In Senegal, Guinea, Guinea-Bissau, Mali, Mauritania and the Gambia the NGO TOSTAN is successfully using community led approaches to eradicate the practice [8]. In Ethiopia, using human rights and development approach, Kembatta Mentti Gezzimma-Tope (KMG), an Ethiopia-based indigenous NGO fights for a society free of FGM and all forms of discrimination and violence, and where women are able to attain justice, equity, and equality for themselves, their families, and their communities [9].

In comparison with other countries, the practice of circumcision in Sudan is widespread. The prevalence of daughter and women circumcision in Sudan was 88% in 2010 [1-3]. That's 12.1 million girls and women who have undergone FGM/C. Worldwide this prevalence ranges as low as 1% in Cameroon and as high as 98% in Somalia [1]. Our findings are corroborated by previous studies. Findings from UNICEF show that Girls and women with no education are nearly four times more likely to support the continuation of FGM/C than girls and women with secondary or higher education. In other higher prevalence FGM countries UNICEF [1] reports the following statistics: Guinea (96%), 19% of girls and women think FGM/C should stop, compared to 42% of boys and men. In **Eritrea**, 60% of girls and women regard FGM/C as a religious requirement. In **Mali**, 58% of girls who have been cut are daughters of mothers who oppose the practice. In **Sierra Leone**, 51% of couples do not agree on whether FGM/C should continue or end. In **Cote D'Ivoire**, 41% of girls and women of Voltaique/Gur background support the continuation of FGM/C, compared to only 3% of Akan girls and women. In **Cameroon**, 85% of boys and men think that FGM/C should not be continued. In **Liberia**, girls and women from the poorest households are twice as likely to have experienced FGM/C as those from the richest households. In **Ethiopia**, 41% of girls and women with no education support the continuation of FGM/C compared to 5% of girls and women with secondary or higher education. In Burkina Faso, **76%** of girls and women have been cut, but only 9% favour the continuation of FGM/C and in **Gambia**, 82% of girls and women, who have undergone FGM/C think the practice should continue, compared to 5% of girls and women who have not been cut [1].

As shown above people's attitudes about FGM/C vary widely across and within countries. In Sudan particularly, our study found strikingly large differences across states and socio-economic and cultural factors. However, when we controlled for many other factors that might confound the relationship between the attitude about FGM/C and these factors in a Bayesian multivariate model, many of the observed associations were no longer statistically significant suggesting that, perhaps most of these associations were not real ones (chance). Specifically, our study shows that factors that really matter in FGM/C attitude in both successive surveys in Sudan were: lack of education, low income, large family size, trust in

levels of support can be found in both surveys in White Nile and South Darfur, where more than half the population thinks the practice should continue. However, it is observed that in most states in Sudan where FGM/C is higher (Kassala state for example), the majority of people think it should end. Therefore, in order to reduce FGM's prevalence, programming efforts for the abandonment should capitalise on these findings and double their efforts first in higher prevalence states of Sudan.

In this study, we postulated (as from our conceptual framework, Figure 1) that pro/anti-FGM attitude was not merely influenced by personal characteristics such as education or wealth rather they mediate the effect of culture on pro/anti-FGM attitude, which in turn is the net effect and interaction between culture, environment and social determinants that specify or shape the information about FGM. Our study findings confirm this hypothesis. We found for both studies in Sudan that although the majority of the population interviewed had secondary education (37.2% in 2011/12 vs 23.8% in 2014), when asked the reason why FGM should continue, in 2012/13, the majority of participants (51.6%) cited the requirement for a good marriage and the importance of tradition (34.4%) compared with 2.1% that cited it as part of Islam instruction and in 2014 28.7% cited the requirement for good marriage, 30.8% of the population cited the importance of tradition compared with 20.2% that cited it as part of Islam instruction. Other factors associated with pro-FGM attitude were having some trust in local government but not police. We believe, that this is in line with Berger and Luckmann's theory that stipulates that externalization and internalization processes, cultures of pro/anti-FGM attitude learn from significant others or other group members with tradition as the social norm and tradition normalizes people's behaviours on pro/anti-FGM attitude imperceptibly and forms a society called a symbolic universe, which gives people a direction and lets individuals judge whether or not their behaviours are legal (Berger and Luckmann 1966: 94). In this regard, the pathway for the abandonment of the harmful practice of FGM should be the interaction between culture, environment and social determinants that specifies or shapes the information seeking behaviour on FGM. Thus, the pro/anti-FGM attitude should be considered as information that is embedded in the fabric of people's lives and work and



constructed through involvement in life's activities, problems, tasks and social and technological structures, as opposed to being independent and context free and the abandonment movement must merely focus on women empowerment (education and wealth) and modernization. The spatial analysis undertaken in this study is the robust approach that accounts for the above interaction beyond individual risk factors on pro/anti-FGM attitude.

There are some limitations in the present study that deserve discussion. First, the cross-sectional nature of the two studies does not allow for establishing temporality and causality of the observed associations. However, given the nature of our independent variables of interest (state of residence, cultural, demographic and socioeconomic factors) associated with attitude toward FGM/C the potential of reverse causation should be minimized. Second, the analysis was based on nationally representative samples of Sudanese; therefore, the generalizability and applicability of these findings to other populations or other Sub-Saharan African countries warrants further investigation. Finally, the way the question of attitude toward FGM/C is asked in the two surveys might also have some implication on the participants' response to these sensitive questions. However, these types of questions have been asked since 1989, where UNICEF (Multiple Indicators Cluster Surveys: MICS data) and Macro International (Demographic Health Surveys (DHS)) modules on FGM/C included similar questions on whether or not the practice should continue [13]. The 2012 to 2014 Sudan DFIDSOP surveys posed questions such as *Do you think this practice should continue?* or *Should it be discontinued?*, followed by pre-coded responses, including *continued*, *discontinued* and ambivalent responses, such as *not sure or refuse to answer*. As in other survey topics, the way in which the questions have been asked has evolved over time. Earlier surveys of MICS and DHS included a larger set of attitudinal questions, inquiring not only whether the practice should continue but also into the reasons behind a respondent's stated opinion, whether that opinion had changed, and views on perceived benefits or inconveniences of the practice. Answers to questions capture a respondent's opinion at one point in time and in the context of responding to a formal survey. Among those who say they favour the discontinuation of FGM/C, it is possible that, with intense exposure to campaign

messages against the practice, they may be reporting what they perceive to be the 'correct' answer, rather than their true opinion [18-24]. Moreover, even a truthful response at one point in time fails to take into account that a person's opinion may shift as he or she is exposed to new information about the practice, or to the opinions of others [18-24]. This issue has been documented in Senegal and the Gambia, where Hernlund and Shell-Duncan [19] emphasize that "there is a broad range of realities inhabited by those who participate in FGM/C in this region – ranging from strong support to strong opposition, but with the potential movement over time by an individual or even community from one category to another, and potentially back again". They add that "the construction of a person's 'opinion' about the practice is more correctly an ongoing positioning vis-à-vis fluctuating needs and realities, representing contingencies that affect decision-making" [1, 20-24]. Therefore, we cannot rule out the possibility that our findings might have been somewhat biased by the shift in attitude over time and the lack of many other important confounders that were not measured by these two surveys. Nevertheless, it is the largest study that has examined both bivariate and multivariate association of attitude toward FGM/C beside the UNICEF study that was limited to the exploration of bivariate association, which by further examination of these associations we have done.

