Prevalence of symptoms of vaginal fistula in 19 sub-Saharan Africa countries: a meta-analysis of national household survey data

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Summary

Background Vaginal fistula is a serious medical disorder characterised by an abnormal opening between the vagina and the bladder or rectum, which results in continuous leakage of urine or stool. The burden of this disorder in sub-Saharan Africa is uncertain. We estimated the lifetime and point prevalence of symptoms of vaginal fistula in this region using national household surveys based on self-report of symptoms.

Methods We considered all Demographic and Health Surveys (DHS) and Multiple Indicators Cluster Surveys (MICS) from sub-Saharan Africa and included data for women of reproductive age (15–49 years). We estimated lifetime prevalence and point prevalence of vaginal fistula with use of Bayesian hierarchical meta-analysis.

Findings We included 19 surveys in our analysis, including 262 100 respondents. Lifetime prevalence was 3·0 cases (95% credible interval 1·3–5·5) per 1000 women of reproductive age. After imputation of missing data, point prevalence was 1·0 case (0·3–2·4) per 1000 women of reproductive age. Ethiopia had the largest number of women who presently have symptoms of vaginal fistula.

Interpretation This study is the first to estimate the burden of vaginal fistula in 19 sub-Saharan Africa countries using nationally representative survey data. Point prevalence was slightly lower than previously estimated but these earlier estimates are within the prevalence's credible intervals. Although vaginal fistula is relatively rare, it is still too common in sub-Saharan Africa.

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Introduction

Vesicovaginal or rectovaginal fistula (vaginal fistula) is a serious disorder in which an abnormal opening (fistula) exists between the vagina and the bladder or rectum. Vaginal fistula in resource-poor settings usually results from prolonged or obstructed labour (obstetric fistula), but can also be the result of sexual assault or inadvertent injuries during surgery, among other reasons. It is a highly debilitating condition, with women often ostracised because of the resulting constant leakage of urine or stool through the vagina.[1,2] Eliminating obstetric fistula has been on the agenda of the United Nations Population Fund, through its Campaign to End Fistula, and the US Agency for International Development (USAID) programme for almost a decade.[3,4] However, quantifying progress through reliable health indicators is difficult. The burden of vaginal fistula among women in sub-Saharan Africa is largely unknown. The most recent community-based estimate of prevalence, using data from only two African countries (Ethiopia and The Gambia), is 1·60 (95% CI 1·16–2·10) obstetric fistulas per 1000 women of reproductive age.[5]

Accurate estimates of the number and proportions of women with vaginal fistula are especially difficult to obtain, as is often the case with indicators of maternal morbidity,[6] because the disorder is rare and patients face discrimination and marginalisation.[1,2] In a 2007 review, Stanton and colleagues[6] described three types of report about frequency, incidence, and prevalence of obstetric fistula. The first category is mostly based on personal communications that report, without denominators, the number of patients treated. This approach was used for the Global Fistula Map,[7] developed by Direct Relief and the Fistula Foundation in partnership with the United Nations Population Fund, which maps the worldwide treatment capacity for vaginal fistula and the number of corrective surgeries done each year. The second type of publication relies on declarations made by the authors, or on surgeons' estimates but the source of data is often unclear. The third type, which is least common, describes methods and provides appropriate denominators, albeit with varying degrees of transparency.

In sub-Saharan Africa, the two main sources of standardised nationally representative survey data are the Demographic and Health Surveys (DHS), sponsored by USAID, and the Multiple Indicators Cluster Survey (MICS) sponsored by UNICEF. In 2004, DHS started to include questions to estimate the prevalence of vaginal fistula symptoms. However, a standardised vaginal fistula module was introduced only after the

recommendations of a 2006 expert meeting. Similarly, the fourth round of MICS (2009–11) included a smaller but similar module of questions in a small number of countries. Some of these survey data have been used to describe the scope and magnitude of the problem of vaginal fistula.[8–11] However, only recently have a sufficiently large number of standardised surveys been done to enable systematic cross-country analysis.

Use of household surveys to estimate prevalence of vaginal fistula, and maternal morbidity generally, is challenging.[12,13] The survey's questions are not as accurate as the gold standard of a gynaecological examination, which could result in overestimated prevalence of such a rare disorder.[14,15] Sensitivity is not a major concern for vaginal fistula because the disorder is rare, therefore prevalence will be overwhelmingly conditioned by the survey's specificity. However, uncertainty remains about the usefulness of self-reported symptoms because the DHS vaginal fistula module has yet to be validated.

We estimated the prevalence of vaginal fistula, adjusting for uncertainty in self-reports, and the characteristics of patients from nationally representative surveys done in sub-Saharan Africa.

