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Investigating the Association between Self-reported Menstrual Hygiene Practices and Prevalence of Female Genital Schistosomiasis and other Genital Abnormalities in Single Adult Zambian women

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Abstract

Investigating the Association between Self-reported Menstrual Hygiene Practices and Prevalence of Female Genital Schistosomiasis and other Genital Abnormalities in Single Adult Zambian women

By Katiana Bougouma

Background: Female genital schistosomiasis (FGS) is an important yet neglected public health problem in many tropical settings. FGS has been linked higher susceptibility to HIV and HPV/Cervical Cancer acquisition, and the burden of disease related to FGS alone is considerable; it is estimated that 56 million adolescent girls and women in Africa are burdened by morbidities associated with FGS, including genital abnormalities (GAs), infertility, pregnancy complications, lost productivity, extreme stigma and other maternal morbidities. The December 2019 UNAIDS report called for an integrated response within Sexual and Reproductive Health services that addresses FGS alongside other issues - including Menstrual Health Management - coherently.

Methods: This cross-sectional clinical study was conducted in two Zambian cities, Lusaka and Ndola. Eligible participants included women $\geq$18 years of age, HIV-negative, and self-identified as sex workers or single mothers. FGS risk factors surveys and gynecological exams were administered. Participants' responses to the FGS risk factors survey, including their self-reported menstrual hygiene practices (MHP) were analyzed via exploratory bivariate analyses.

Results: The most reported absorbent type was sanitary pads (79.21%), followed by reusable cloths or towels (11.88%); 4.95% of participants reported using baby diapers, and one participant (0.99%) reported using cotton wool. 17.82% of women reported changing their absorbent at most twice a day, and 75.25% three times or more. 21.78% of participants reported self-washing at most twice a day, and 73.17% three times a day or more. 45.54% of women reported changing in a private room in the house, versus 51.49% reporting changing in a household toilet (with access to water). Participants also reported histories of infertility (22.77%), irregular bleeding (7.92%), contact pain during intercourse (6.93%), bloody urine (1.98%), and genital ulcer (1.98%). Less than 5% of participants reported living within 10 minutes of any open body of water such as rivers or streams (4.95%) and canal or drainage ditches (1.98%); 4.95% of participants reported entering nearby bodies of water every day. The main self-reported GA symptoms included vaginal itching (4.95%), abnormal vaginal discharge (4.95%), pelvic/back pain (3.96%), Cystitis/dysuria (UTI, 2.97%), Dyspareunia (painful intercourse, 2.97%), lower abdominal pain (2.97%), unpleasant vaginal or discharge odor (1.98%), and bloody vaginal discharge (0.99%)

Conclusion: Absorbent type was significantly associated with self-reported history of infertility, vaginal itching, an abnormal vaginal discharge. Self-wash frequency and Changing frequency were found to be MHPs associated with daily water sourcing. Self-reported history of infertility was significantly associated with stigma around reproductive health. Interventions aimed at urogenital schistosomiasis control should integrate support of adequate MHM to their approaches (including clean water, sanitation, and menstrual absorbent provisions). Future studies should aim to define and quantify the relationship between MHPs and laboratory confirmed cases of FGS and GAs.

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Introduction

Human schistosomiasis, also known as snail fever or bilharzia, is a Helminth Transmitted Disease which proliferates in areas where fresh water is contaminated with schistosome larvae. Female Genital Schistosomiasis (FGS) is a urogenital condition and a manifestation mainly of *Schistosoma haematobium* infection. The pathogen affects both the urinary as well as the genital tract. In FGS, parasite eggs are deposited in the genital tract and the disease is characterized by histologic vaginal or cervical mucosal inflammation and unique clinical findings [1].

Identification of FGS is difficult due to the commonality of its symptoms, which are often confused for symptoms of other genital abnormalities (GAs) [2]. Furthermore, clinicians are generally unaware of FGS because it is not typically described in the medical textbooks or nursing curricula in the countries where schistosomiasis is endemic [3]. In the recently published Zambian Ministry of Health *Elimination of Neglected Tropical Disease National Masterplan, 2019-2023*, there are no guidelines for FGS identification in adults [4]. Yet, it has been found that cervical schistosomiasis lesions could become co-factors for viral infection such as HIV and HPV [5]. In fact, past studies have suggested an association between FGS and prevalent HIV infection, as well as with HIV transmission and acquisition [1]. Yet, despite its confirmed interplay with the unfolding HIV epidemic as an Africa-specific epidemiological driver, FGS remains a neglected disease, endemic in many developing regions of the world, including Sub-Saharan Africa. In December 2019, a UNAIDS report entitled 'No more neglect: Female genital schistosomiasis and HIV' was published, re-setting the HIV intervention agenda to prioritize the control of FGS [6].