In conclusion, this is the first and largest study that examined the geographic variation of pro-FGM in an adult population from sub-Saharan Africa. We found several consistent associations between socio-demographic and cultural variables and pro-FGM attitude in successive nationwide samples of Sudanese from the 2012 to 2014 Opinion poll data. The spatial analysis showed distinct patterns in the pro-FGM attitude across the country's states, pointing to the potential influence of demographic, cultural, socio-economic and environmental factors, as well as to an increasing effect of time and age of the individual, which are all driving the ongoing decline in FGM/C prevalence. Importantly, anti-FGM stakeholders can use this geographic information on pro-FGM mapping for planning purposes, educational purposes but also in the decision making process for the allocation of public resources to the most affected areas of the population in Sudan.

## Conclusions and Recommendations

During 2012/2013 and 2014 in Sudan, the overall percentage of people with a positive attitude towards FGM continuation was 27.5 and 18.3% respectively. Factors associated with pro-FGM are varied and complex: Lack of education, low income, large family size, trusts in tribal leaders and local government, tribal identity and living in White Nile and South Darfur. The eradication of FGM/C must involve the identification of issues that are sustaining the practice in different localities and subsequent action supported either by logical persuasion following aggressive health education or by legislation. Policies should capitalize on these findings and local, tribal, religious and government leaders should be involved in continuing programs of action.

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## Figure legends

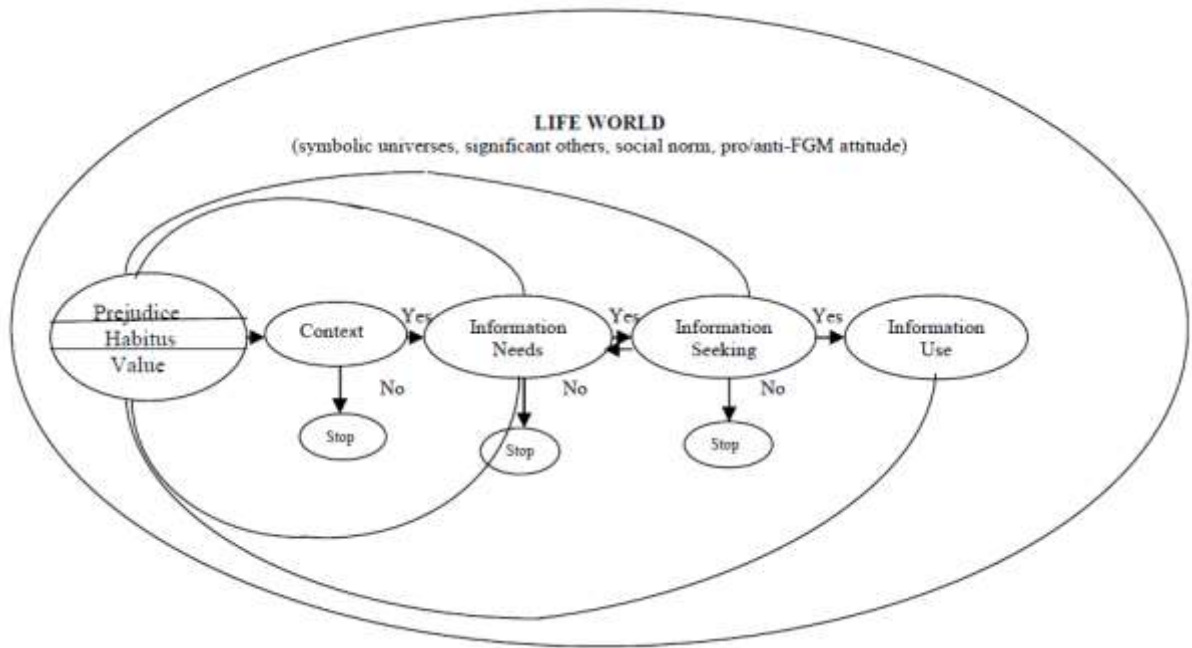
**Figure 1:** The model of culture and human information behaviour adapted from Nei-Ching Yeh (*Information Research*, Vol. 12 No. 2, January 2007).

**Figure 2:** Left: Estimated nonparametric effect of respondent's age in 2012/13 (left) and in 2014 (right). Shown is the posterior mean within 80% credible regions. [DFID Opinion poll data]

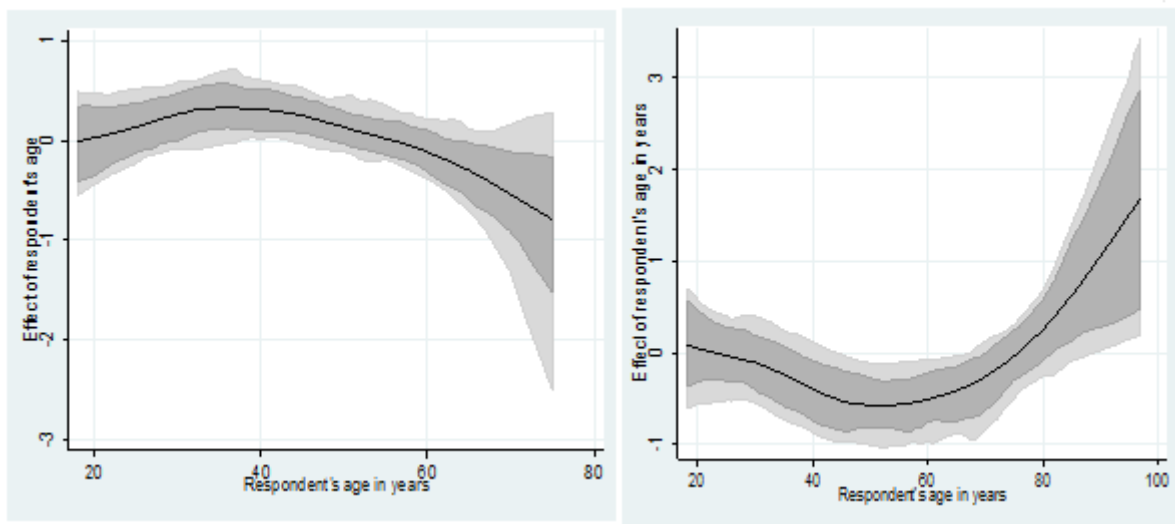
**Figure 3:** Left: Adjusted total residual spatial effects, at state level in Sudan, of positive attitude surrounding FGM continuation (pro-FGM) in 2012/13. Shown are the posterior odds ratios. Right: Corresponding posterior probabilities at 90% nominal level.