Methods

Data sources

We considered all nationally representative DHS and MICS reports with available individual-data records from sub-Saharan Africa. We included only surveys with questions about "constant leakage of urine or stool through vagina" or that incorporated a vaginal fistula module in the questionnaire (appendix). Both DHS and MICS are face-to-face household surveys administered to women of reproductive age (15–49 years).[16] They are household surveys that use a multistage sampling method to select a nationally representative sample of women, excluding homeless and institutionalised individuals. The sampling process is generally stratified by geographic regions, degree of urbanisation, or both. A standard questionnaire is administered by trained staff to obtain information on sociodemographic characteristics, health indicators, and, in some countries, self-reported symptoms of vaginal fistula.

See Online for appendix

Procedures

The list of fistula-related questions varied by survey, but for those with a vaginal fistula module, respondents were asked about their knowledge of fistula, experience of fistula symptoms, presumed cause of their fistula, whether treatment was sought, and the outcome of this treatment. Additionally, some of the DHS questionnaires and all MICS questionnaires used a contingency question about fistula knowledge before asking about experience of fistula symptoms. Probing questions were often used, as well as local terms to describe the condition (eg, *maladie d'urine* in francophone countries; appendix). For surveys with a contingency question, we have assumed that, if a respondent had never heard of "a problem such that [a woman] experience a constant leakage of urine or stool from her vagina during the day and night", this respondent had never had symptoms of vaginal fistula.

A few surveys included fistula questions only for women who had had a livebirth in the past 5 years, for ever-pregnant women, or for ever-married women. Because these surveys used different population denominators, they were excluded from our prevalence estimates. For countries with more than one survey of fistula symptoms, only the most recent survey was used to estimate prevalence.

We assessed two main estimates of prevalence. First, we estimated lifetime prevalence of fistula symptoms. This measure is the proportion of respondents who reported having ever had symptoms of vaginal fistula. Second, we estimated point prevalence (or present prevalence) of fistula symptoms. One survey explicitly asked if women suffered from such symptoms at the time of interview (ie, DR Congo DHS 2007), whereas others collected information for women who sought treatment for vaginal fistula and the outcome of such treatment. Only women who reported a complete remission (no more leakage of urine or stool) were considered cured and were therefore not included in the numerator of point prevalence.

We estimated the number of women who had ever had fistula symptoms and the number of women who presently had vaginal fistula symptoms for each country by multiplying the prevalence estimates by the country-specific number of women of reproductive age according to the 2010 population estimates from the UNDP World Population Prospects.[17]

Statistical analysis

We calculated prevalence for each country separately with sampling weights provided by DHS and MICS. These proportions were then back-transformed to the number of women reporting symptoms of vaginal fistula and rounded to the nearest integer. This step enabled us to account for the respondents' different probabilities of inclusion in the surveys. Clustering of observations for lifetime prevalence of vaginal fistula symptoms could be safely ignored because the estimated intraclass correlation coefficient[18] for this rare outcome is very small (0·004) and the average number of women surveyed per cluster was also small (<30).

We calculated pooled prevalence of vaginal fistula with use of a flexible hierarchical Bayesian approach, which enables sources of variation to be incorporated.[19,20] To adjust for limitations of the survey instruments, we adapted the latent-class model described by Joseph and colleagues[21] for meta-analysis of prevalence. The model assumes that each survey has its own true, but unobserved, prevalence and that the survey instruments

have a common sensitivity and specificity. The relation between these variables is expressed as:

$$P_0 = \pi(Se) + (1-\pi)(1-Sp)$$

where P_0 is the observed prevalence (as per the survey instrument), π is the true unobserved prevalence of the disease, Se is the survey instrument's sensitivity, and Sp is the instrument's specificity. Because the accuracy of the DHS and MICS vaginal fistula questions has never been quantified, the uncertainty related to the sensitivity and specificity of the survey instrument was explicitly incorporated into our Bayesian meta-analysis. We used a binomial distribution to model the number of women reporting vaginal fistula symptoms (n_i). Each survey has its own prevalence (π_i), considered as a random variable. The logit of this variable follows a normal distribution with mean υ and SD σ. The complete model specification takes the form:

Likelihood:

$$n_i \sim binomial\,(p_i, N_i)$$
$$p_i = \pi_i\,(Se) + (1-\pi_i)\,(1-Sp)$$
$$logit\,(\pi_i) = \mu_i$$
$$\mu_i \sim normal\,(\upsilon,\ \frac{1}{\sigma^2})$$

Prior distributions for model parameters and hyperparameters:

$$\upsilon \sim normal\,(0{,}0{\cdot}001)$$
$$\sigma \sim uniform\,(0{,}100)$$
$$Se \sim uniform\,(0{\cdot}95{,}1)$$
$$Sp \sim uniform\,(0{,}0{\cdot}9995)$$

We used a non-informative prior for the mean of the logit-transformed individual prevalences (μ_i). Furthermore, we assumed that the individual survey's logit-transformed prevalences were drawn from a normal distribution with an SD that had a non-informative uniform distribution. We elicited priors for sensitivity and specificity with uniform distributions. We assumed that the sensitivity of the survey would most likely be 95–100% and that specificity would be 0–99·95%. This informative prior entails that we expect a minimum of 0·5 false positives per 1000 interviewed women. Using zero for the lower bound of the uniform distribution for specificity does not affect the posterior distribution of the prevalence estimate because a rare outcome entails that specificity cannot be lower than 1 minus the observed prevalence (appendix).