**Figure 4:** Left: Adjusted total residual spatial effects, at state level in Sudan, of positive attitude surrounding FGM continuation (pro-FGM) in 2014. Shown are the posterior odds ratios. Right: Corresponding posterior probabilities at 90% nominal level.

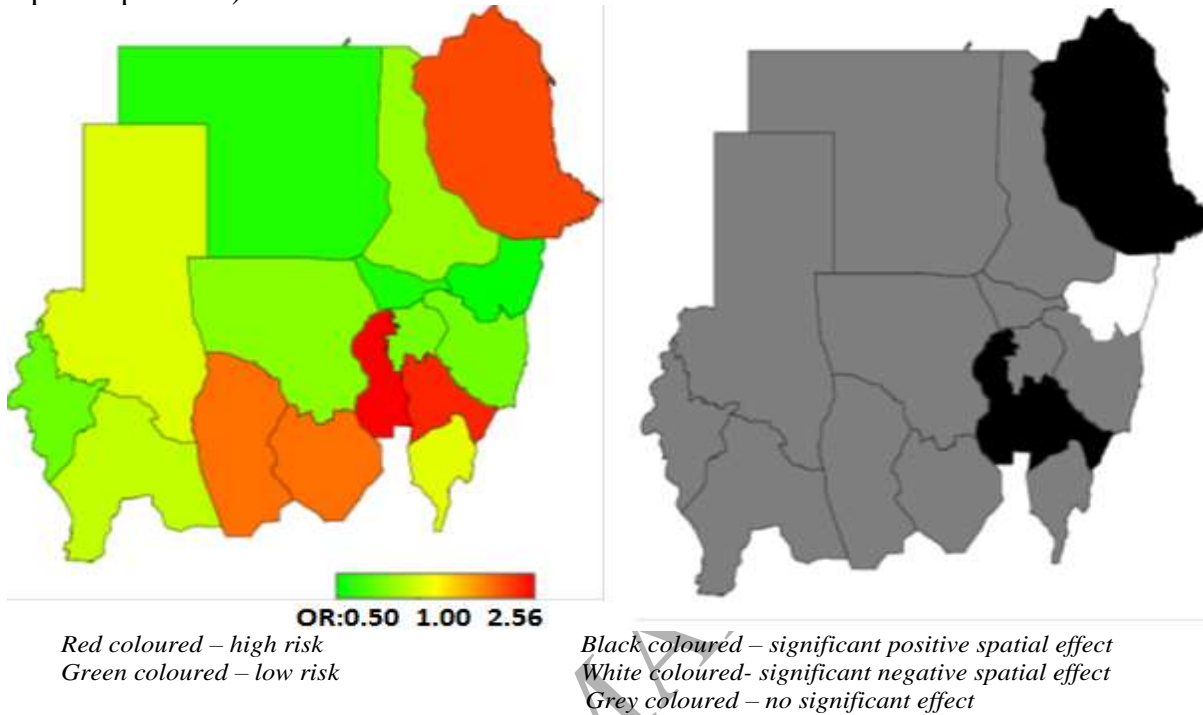
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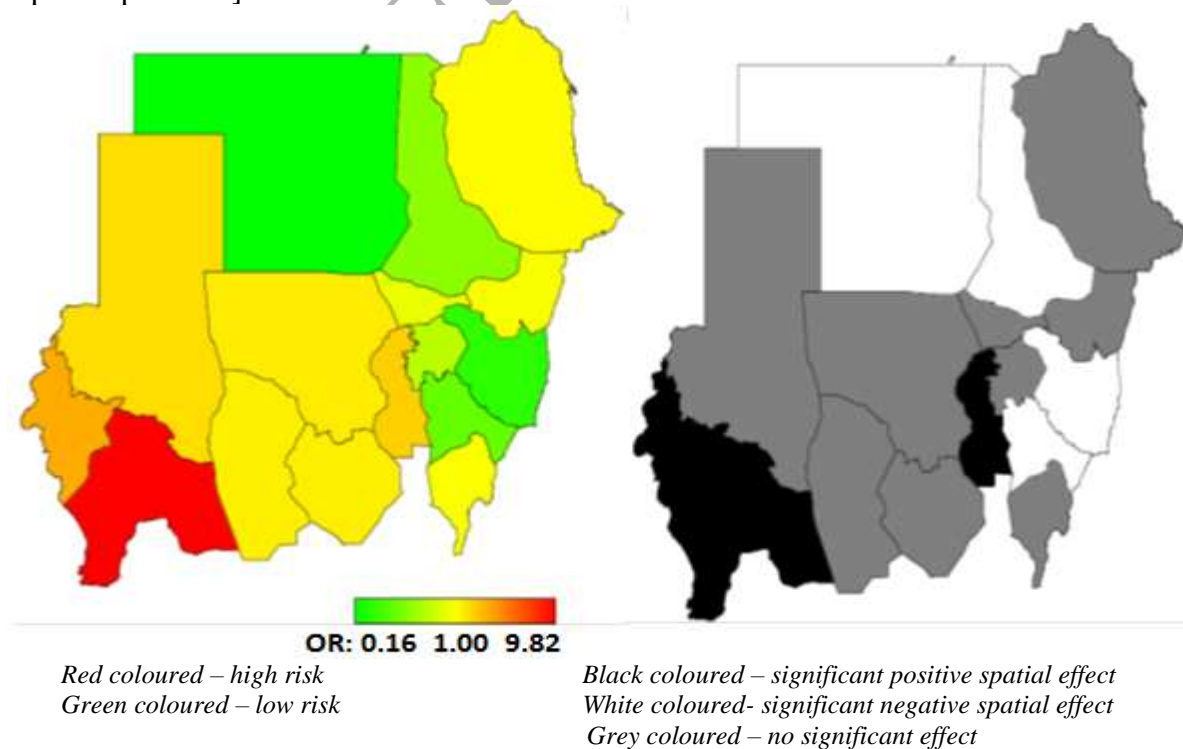
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**Figure 3:** Left: Adjusted total residual spatial effects, at state level in Sudan, of positive attitude surrounding FGM continuation (pro-FGM) in 2012/13. Shown are the posterior odds ratios. Right: Corresponding posterior probabilities at 80% nominal level [2012-2013 DFID Opinion poll data)



**Figure 4:** Left: Adjusted total residual spatial effects, at state level in Sudan, of positive attitude surrounding FGM continuation (pro-FGM) in 2014. Shown are the posterior odds ratios. Right: Corresponding posterior probabilities at 90% nominal level [2014 DFID Opinion poll data].



**Table 1:** Baseline characteristics of the study population (DFID Sudan, 2012/13 & 2014)\*

Variable	2012/13 (N=2,364)	2014 (N=2,376)
Mean age <sup>†</sup> (SD) for respondent	34.8(12.5)	35.8(12.9)
FGM should stop (%)		
Yes	72.5	81.7
No	27.5	18.3
Why FGM should continue (%)		
Required for good marriage	51.6	28.7
Important for tradition	34.4	30.8
Part of culture	11.9	20.2
Part of Islamic instruction	2.1	20.2
Age (%)		
<25 years	17.4	23.2
25-30 years	19.9	35.7
36-50 years	15.5	25.5
>50 years	47.2	15.6
Gender (%)		
Female	49.9	47.6
Male	50.1	52.4
Married (%)		
Yes	58.0	63.7
No	42.0	36.3
Education (%)		
No education	14.1	7.2
Primary/Interim education	21.5	13.9
Secondary education/Diploma	37.2	23.8
BSc	22.0	42.0
Higher education (Higher diploma, MSc,PhD)	5.2	13.1
Household income (%)		
<100STG	46.0	33.9
100-500 STG	31.8	37.1
501-1000 STG	22.2	19.1
1001-2000 STG		6.0
2001-3000 STG		3.9
Family size (%)		

Small (1-4 children)	61.9	52.9
Middle (5-7 children)	28.5	31.9
Large (8+ children)	9.6	15.2
Place of residence (%)		
Urban	35.7	35.4
Rural	64.3	64.6
Trust in the tribal leader (%)		
A lot	43.0	31.6
Some	36.2	31.4
A Little	20.8	18.3
Not at all		18.6
Trust in Imam (%)		
A lot	60.5	69.3
Some	21.0	16.6
A Little	10.0	6.8
Not at all	8.5	7.3
Trust in the Federal Government (%)		
A lot	15.8	23.5
Some	30.6	29.1
A little	27.6	22.9
Not at all	26.0	24.5
Trust in the Local Government (%)		
A lot	12.8	22.0
Some	30.8	26.1
A little	29.5	26.0
Not at all	27.0	25.9
Trust in the Police (%)		
A lot	23.9	33.3
Some	34.4	31.4
A little	23.9	19.4
Not at all	17.8	15.9
Trust in the Judiciary system (%)		
A lot	25.0	35.0
Some	38.1	31.3



	21.7	20.5
A little	21.7	20.5
Not at all	15.2	13.2
Islamic Law (%)		
Should be at the heart of the constitution	55.2	82.4
Should be part of the constitution	44.8	17.6
Have a choice about my future		
A lot	39.7	42.8
Some	25.8	23.7
A little	20.3	19.6
Not at all	14.2	13.9
Identity		
Sudanese	81.2	78.3
My state	2.6	1.9
Arab	1.3	1.8
African	2.0	1.4
My tribe	4.6	4.3
My religious affiliation	8.3	12.2
Able to hold decision makers to account		
A lot	20.5	22.3
Some	21.7	21.2
A little	19.9	17.6
Not at all	37.9	38.9
If election held would vote		
Yes	80.8	70.1
No	19.2	29.9
State of residence (%)		
Al Gedarif	6.3	6.3
Al Gezira	7.3	7.6
Blue Nile	6.3	5.9
Kassala	5.9	6.3
Khartoum	10.9	10.9
North Darfur	4.3	3.8
North Kordofan	6.3	6.3
North State	6.3	6.3

Red Sea	6.3	6.3
River Nile	6.3	6.3
Sinnar	6.3	6.3
South Darfur	8.4	8.7
South Kordofan	6.1	6.3
West Darfur	6.4	6.3
White Nile	6.3	6.3

\* Data are expressed as mean (standard deviation) or as percentages.

†Age ranges from 18 to 97 years of age.

**Table 2: Baseline characteristics of the study population by intend to continue circumcision practice<sup>†</sup>**  
(DFID Sudan, 2012/13 & 2014)\*

Variable	2012/13			2014		
	Stop FGM (N=1,616)	Continue FGM (N=612)	P-value <sup>†</sup>	Stop FGM (N=1800)	Continue FGM (N=404)	P-value <sup>†</sup>
Age			p=0.37			p=0.67
<25 years	478(74.9)	160(25.1)		406(81.0)	95(19.0)	
25-30 years	511(70.7)	212(29.3)		648(82.0)	142(18.0)	
36-50 years	407(72.6)	154(27.4)		474(82.9)	98(17.1)	
>50 years	220(71.9)	86(28.1)		272(79.8)	69(20.2)	
Gender			p=0.06			p=0.74
Female	817(74.3)	282(25.7)		881(81.9)	194(18.1)	
Male	799(70.8)	330(29.2)		919(81.4)	210(18.6)	
Married			p=0.005			p=0.07
Yes	906(70.3)	383(29.7)		1125(80.7)	269(19.3)	
No	709(75.7)	228(24.3)		652(83.8)	126(16.2)	
Education (%)			p<0.001			p<0.001
No education	201(62.4)	121(37.6)		121(79.6)	31(20.4)	

Primary/Interim	332(68.9)	150(31.1)		207(70.4)	87(29.6)	
education						
Secondary education/Diploma	624(76.1)	196(23.9)		420(79.8)	106(20.2)	
BSc	370(75.7)	119(24.3)		804(85.8)	133(14.2)	
Higher educ (Higher diploma, MSc,PhD)	89(77.4)	26(22.6)		230(83.9)	44(16.1)	
Household income			p<0.001			p<0.001
<100 STG	621(67.9)	293(32.1)		520(71.9)	203(28.1)	
100-500 STG	486(77.3)	143(22.7)		722(86.7)	111(13.3)	
501-1000 STG	312(74.3)	108(25.7)		377(87.7)	53(12.3)	
1001-2000 STG				107(82.9)	22(17.1)	
2001-3000 STG				74(83.1)	15(16.9)	
Family size			p=0.03			p<0.001
Small (1-4 children)	960(70.6)	399(29.4)		986(84.6)	180(15.4)	
Middle (5-7children)	494(76.1)	155(23.9)		570(81.0)	134(19.0)	
Large (8+ children)	162(73.6)	58(26.4)		244(73.0)	90(27.0)	
Place of residence (%)			p<0.001			p=0.003
Urban	603(77.3)	177(22.7)		663(85.0)	117(15.0)	
Rural	1013(70.0)	435(30.0)		1137(79.8)	287(20.2)	
Trust in the tribal leader			p=0.66			p<0.001
A lot	555(70.5)	232(29.5)		457(76.9)	137(23.1)	
Some	465(71.5)	185(28.5)		518(86.9)	78(13.1)	
A little	264(73.1)	97(26.9)		265(78.6)	72(21.4)	
Not at all				286(83.6)	56(16.4)	
Trust in Imam			p=0.001			p<0.001
A lot	883(83.5)	384(30.3)		1243(83.5)	245(16.5)	
Some	336(75.0)	112(25.0)		268(81.5)	61(18.5)	
A little	153(72.9)	57(27.1)		99(72.3)	38(27.7)	
Not at all	147(83.1)	30(16.9)		107(71.3)	43(28.7)	
Trust in Fed. Govern.			p=0.005			p=0.02
A lot	211(65.1)	113(34.9)		383(81.0)	90(19.0)	
Some	424(71.3)	171(28.7)		501(85.8)	83(14.2)	
A little	399(74.2)	139(25.8)		355(78.9)	95(21.1)	