Among women who reported having ever had vaginal fistula symptoms, we had to impute observations for respondents who had missing information about whether treatment was sought and the outcome of treatment. Furthermore, five surveys recorded information about treatment-seeking but not the outcome of treatment. For these surveys, we imputed present prevalence on the basis of the meta-analysis estimate of

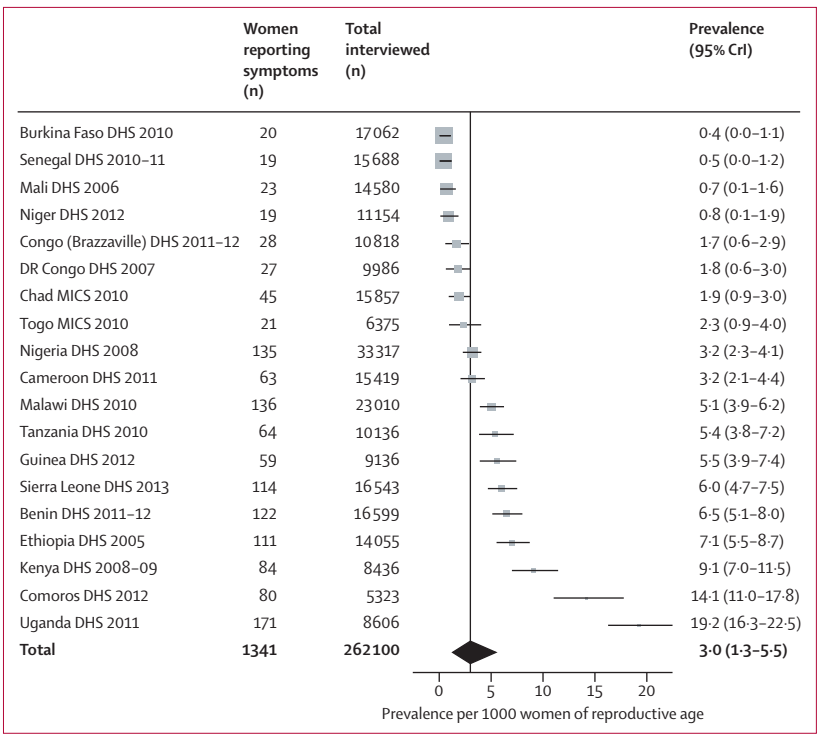

Figure 1: **Lifetime prevalence of vaginal fistula symptoms per 1000 women of reproductive age in sub-Saharan Africa (2005–12)**
CrI=credible interval.