Not at all	400(75.9)	127(24.1)		402(83.6)	79(16.4)	
Trust in local Gov.			p=0.003			p=0.03
A lot	181(65.8)	94(34.2)		376(80.7)	90(19.3)	
Some	451(70.7)	187(29.3)		455(84.3)	85(15.7)	
A little	426(72.0)	166(28.0)		412(78.3)	114(21.7)	
Not at all	433(77.3)	127(22.7)		445(84.4)	82(15.6)	
Trust in the Police			p<0.001			p=0.099
A lot	331(64.4)	183(35.6)		592(82.3)	127(17.7)	
Some	540(76.4)	167(23.6)		563(84.8)	101(15.2)	
A little	380(73.6)	136(26.4)		313(78.8)	84(21.2)	
Not at all	284(75.1)	94(24.9)		258(81.4)	59(18.6)	
Trust in the Judiciary			p=0.15			p=0.06
A lot	376(70.4)	158(29.6)		622(84.4)	115(15.6)	
Some	570(73.4)	206(26.6)		519(79.4)	135(20.6)	
A little	328(72.4)	125(27.9)		338(83.1)	69(16.9)	
Not at all	251(77.5)	73(22.5)		208(79.4)	54(20.6)	
Islamic Law			p=0.003			p=0.23
Should be at the heart of the constitution	788(69.9)	339(30.1)		1421(82.4)	303(17.6)	
Should be part of the constitution	705(75.7)	226(24.3)		296(79.8)	75(20.2)	
Choice about my future			p<0.001			p=0.90
A lot	561(66.7)	280(33.3)		757(81.6)	171(18.4)	
Some	394(77.0)	118(23.0)		425(82.9)	88(17.1)	
A little	336(79.1)	89(20.9)		331(81.5)	75(18.5)	
Not at all	229(75.8)	73(24.2)		240(80.8)	57(19.2)	
Identity			p<0.001			p<0.001
Sudanese	1331(74.5)	456(25.5)		1440(83.8)	279(16.2)	
My state	27(56.3)	21(43.7)		22(68.8)	10(31.2)	
Arab	17(60.7)	11(39.3)		24(64.9)	13(35.1)	
African	28(62.2)	17(37.8)		23(76.7)	7(23.3)	
My tribe	60(59.4)	41(40.6)		50(55.6)	40(44.4)	
My religious affiliation	125(72.7)	47(27.3)		223(81.4)	51(18.6)	

Hold decision makers to			p<0.001			p=0.03
account						
A lot	255(63.4)	147(36.6)		364(80.9)	86(19.1)	
Some	283(68.4)	131(31.6)		335(80.1)	83(19.9)	
A little	277(77.2)	82(22.8)		272(78.2)	76(21.8)	
Not at all	585(79.7)	149(20.3)		656(85.0)	116(15.0)	
If election held would vote			p=0.002			p=0.09
Yes	1283(74.3)	444(25.7)		1247(82.8)	260(17.2)	
No	279(66.9)	138(33.1)		497(79.7)	127(20.3)	
State of residence (%)			p<0.001			p<0.001
Al Gedarif	105(70.5)	44(29.5)		141(96.6)	5(3.4)	
Al Gezira	142(83.5)	28(16.5)		153(92.7)	12(7.3)	
Blue Nile	90(60.0)	60(40.0)		89(81.6)	20(18.4)	
Kassala	125(90.6)	13(9.4)		119(90.8)	12(9.2)	
Khartoum	187(89.0)	23(11.0)		206(84.4)	38(15.6)	
North Darfur	51(59.3)	35(40.7)		64(79.0)	17(21.0)	
North Kordofan	113 (80.1)	28 (19.9)		109 (72.7)	41 (27.3)	
North State	130(87.2)	19(12.8)		148(98.7)	2(1.3)	
Red Sea	81(54.0)	69(46.0)		122(81.9)	27(18.1)	
River Nile	101(69.2)	45(30.8)		131(89.1)	16(10.9)	
Sinnar	79(54.1)	67(45.9)		135(90.6)	14(9.4)	
South Darfur	151(79.9)	38(20.1)		80(44.7)	99(55.3)	
South Kordofan	84(68.3)	39(31.7)		118(80.3)	29(19.7)	
West Darfur	103(76.3)	32(23.7)		86(76.8)	26(23.2)	
White Nile	74(50.7)	72(49.3)		99(68.3)	46(31.7)	

\*Data are expressed as mean (standard deviation) or as percentages.

†P-values for comparison between pro-FGM and ant-FGM subjects.

**Table 3: Unadjusted and fully adjusted odds ratios of intend to continue FGM across selected covariates (DFID Sudan, 2012/13 &2014)**

Variable	2012/13		2014	
	Unadjusted OR & 95%CI <sup>†</sup>	Fully adjusted OR & 95% CI <sup>†</sup>	Unadjusted OR & 95%CI <sup>†</sup>	Fully adjusted OR & 95% CI <sup>†</sup>
Age				
<25 years	1.00	1.00	1.13(0.83,1.55)	1.49(0.87, 2.55)
25-30 years	1.24(0.97, 1.58)	1.50(0.99, 2.25)	1.06(0.80,1.41)	1.41(0.92, 2.18)
36-50 years	1.13(0.87, 1.46)	1.27(0.78, 2.06)	1.00	1.00
>50 years	1.17(0.86, 1.59)	0.90(0.50, 1.62)	1.23(0.87,1.73)	1.11(0.65, 1.89)
Gender				
Female	1.20(0.99, 1.44)	0.97(0.71, 1.32)	0.96(0.78,1.20)	1.03(0.73, 1.44)
Male	1.00	1.00	1.00	1.00
Marriage				
Yes	1.31(1.09, 1.59)	1.15(0.80, 1.66)	1.24(0.98,1.56)	1.44(0.94, 2.21)
No	1.00	1.00	1.00	1.00
Education (%)				
No education	2.06(1.26, 3.37)	1.97(0.86, 4.50)	1.55(1.00, 2.39)	0.70(0.30, 1.63)
Primary/Interim education	1.55(0.96, 2.49)	1.65(0.78, 3.49)	2.54(1.86,3.47)	1.95(1.18, 3.22)
Secondary education/Diploma	1.08(0.68, 1.71)	1.12(0.55, 2.27)	1.53(1.15,2.02)	1.31(0.87, 1.98)
BSc	1.10(0.68, 1.79)	1.24(0.60, 2.54)	1.00	1.00
Higher educ.(Higher diploma, MSc, PhD)	1.00	1.00	1.16(0.80, 1.68)	0.74(0.42, 1.32)
Household income				
<100 STG	1.60(1.27, 2.02)	1.30(0.88, 1.91)	2.78(2.00, 3.86)	1.41(0.87, 2.28)
100-500 STG	1.00	1.00	1.09(0.77, 1.55)	1.12(0.69, 1.81)
501-1000 STG	1.18(0.88, 1.57)	1.33(0.86, 2.06)	1.00	1.00
1001-2000 STG			1.46(0.85, 2.51)	1.34(0.64, 2.82)
2001-3000 STG			1.44(0.77, 2.69)	0.83(0.25, 2.72)
Family size				
Small (1-4 children)	1.32(1.07, 1.64)	0.99(0.69, 1.41)	1.00	1.00
Middle (5-7 children)	1.00	1.00	1.29(1.01, 1.65)	0.94(0.63, 1.39)
Large (8+ children )	1.14(0.80, 1.62)	1.02(0.57, 1.84)	2.02(1.51, 2.70)	1.61(1.00, 2.61)
Place of residence (%)				

Urban	1.00	1.00	1.00	1.00
Rural	1.46(1.20, 1.79)	1.04(0.73, 1.48)	1.43(1.13,1.81)	1.12(0.77, 1.63)
Trust in the tribal leader				
A lot	1.14(0.86, 1.50)	1.00(0.66, 1.52)	1.99(1.47, 2.70)	1.52(0.96, 2.42)
Some	1.08(0.81, 1.44)	1.02(0.66, 1.58)	1.00	1.00
A Little	1.00	1.00	1.80(1.27, 2.57)	1.62(0.96, 2.74)
Not at all			1.30(0.90, 1.89)	1.25(0.71, 2.21)
Trust in Imam				
A lot	2.13(1.41, 3.21)	1.45(0.69, 3.07)	1.00	1.00
Some	1.63(1.04, 2.55)	1.28(0.58, 2.86)	1.15(0.85, 1.57)	0.68(0.41, 1.15)
A Little	1.83(1.11, 3.00)	1.86(0.78, 4.47)	1.95(1.31, 2.90)	1.04(0.52, 2.06)
Not at all	1.00	1.00	2.04(1.40, 2.98)	1.00(0.47, 2.12)
Trust in the Fed. Government				
A lot	1.69(1.25, 2.28)	0.94(0.54, 1.63)	1.42(1.02, 1.97)	1.54(0.90, 2.63)
Some	1.27(0.97, 1.66)	1.32(0.82, 2.12)	1.00	1.00
A little	1.10(0.83, 1.45)	0.97(0.60, 1.57)	1.62(1.17, 2.23)	1.12(0.68, 1.85)
Not at all	1.00	1.00	1.19(0.85, 1.66)	1.22(0.67, 2.22)
Trust in the local Government				
A lot	1.77(1.29, 2.43)	1.55(0.90, 2.66)	1.30(0.93, 1.81)	1.91(0.99,3.68)
Some	1.41(1.09, 1.84)	1.64(1.05, 2.57)	1.01(0.73, 1.41)	2.00(1.09, 3.67)
A little	1.33(1.02, 1.74)	1.51(0.96, 2.39)	1.50(1.10, 2.06)	2.07(1.17, 3.65)
Not at all	1.00	1.00	1.00	1.00
Trust in the Police				
A lot	1.79(1.39, 2.30)	1.70(1.12, 2.57)	1.00	1.00
Some	1.00	1.00	0.84(0.63, 1.11)	1.16(0.72, 1.87)
A little	1.16(0.89, 1.50)	1.25(0.82, 1.93)	1.25(0.92, 1.70)	1.02(0.58, 1.79)
Not at all	1.07(0.80, 1.43)	1.64(0.97, 2.77)	1.07(0.76, 1.50)	0.96(0.51, 1.81)
Trust in the Judiciary system				
A lot	1.44(1.05, 1.99)	1.14(0.64, 2.05)	1.00	1.00
Some	1.24(0.92, 1.69)	1.35(0.78, 2.32)	1.41(1.07, 1.85)	0.92(0.57, 1.48)
A little	1.31(0.94, 1.83)	1.28(0.73, 2.27)	1.10(0.80, 1.53)	0.64(0.37, 1.10)
Not at all	1.00	1.00	1.40(0.98, 2.01)	1.51(0.81, 2.84)
Islamic Law				
Should be at the heart of	1.34(1.10, 1.63)	0.90(0.66, 1.25)	0.84(0.63, 1.12)	0.75(0.50, 1.13)

the constitution	ACCEPTED MANUSCRIPT			
Should be part of the constitution	1.00	1.00	1.00	1.00
Choice about my future				
A lot	1.88(1.43, 2.48)	0.86(0.53, 1.38)	1.09(0.82, 1.45)	1.05(0.69, 1.61)
Some	1.13(0.83, 1.54)	0.74(0.44, 1.23)	1.00	1.00
A little	1.00	1.00	1.09(0.78, 1.54)	0.68(0.40, 1.17)
Not at all	1.20(0.85, 1.71)	0.88(0.48, 1.62)	1.15(0.79, 1.66)	1.53(0.81, 2.88)
Identity				
Sudanese	1.00	1.00	1.00	1.00
My state	2.27(1.27, 4.06)	2.20(0.84, 5.77)	2.35(1.10, 5.01)	1.83(0.56, 5.93)
Arab	1.89(0.88, 4.06)	1.26(0.29, 5.41)	2.79(1.41, 5.56)	2.57(0.69, 9.56)
African	1.77(0.96, 3.27)	2.91(1.17, 7.26)	1.57(0.67, 3.70)	0.78(0.20, 3.02)
My tribe	1.99(1.32, 3.01)	1.39(0.68, 2.81)	4.13(2.67, 6.38)	3.10(1.57, 6.14)
My religious affiliation	1.10(0.77, 1.56)	0.89(0.52, 1.53)	1.18(0.85, 1.64)	1.35(0.81, 2.26)
Hold decision makers to account				
A lot	2.26(1.73, 2.97)	1.49(0.94, 2.35)	1.34(0.98, 1.82)	1.06(0.65, 1.74)
Some	1.82(1.38, 2.39)	1.41(0.90, 2.20)	1.40(1.03, 1.91)	1.40(0.87, 2.26)
A little	1.16(0.86, 1.58)	1.26(0.80, 2.01)	1.58(1.14, 2.18)	1.42(0.88, 2.29)
Not at all	1.00	1.00	1.00	1.00
If election held would vote				
Yes	0.70(0.56, 0.88)	0.67(0.45, 1.01)	0.82(0.64, 1.03)	0.76(0.51, 1.13)
No	1.00	1.00	1.00	1.00
State of residence (%)				
Al Gedarif	4.03(2.06, 7.88)	1.68(0.62, 4.56)	0.35(0.12, 1.03)	0.11(0.02, 0.57)
Al Gezira	1.89(0.94, 3.82)	1.64(0.64, 4.21)	0.78(0.34, 1.79)	0.57(0.17, 1.86)
Blue Nile	6.41(3.32, 12.4)	2.00(0.77, 5.22)	2.23(1.04, 4.80)	0.99(0.35, 2.76)
Kassala	1.00	1.00	1.00	1.00
Khartoum	1.18(0.58, 2.42)	1.18(0.42, 3.34)	1.83(0.92, 3.64)	0.88(0.33, 2.38)
North Darfur	6.60(3.23, 13.5)	3.53(1.15, 10.8)	2.63(1.18, 5.86)	1.35(0.47, 3.93)
North Kordofan	2.38(1.18, 4.82)	1.64(0.51, 5.32)	3.73(1.86, 7.47)	1.08(0.39, 2.95)
North State	1.41(0.67, 2.97)	1.11(0.31, 3.97)	0.13(0.03, 0.61)	0.05(0.01, 0.28)
Red Sea	8.19(4.25, 15.8)	6.00(2.05, 17.6)	2.19(1.06, 4.53)	0.98(0.38, 2.51)