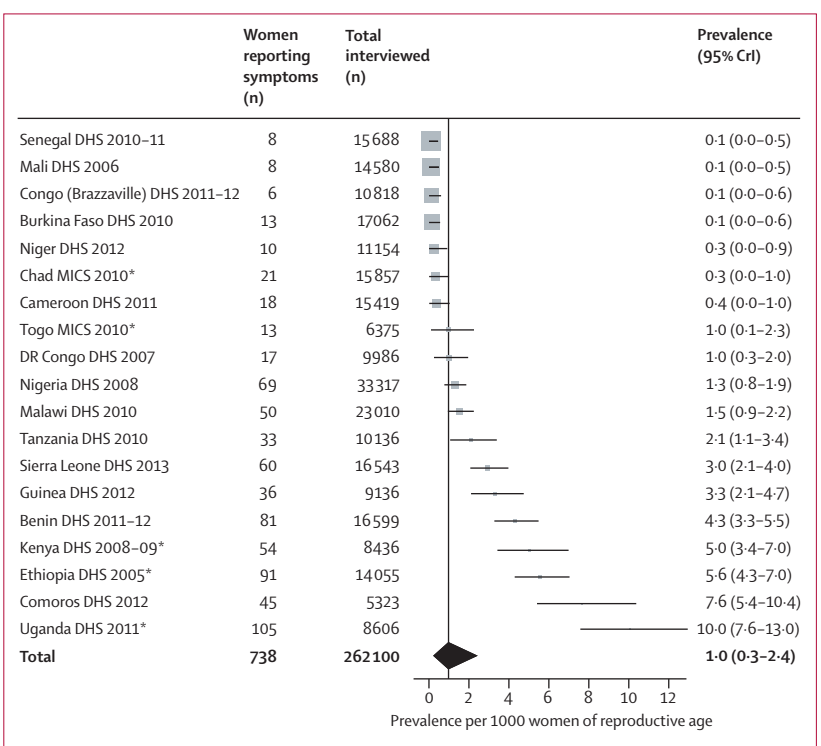

Figure 2: **Point prevalence of vaginal fistula symptoms per 1000 women of reproductive age in sub-Saharan Africa (2005–12)**
*No information recorded about whether treatment for vaginal fistula was successful; responses were imputed on the basis of overall rate of treatment success. CrI=credible interval.

the proportion of successfully treated women. We modified the model to impute these responses by explicitly taking into account the associated uncertainty (appendix).

We used hierarchical Bayesian meta-analysis to estimate self-reported cause of vaginal fistula symptoms, the proportion of respondents who reported vaginal fistula symptoms who sought care, the proportion for whom treatment resulted in complete remission, and, for women who did not seek care, the reason for not seeking treatment. These meta-analyses used the same model specification described above, with the difference that we could not adjust for the imperfect sensitivity and specificity of the case definition since these questions were contingent on reporting vaginal fistula symptoms. We excluded observations with missing values from these analyses.

We fitted models with Markov chain Monte Carlo simulations. We estimated the posterior distributions of the parameters of interest with JAGS.[22,23] Inferences were based on 200 000 iterations (an additional 50 000 iterations were used as burn-in). We used the "rjags" library[24] to run JAGS with R statistical software. We report the median of the posterior distribution and its 95% credible intervals (CrI) as summary estimates.

Role of the funding source

The funders had no role in study design, data collection, data analysis, data interpretation, or writing of the report. FK-S was responsible for the decision to submit for publication.

Results

29 population-based surveys done in sub-Saharan Africa included questions about vaginal fistula (appendix). Individual-data records for the following surveys were not in the public domain and were therefore excluded from our analyses: Equatorial Guinea (DHS 2011), Guinea-Bissau (MICS4 2010), and Mauritania (MICS4 2011). We also excluded Côte d'Ivoire (DHS 2011–12) and Malawi (DHS 2004) because the incontinence questions were not specific—they referred to general incontinence, which could result from several other disorders (appendix).[25] Finally, we excluded Mali (DHS 2012–13) because its sample was not nationally representative: almost half of the country's regions were not surveyed because of armed conflict.

Hence, we considered 23 surveys for our analyses. Of these, we included 19 surveys in the meta-analysis of lifetime prevalence of vaginal fistula (a total of 262 100 respondents). We excluded those with different

	Sample size (unweighted; n)		Mean age (years)*		Illiteracy (%)*		Proportion living in urban areas (%)*		Mean number of children ever born*		Mean age at first birth (years)*†	
	VF	Not VF	VF	Not VF	VF	Not VF	VF	Not VF	VF	Not VF	VF	Not VF
Benin DHS 2011–12	127	16 472	28·6	28·9	70·4%	72·4%	61·6%	46·3%	2·4	2·7	20·1	20·0
Burkina Faso DHS 2010	20	17 042	33·6	28·8	57·9%	82·8%	42·9%	27·1%	3·3	3·3	19·8	19·0
Cameroon DHS 2011	56	15 363	31·0	27·9	37·6%	40·0%	68·2%	53·8%	3·2	2·7	19·5	18·8
Chad MICS 2010	40	15 817	29·1	27·8	83·6%	85·8%	45·5%	24·9%	4·1	3·9	12·9	18·4
Comoros DHS 2012	110	5213	30·5	27·6	57·4%	46·2%	51·8%	32·8%	3·1	2·1	20·3	20·6
Congo (Brazzaville) DHS 2011–12	27	10 791	30·0	28·6	25·5%	25·6%	70·8%	68·6%	2·7	2·5	17·5	19·1
DR Congo DHS 2007	44	9942	30·0	28·3	38·7%	51·3%	44·5%	45·4%	4·2	3·0	18·4	19·2
Ethiopia DHS 2005	103	13 952	32·6	28·0	81·5%	78·1%	19·2%	17·7%	4·4	3·1	18·3	18·5
Guinea DHS 2012	63	9073	30·6	28·4	81·6%	79·7%	43·5%	36·3%	3·2	3·0	18·9	18·2
Kenya DHS 2008–09	78	8358	32·6	28·4	36·1%	26·2%	16·0%	25·5%	3·9	2·7	19·0	19·2
Malawi DHS 2010	132	22 878	29·2	28·0	51·1%	40·6%	10·7%	18·7%	3·3	3·1	19·1	18·4
Mali DHS 2006	18	14 562	34·3	28·4	100·0%	88·0%	26·8%	33·7%	5·6	3·6	19·1	18·2
Niger DHS 2006	20	9169	28·4	28·6	95·7%	92·5%	22·2%	19·5%	3·7	4·0	18·0	17·8
Niger DHS 2012	16	11 138	28·7	28·8	100·0%	89·2%	0·0%	18·8%	4·8	4·2	16·9	18·2
Nigeria DHS 2008	142	33 175	30·8	28·7	57·2%	52·5%	30·2%	35·7%	3·6	3·1	19·0	19·4
Rwanda DHS 2005‡	164	5222	29·1	31·3	52·0%	44·4%	9·9%	14·4%	3·7	4·2	20·7	21·1
Senegal DHS 2010–11	18	15 670	31·7	27·9	72·1%	71·1%	55·2%	49·3%	3·5	2·5	19·4	19·7
Sierra Leone DHS 2013	112	16 431	30·3	28·4	78·9%	68·5%	44·9%	35·4%	3·6	2·9	17·8	18·7
Swaziland MICS 2010‡	57	3261	34·8	31·7	16·2%	12·3%	19·6%	30·5%	4·0	3·0	29·5	26·5
Tanzania DHS 2010	51	10 085	30·8	28·6	36·1%	33·0%	34·1%	28·5%	2·9	2·9	18·7	19·0
Togo MICS 2010	23	6352	32·9	29·2	78·4%	57·9%	29·3%	45·3%	4·1	2·7	19·0	19·7
Uganda DHS 2006	201	8275	30·8	28·0	60·2%	51·0%	10·7%	17·0%	4·7	3·5	18·1	18·2
Uganda DHS 2011	164	8442	31·0	28·0	51·5%	48·5%	11·4%	19·9%	4·4	3·4	17·9	18·2