River Nile	4.28(2.19, 8.38)	3.19(1.09, 9.38)	1.21(0.55, 2.66)	0.47(0.16, 1.37)
Sinnar	8.15(4.23, 15.7)	6.00(2.56, 14.1)	1.03(0.46, 2.31)	0.24(0.07, 0.81)
South Darfur	2.42(1.23, 4.74)	2.30(0.92, 5.74)	12.3(6.33, 23.8)	7.93(2.98, 21.1)
South Kordofan	4.46(2.25, 8.86)	4.36(1.57, 12.2)	2.44(1.19, 5.00)	1.00(0.36, 2.79)
West Darfur	2.99(1.49, 5.99)	1.58(0.58, 4.32)	3.00(1.43, 6.27)	1.71(0.61, 4.84)
White Nile	9.36(4.85, 18.0)	7.14(3.04, 16.8)	4.61(2.31, 9.18)	1.56(0.54, 4.45)

<sup>‡</sup>Unadjusted marginal odds ratio (OR) from standard logistic regression models. <sup>†</sup>Adjusted marginal odds ratio (OR) from standard logistic regression models.

**Table 4: fully adjusted and Bayesian odds ratios of intend to continue FGM across selected covariates (DFID Sudan, 2012/13 &2014)**

Variable	2012/13		2014	
	Fully adjusted OR & 95% CI <sup>†</sup>	Bayesian OR & 95% CI <sup>†</sup>	Fully adjusted OR & 95% CI <sup>†</sup>	Bayesian OR & 95% CI <sup>†</sup>
Age				
<25 years	1.00		1.49(0.87, 2.55)	
25-30 years	1.50(0.99, 2.25)		1.41(0.92, 2.18)	
36-50 years	1.27(0.78, 2.06)		1.00	
>50 years	0.90(0.50, 1.62)		1.11(0.65, 1.89)	
Gender				
Female	0.97(0.71, 1.32)	0.94(0.75, 1.27)	1.03(0.73, 1.44)	1.00(0.71, 1.33)
Male	1.00	1.00	1.00	1.00
Marriage				
Yes	1.15(0.80, 1.66)	1.12(0.85, 1.55)	1.44(0.94, 2.21)	1.54(0.95, 2.66)
No	1.00	1.00	1.00	1.00
Education (%)				
No education	1.97(0.86, 4.50)	2.15(1.03, 3.80)	0.70(0.30, 1.63)	0.57(0.24, 1.27)
Primary/Interim	1.65(0.78, 3.49)	1.67(0.84, 3.22)	1.95(1.18, 3.22)	2.07(1.29, 3.18)

education	ACCEPTED MANUSCRIPT			
Secondary education/Diploma	1.12(0.55, 2.27)	1.14(0.58, 1.95)	1.31(0.87, 1.98)	1.32(0.91, 1.86)
BSc	1.24(0.60, 2.54)	1.26(0.65, 2.23)	1.00	1.00
Higher educ.(Higher diploma, MSc, PhD)	1.00	1.00	0.74(0.42, 1.32)	0.76(0.44, 1.26)
Household income				
<100 STG	1.30(0.88, 1.91)	1.40(0.97, 2.07)	1.41(0.87, 2.28)	1.43(0.90, 2.38)
100-500 STG	1.00	1.00	1.12(0.69, 1.81)	1.05(0.59, 1.76)
501-1000 STG	1.33(0.86, 2.06)	1.43(1.03, 2.36)	1.00	1.00
1001-2000 STG			1.34(0.64, 2.82)	1.22(0.56, 2.61)
2001-3000 STG			0.83(0.25, 2.72)	0.73(0.21, 1.87)
Family size				
Small (1-4 children)	0.99(0.69, 1.41)	1.04(0.71, 1.51)	1.00	1.00
Middle (5-7 children)	1.00	1.00	0.94(0.63, 1.39)	1.01(0.67, 1.46)
Large (8+ children )	1.02(0.57, 1.84)	1.06(0.65, 1.79)	1.61(1.00, 2.61)	1.72(1.19, 2.78)
Place of residence (%)				
Urban	1.00	1.00	1.00	1.00
Rural	1.04(0.73, 1.48)	1.07(0.74, 1.58)	1.12(0.77, 1.63)	1.17(0.84, 1.72)
Trust in the tribal leader				
A lot	1.00(0.66, 1.52)	0.97(0.66, 1.31)	1.52(0.96, 2.42)	1.52(0.85, 2.38)
Some	1.02(0.66, 1.58)	1.03(0.72, 1.44)	1.00	1.00
A Little	1.00	1.00	1.62(0.96, 2.74)	1.73(1.05, 2.80)
Not at all			1.25(0.71, 2.21)	1.25(0.77, 2.11)
Trust in Imam				
A lot	1.45(0.69, 3.07)	1.48(0.81, 2.71)	1.00	1.00
Some	1.28(0.58, 2.86)	1.27(0.63, 2.54)	0.68(0.41, 1.15)	0.72(0.44, 1.12)
A Little	1.86(0.78, 4.47)	1.82(0.81, 3.98)	1.04(0.52, 2.06)	1.08(0.57, 2.35)
Not at all	1.00	1.00	1.00(0.47, 2.12)	1.07(0.50, 1.89)
Trust in the Fed. Government				
A lot	0.94(0.54, 1.63)	0.91(0.60, 1.78)	1.54(0.90, 2.63)	1.63(0.89, 2.75)
Some	1.32(0.82, 2.12)	1.24(0.86, 1.97)	1.00	1.00
A little	0.97(0.60, 1.57)	0.93(0.66, 1.54)	1.12(0.68, 1.85)	1.15(0.76, 1.90)
Not at all	1.00	1.00	1.22(0.67, 2.22)	1.29(0.68, 2.30)