VF=ever had vaginal fistula symptoms. Not VF=never had vaginal fistula symptoms. DHS=Demographic and Health Survey. MICS=Multiple Indicator Cluster Survey. *Takes into account sampling weights. †Excludes women who have never given birth. ‡Have different denominators: women who had a livebirth in preceding 5 years for Rwanda and ever-pregnant women for Swaziland.

Table 1: **Characteristics of respondents, stratified by presence of symptoms of vaginal fistula**

population denominators (Rwanda DHS 2005, and Swaziland MICS 2010) and only included the most recent survey per country (Niger DHS 2012, and Uganda DHS 2011). We also included 19 surveys in our estimates of point prevalence of vaginal fistula symptoms: 14 surveys had information about present vaginal fistula symptoms or treatment-seeking and treatment outcome (141 responses with missing information were imputed) and for the five remaining surveys that only recorded whether treatment was sought, observations were imputed based on overall treatment success (229 responses imputed).

Lifetime prevalence of vaginal fistula was 3·0 cases per 1000 women of reproductive age (95% CrI 1·3–5·5). Prevalence varied between countries, from 0·4 (0·0–1·1) in Burkina Faso, to 19·2 (16·3–22·5) in Uganda (figure 1). Point prevalence of vaginal fistula symptoms was 1·0 cases per 1000 women of reproductive age (95% CrI 0·3–2·4; figure 2). Replacing our moderately informative prior for specificity with a completely vague prior that uniformly covers the 0–100% range, the estimates increase to 3·3 per 1000 women (95% CrI 1·4–5·9) for lifetime prevalence and 1·4 per 1000 women (0·4–2·9) for point prevalence (appendix). However, the vaginal fistula questions are very unlikely to have had a perfect specificity given that the prevalence of daily post-partum urinary incontinence was 3% according to a recent review[26] and stress urinary incontinence in pregnant women is common.[27,28] Adjusting for limitations of the survey instruments improved prevalence estimates. Assuming a perfect sensitivity and specificity (uncorrected estimates), lifetime prevalence was 4·4 per 1000 women (95% CrI 2·9–6·5) and point prevalence was 2·1 per 1000 women (1·2–3·3). The difference between the corrected and uncorrected estimates suggests that many reports of vaginal fistula symptoms could be false positives.

Respondents who reported having ever had vaginal fistula symptoms were slightly older and generally reported having had more children than did women who did not report such symptoms (table 1). Illiteracy was generally more common in women with vaginal fistula symptoms. The associations between reports of vaginal fistula symptoms and living in an urban area and age at first birth were highly variable between countries.

We estimated that Uganda and Ethiopia had the largest number of women of reproductive age who had ever had vaginal fistula symptoms. Ethiopia also had the largest burden of women who presently had symptoms of vaginal fistula (table 2).

Most fistulas were reported to have resulted from pregnancy (71·4%, 95% CrI 59·0–81·4), followed by other or unknown causes (14·8%, 6·8–27·3), pelvic operations or surgery (4·2%, 2·2–27·3), and sexual assaults (3·4%, 6·8–27·3; appendix). Scaling these estimates to sum to 1 and after proportional reallocation of the other or unknown causes categories, causes of fistulas were most often pregnancy-related (90·4%), followed by pelvic operation (5·3%), and sexual assault (4·3%). The proportion of fistulas that resulted from a sexual assault was highest in DR Congo (22%).

	Number of women who have ever had symptoms	Number of women who presently have symptoms
Benin DHS 2011–12	14 600 (11 500–18 000)	9600 (7300–12 300)
Burkina Faso DHS 2010	1500 (100–4000)	500 (0–2000)
Cameroon DHS 2011	15 500 (10 000–21 400)	1900 (100–5000)
Chad MICS 2010	4900 (2300–7500)	800 (0–2500)
Comoros DHS 2012	2300 (1800–2900)	1200 (900–1700)
Congo (Brazzaville) DHS 2011–12	1600 (600–2800)	100 (0–600)
DR Congo DHS 2007	25 200 (9000–43 100)	14 200 (3600–27 700)
Ethiopia DHS 2005	140 500 (109 700–173 800)	110 800 (85 500–140 100)
Guinea DHS 2012	13 900 (9800–18 700)	8300 (5300–11 900)
Kenya DHS 2008–09	90 100 (69 400–113 700)	49 900 (34 000–69 200)
Malawi DHS 2010	16 900 (13 100–20 900)	5200 (3200–7500)
Mali DHS 2006	2300 (200–4900)	300 (0–1500)
Niger DHS 2012	2800 (400–6200)	900 (0–3000)
Nigeria DHS 2008	115 200 (82 400–147 700)	46 800 (28 000–67 800)
Senegal DHS 2010–11	1500 (100–3800)	300 (0–1400)
Sierra Leone DHS 2013	8500 (6600–10 600)	4100 (2900–5600)
Tanzania DHS 2010	55 300 (39 400–73 400)	21 400 (10 800–34 700)
Togo MICS 2010	3700 (1400–6300)	1500 (200–3500)
Uganda DHS 2011	142 100 (120 300–166 100)	74 200 (56 000–95 700)

Data are median (95% credible intervals). DHS=Demographic and Health Survey. MICS=Multiple Indicator Cluster Survey.

Table 2: **Burden of lifetime and present vaginal fistula in women of reproductive age (15–49 years)**

Among the 19 surveys that recorded whether treatment was sought, 70·3% (95% CrI 61·2–78·7) of women who had ever had vaginal fistula symptoms reported having sought any treatment (appendix). 13 surveys collected information about treatment outcome and 74·7% (95% CrI 69·2–79·9) of women who reported having sought treatment had a complete remission—defined as no more leakage of urine or stool (appendix). The reasons most often mentioned for not having sought treatment were cost (23·8%, 95% CrI 12·9–37·5), not knowing where to find treatment (22·3%, 12·0–34·7), not knowing the disorder was curable (21·1%, 7·2–33·7), and feeling too embarrassed (10·9%, 6·2–17·2; appendix).

Women who did not report having sought care were generally younger and of lower socioeconomic status than those who had (table 3), although the direction of association varied by country.

Discussion

Our meta-analysis of national household surveys from sub-Saharan Africa has shown that around three per 1000 women of reproductive age have had symptoms of vaginal fistula during their lifetime and that roughly one per 1000 have such symptoms at present. Ethiopia had the largest number of women of reproductive age who presently have symptoms, followed by Uganda. To the best of our knowledge, this study reports the first estimate of the burden of vaginal fistula in sub-Saharan