Trust in the local Government	ACCEPTED MANUSCRIPT			
A lot	1.55(0.90, 2.66)	1.46(0.81, 2.52)	1.91(0.99,3.68)	1.92(0.84, 3.54)
Some	1.64(1.05, 2.57)	1.59(1.05, 2.64)	2.00(1.09, 3.67)	2.13(0.93, 4.23)
A little	1.51(0.96, 2.39)	1.47(1.03, 2.03)	2.07(1.17, 3.65)	2.10(1.03, 4.04)
Not at all	1.00	1.00	1.00	1.00
Trust in the Police				
A lot	1.70(1.12, 2.57)	1.71(1.11, 2.47)	1.00	1.00
Some	1.00	1.00	1.16(0.72, 1.87)	1.15(0.72, 1.89)
A little	1.25(0.82, 1.93)	1.26(0.84, 1.94)	1.02(0.58, 1.79)	1.03(0.59, 1.86)
Not at all	1.64(0.97, 2.77)	1.67(1.00, 2.89)	0.96(0.51, 1.81)	0.94(0.58, 1.74)
Trust in the Judiciary system				
A lot	1.14(0.64, 2.05)	1.21(0.69, 2.15)	1.00	1.00
Some	1.35(0.78, 2.32)	1.47(0.92, 2.54)	0.92(0.57, 1.48)	0.95(0.66, 1.35)
A little	1.28(0.73, 2.27)	1.33(0.82, 2.24)	0.64(0.37, 1.10)	0.66(0.38, 1.17)
Not at all	1.00	1.00	1.51(0.81, 2.84)	1.51(0.83, 2.79)
Islamic Law				
Should be at the heart of the constitution	0.90(0.66, 1.25)	0.89(0.67, 1.23)	0.75(0.50, 1.13)	0.81(0.59, 1.21)
Should be part of the constitution	1.00	1.00	1.00	1.00
Choice about my future				
A lot	0.86(0.53, 1.38)	0.95(0.64, 1.54)	1.05(0.69, 1.61)	1.04(0.71, 1.68)
Some	0.74(0.44, 1.23)	0.78(0.50, 1.29)	1.00	1.00
A little	1.00	1.00	0.68(0.40, 1.17)	0.72(0.42, 1.15)
Not at all	0.88(0.48, 1.62)	0.91(0.52, 1.61)	1.53(0.81, 2.88)	1.38(0.77, 3.22)
Identity				
Sudanese	1.00	1.00	1.00	1.00
My state	2.20(0.84, 5.77)	1.92(0.72, 4.27)	1.83(0.56, 5.93)	1.71(0.47, 5.51)
Arab	1.26(0.29, 5.41)	1.07(0.17, 5.84)	2.57(0.69, 9.56)	2.85(0.77, 9.14)
African	2.91(1.17, 7.26)	3.16(1.24, 6.48)	0.78(0.20, 3.02)	0.89(0.27, 3.43)
My tribe	1.39(0.68, 2.81)	1.44(0.79, 2.82)	3.10(1.57, 6.14)	3.23(1.75, 6.34)
My religious affiliation	0.89(0.52, 1.53)	0.83(0.43, 1.33)	1.35(0.81, 2.26)	1.28(0.85, 2.20)
Hold decision makers to account				

	1.49(0.94, 2.35)	0.00(0.00, 0.65)	1.06(0.65, 1.74)	0.07(0.00, 28.9)
A lot	1.49(0.94, 2.35)	0.00(0.00, 0.65)	1.06(0.65, 1.74)	0.07(0.00, 28.9)
Some	1.41(0.90, 2.20)	0.00(0.00, 0.57)	1.40(0.87, 2.26)	0.10(0.00, 22.3)
A little	1.26(0.80, 2.01)	0.00(0.00, 0.49)	1.42(0.88, 2.29)	0.10(0.00, 21.1)
Not at all	1.00	0.00(0.00, 0.42)	1.00	0.06(0.00, 23.5)
If election held would vote				
Yes	0.67(0.45, 1.01)	0.65(0.46, 0.89)	0.76(0.51, 1.13)	0.78(0.56, 1.09)
No	1.00	1.00	1.00	1.00
State of residence (%)				
Al Gedarif	1.68(0.62, 4.56)	0.80(0.47, 1.46)	0.11(0.02, 0.57)	0.23(0.07, 0.67)
Al Gezira	1.64(0.64, 4.21)	0.69(0.33, 1.22)	0.57(0.17, 1.86)	0.71(0.30, 1.81)
Blue Nile	2.00(0.77, 5.22)	0.86(0.47, 1.45)	0.99(0.35, 2.76)	1.22(0.62, 2.51)
Kassala	1.00	0.50(0.24, 0.80)	1.00	1.19(0.56, 2.73)
Khartoum	1.18(0.42, 3.34)	0.57(0.28, 1.04)	0.88(0.33, 2.38)	1.05(0.44, 2.19)
North Darfur	3.53(1.15, 10.8)	1.26(0.68, 2.80)	1.35(0.47, 3.93)	1.63(0.62, 2.89)
North Kordofan	1.64(0.51, 5.32)	0.79(0.36, 1.84)	1.08(0.39, 2.95)	1.44(0.76, 3.41)
North State	1.11(0.31, 3.97)	0.61(0.24, 1.33)	0.05(0.01, 0.28)	0.16(0.04, 0.48)
Red Sea	6.00(2.05, 17.6)	1.88(1.00, 3.74)	0.98(0.38, 2.51)	1.28(0.67, 2.34)
River Nile	3.19(1.09, 9.38)	1.17(0.63, 2.49)	0.47(0.16, 1.37)	0.50(0.21, 0.95)
Sinnar	6.00(2.56, 14.1)	2.24(1.47, 4.08)	0.24(0.07, 0.81)	0.36(0.14, 0.90)
South Darfur	2.30(0.92, 5.74)	0.88(0.49, 1.50)	7.93(2.98, 21.1)	9.82(5.39, 21.4)
South Kordofan	4.36(1.57, 12.2)	1.62(0.83, 3.21)	1.00(0.36, 2.79)	1.41(0.56, 2.65)
West Darfur	1.58(0.58, 4.32)	0.69(0.34, 1.39)	1.71(0.61, 4.84)	2.44(1.25, 4.25)
White Nile	7.14(3.04, 16.8)	2.56(1.64, 4.59)	1.56(0.54, 4.45)	1.83(1.04, 4.57)

<sup>‡</sup>Adjusted marginal odds ratio (OR) from standard logistic regression models. <sup>†</sup>Spatially adjusted posterior odds ratio (POR) from Bayesian geo-additive regression models after controlling for nonlinear effect of age, categorical variables and the state of residence (spatial effects).