	Sample size (unweighted; n)		Mean age (years)*		Illiteracy (%)*		Proportion in bottom quintile of SES (%)*		Proportion living in urban areas (%)*	
	Have sought treatment	Have not sought treatment	Have sought treatment	Have not sought treatment	Have sought treatment	Have not sought treatment	Have sought treatment	Have not sought treatment	Have sought treatment	Have not sought treatment
Benin DHS 2011–12	56	71	30·0	27·5	71·8%	69·3%	13·0%	10·5%	55·6%	66·5%
Burkina Faso DHS 2010	8	5	33·6	28·1	62·8%	35·4%	11·6%	0·0%	55·9%	52·3%
Cameroon DHS 2011	33	7	31·1	32·5	32·8%	56·6%	1·3%	20·9%	72·4%	57·2%
Chad MICS 2010	32	6	29·6	28·9	81·4%	91·8%	17·7%	23·2%	52·7%	12·5%
Comoros DHS 2012	67	33	30·9	29·4	47·0%	69·3%	12·9%	28·4%	52·7%	53·1%
Congo (Brazzaville) DHS 2011–12	19	2	30·4	26·8	22·2%	0·0%	10·9%	55·0%	80·7%	45·0%
DR Congo DHS 2007	31	12	28·6	31·7	38·1%	55·7%	13·5%	12·4%	46·8%	58·1%
Ethiopia DHS 2005	33	67	36·1	31·2	86·8%	80·1%	18·3%	23·3%	29·1%	13·8%
Guinea DHS 2012	37	24	30·8	30·5	85·2%	74·0%	13·8%	47·8%	47·1%	33·8%
Kenya DHS 2008-09	47	31	35·6	28·6	35·8%	36·4%	10·9%	13·0%	19·3%	11·6%
Malawi DHS 2010	108	24	29·9	25·4	53·1%	39·0%	25·1%	17·9%	11·0%	8·5%
Mali DHS 2006	16	2	35·0	30·9	100·0%	100·0%	26·6%	100·0%	32·4%	0·0%
Niger DHS 2006	4	3	28·5	30·0	100·0%	100·0%	32·8%	66·7%	7·1%	0·0%
Niger DHS 2012	15	1	28·0	35·0	100·0%	100·0%	19·2%	0·0%	0·0%	0·0%
Nigeria DHS 2008	62	23	30·6	31·6	70·6%	57·4%	34·2%	18·2%	25·2%	28·5%
Rwanda DHS 2005†	57	106	28·1	29·7	51·3%	52·8%	10·4%	25·6%	12·0%	8·8%
Senegal DHS 2010–11	12	6	30·7	35·6	68·3%	86·0%	26·4%	50·9%	60·4%	35·8%
Sierra Leone DHS 2013	68	35	31·0	28·6	76·9%	85·6%	14·1%	22·7%	46·8%	38·2%
Tanzania DHS 2010	18	6	33·1	26·5	31·5%	64·2%	21·9%	24·7%	24·7%	37·6%
Togo MICS 2010	14	9	34·1	31·2	76·5%	81·2%	5·4%	40·6%	36·4%	18·8%
Uganda DHS 2011	98	66	32·1	29·1	56·7%	42·8%	18·0%	18·5%	13·3%	8·3%

DHS=Demographic and Health Survey. MICS=Multiple Indicator Cluster Survey. SES=socioeconomic status. *Takes into account sampling weights. †Has a different denominator: women with a livebirth in preceding 5 years.

Table 3: **Characteristics of women reporting vaginal fistulas symptoms, stratified by care**

Africa based on recent large national surveys (panel). Our estimated point prevalence of symptoms is consistent with the number reported by Adler and colleagues[5] (1·6 cases per 1000 women of reproductive age). Another commonly used estimate of prevalence comes from the 2000 update of the Global Burden of Disease Study. This estimate assumed that 2·15% of neglected obstructed labour would result in a vaginal fistula, yielding a prevalence of 1·88 cases per 1000 women aged 15–44 years in sub-Saharan Africa.[29] Our study shows that prevalence of vaginal fistula estimated from self-reporting is lower (1·0 per 1000) than previously reported, but these previous estimates are within our credible intervals (0·3–2·4).

Most women with symptoms reported that the cause of fistula was pregnancy. Sexual assaults were not a common cause of vaginal fistula, except in countries that have had armed conflicts such as DR Congo,[30,31] where more than a fifth of women with symptoms reported sexual assault as the cause. Of all women who reported having had vaginal fistula symptoms, more than two-thirds reported having sought some form of treatment. This proportion might include women seeking care through traditional healers who can do little when modern interventions are needed. Among women who sought care, almost three-quarters reported a complete remission. This proportion is consistent with previous reports, taking into account that several surgeries are sometimes needed for complete remission[32–34] and that a small yet unknown proportion of fistulas are deemed incurable within the challenging health system conditions and low resources of sub-Saharan Africa.[35,36] Our results suggest that cost, knowing that effective surgery exists, and where to go to obtain services are the main barriers to treatment.

Our study has some limitations. DHS and MICS have constraints in terms of collecting information about a sensitive and stigmatising disease.[16] Being household-based, such data could underestimate prevalence if a substantial number of women with vaginal fistula are homeless, ostracised by their family,[37] or housed in long-term care facilities dedicated to patients with fistula.[38] This shortcoming would mostly affect our estimates of point prevalence. Second, only women of reproductive age were interviewed, although women older than age 50 years and those younger than age 15 years could also have vaginal fistula. Third, we assumed that the surveys had common sensitivity and specificity. This assumption was needed to ensure model identifiability (ie, for the model to produce precise inferences). Even if DHS and

Panel: **Research in context**

Systematic review

Vaginal fistula affects the health and lives of many women in the most deprived parts of the world. As an issue of public health and reproductive health rights, it embodies many of the challenges faced by the post-2015 maternal health agenda in sub-Saharan Africa (how to ensure timely access to emergency obstetric care, address the shortages of skilled human resources, improve quality of care within low-resource health systems, and maintain the rights of women to reproductive health care during their whole life). Over the past decade, an international campaign has boosted fistula prevention, treatment, and research. Yet, the planning and evaluation of fistula interventions have been hampered by the lack of reliable prevalence estimates. A systematic review[5] identified only two robust population-based studies of the prevalence or incidence of vaginal fistula in Africa. We searched PubMed, Web of Knowledge, and Google Scholar with the term "("obstetric fistula" OR "vesico-vaginal fistula" OR "vesicovaginal fistula" OR "recto-vaginal fistula" OR "rectovaginal fistula" OR "genito-urinary fistula" OR "genitourinary fistula") AND ("prevalence" OR "incidence")". This search confirmed the lack of population-based estimates of fistula burden in Africa. Adler and colleagues[5] had rejected all studies based on self-reports of fistula because of concerns about the accuracy of maternal morbidity questionnaires. Taking these concerns into account, we used a Bayesian approach to estimate the pooled prevalence from the Demographic and Health Surveys and the Multiple Indicator Cluster Surveys, which enabled us to incorporate uncertainty about the surveys' accuracy.

Interpretation

The lifetime prevalence of vaginal fistula symptoms in sub-Saharan Africa was 3·0 (95% CrI 1·3–5·5) per 1000 women of childbearing age and the point prevalence was 1·0 (0·3–2·4) per 1000 women. Ethiopia had the largest number of women who presently have symptoms, followed by Uganda. The prevalence of vaginal fistula according to self-report was lower than previously reported, but previous estimates are with the credible intervals. We have improved on earlier estimates by including many more countries. However, our results should be interpreted with caution because of the potential limitations of surveying a rare and ostracising disorder such as fistula. Although vaginal fistula is rare, it remains too common in sub-Saharan Africa.

MICS used a standardised method, we cannot rule out that the quality of a questionnaire's translation into local languages could have resulted in different sensitivity or specificity for the vaginal fistula questions. Furthermore, the respondents' understanding of the question and familiarity with vaginal fistula could have varied between region and country. This effect could partly explain why prevalence in Uganda was many times higher than that in the other countries, despite our adjustments. However, exclusion of this survey from the meta-analyses had only a minor effect on our overall summary measures, with estimates of 2·8 (95% CrI 1·2–4·9) per 1000 women for lifetime prevalence and 0·9 (0·2–2·1) per 1000 for point prevalence.

Fourth, our CrIs were not adjusted for the complex survey design, which could underestimate the sampling variance. Nonetheless, use of the design-based adjustment of Korn and Graubard,[39] which substitutes the original sample size for an effective sample size adjusted for the correct number of degrees of freedom, had little effect on the width of the CrI for lifetime prevalence (this adjustment could not be done for point prevalence because of the imputation of missing observations; data not shown). Finally, survey data provide lifetime and not lifecourse information. Profile differences between women who reported vaginal fistula symptoms and those who did not, as well as those who did and did not seek treatment, should be interpreted with caution. For example, the high proportion of women reporting vaginal fistula who, in certain countries, live in urban areas could have resulted from migration caused by greater accessibility to treatment services in urban centres. Additionally, these descriptions are limited by the fact that the case definition probably includes a high proportion of false positives.

This study also has strengths. First, our prevalence estimates are based on 19 nationally representative surveys and responses were pooled. As such, we have improved on earlier estimates by greatly expanding the number of countries represented. We also incorporated uncertainty about the accuracy of the questions about vaginal fistula, as well as uncertainty in the imputation of missing observations for point prevalence through a cohesive Bayesian approach.

Our findings show that the point prevalence of vaginal fistula is slightly lower than previously reported. This difference could have resulted from continued improvements of maternal health in sub-Saharan Africa over the past decade[40,41] and the increased availability of and accessibility to corrective surgery.[42,43] Despite the high uncertainty of our estimates, we have shown that national household surveys based on self-report of symptoms can be used to estimate disease burden. In view of the potentially high rate of false positives, estimates from self-reported vaginal fistula symptoms should be adjusted for the imperfect specificity of the questionnaires.

Contributors

FK-S developed the original research idea with contributions by SS, MM-G, and VF. FK-S and SS did the background literature review. MM-G assembled and managed the databases, specified the Bayesian models, and did the meta-analyses with contributions by FK-S. MM-G and FK-S drafted the report. MCC, NMa, NMe, and VF critically reviewed the report. All authors have read and approved the final version.

Declaration of interests

We declare no competing interests.

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