The World Health Organization (WHO) estimates that up to 56 million women and girls are living with female genital schistosomiasis (FGS) in sub-Saharan Africa. Also, according to the aforementioned December 2019 UNAIDS report on FGS [6], of the estimated 220 million people requiring preventive chemotherapy for schistosomiasis (in the form of Praziquantel treatment), more than 90% live in Africa. The same UNAIDS report (2019) called for an integrated response within sexual and reproductive health services that will addresses FGS along with other issues – including menstrual hygiene – coherently. Despite being one of the most common gynecologic conditions in Africa, with for instance 3.8 million people infected with schistosomes found in in Zambia [1], FGS is still underdiagnosed. The infection also causes reproductive disorders including infertility, pregnancy complications, lost productivity, and extreme stigma.

Given the nature of the signs and symptoms of FGS, infected women tend to approach health services with complaints of infertility and maternal morbidity (which can have negative social and psychological impacts on women), or with symptoms of sexually transmitted infections including menstrual and genital abnormalities [7]. While syndromic management of FGS is currently the most widespread method for control and eradication for adults in many developing countries, it has failed to prove effective for FGS control. Thus, recent research efforts have investigated identifying other factors associated with the prevalence and incidence of FGS to explore new upstream disease control avenues.

While diagnosis of FGS has been improved by the WHO pocket atlas (http://pocketatlas.org) and published criteria to identify lesions, much work is needed to improve clinical FGS diagnosis along with that of other GAs in feasible, affordable, and sustainable ways. In Zambia, where schistosomiasis (mainly *S. haematobium*) is endemic with prevalence ranging from 5-40% [8], mass drug administration of praziquantel target children ages 5-14, in line with WHO guidelines. However, despite an urgent call by WHO to treat adults, adult praziquantel coverage is currently low, hovering at about 14% [9], and it is estimated that today, 120 million people are symptomatic.

In October 2019, UNOCHA launched the Zambia Humanitarian Response Plan to address the emergency level food and water insecurity, and the increasing numbers of refugees in Zambia from neighboring conflicts. Diminished access to clean water in several regions has led to a surge of cholera cases, and has also modified people's open water contact behavior, one of the main risk factors associated with FGS.

In “Connecting Female Genital Schistosomiasis and Menstrual Hygiene Initiatives” (2020) Stothard and colleagues argued that the motivation(s) for use of unsafe washing water in menstrual hygiene management (MHM) is a largely overlooked facet of urogenital schistosomiasis control [10]. This argument is all the more relevant to consider in low resource settings, where the socio-cultural context may greatly influence the types of practices generally understood or accepted as hygienic [11]. In fact, more girls in resource-poor countries, including the sub-Saharan region, tend to use old cloths, tissue paper, cotton or wool pieces, or some combination of these items to manage their menstrual bleeding [12]. Furthermore, many girls and women may lack the knowledge to practice healthy and hygienic menstrual hygiene in low-resource settings; the stigmatized nature of menstruation, the taboos around the visibility of menstrual blood, and the threat of sexual advances or teasing by males all contribute to women’s and girls’ menstrual experiences in those contexts. In a study examining Zambian schoolgirls’ knowledge and experiences with their MHM, researchers found that most girls reported learning about menstruation only at menarche (that is, when they first started menstruating) and did not know the physiological basis of menstruation at the time of the interview [13].

The impact of menstrual hygiene, a critical aspect of girls and women’s health, has been largely neglected by researchers in the water, sanitation, and hygiene (WASH) sector [14].When it comes to the connection between menstrual hygiene and genital diseases and abnormalities, a recent study on menstrual health management investigated whether some menstrual hygiene practices (MHPs) deemed unhygienic could predict self-reported reproductive tract infections (RTIs). Although no laboratory-based diagnosis was performed in that study (diagnosis based on syndromic management), it was found that some MHPs, including unhygienic WASH conditions and the use of reusable absorbent materials, seemed to be associated with the presence of self-reported GI symptoms [14]. Furthermore, over 50% of women surveyed in an algorithm development study in Uganda reported washing and reusing their absorbent materials during their last menstruation [15].

In the existing literature, the association between adult women’s self-reported MHPs and the prevalence of FGS (a RTI most often associated with contaminated freshwater contact) still needs to be elucidated and interpreted within the socio-cultural and economical context of sub-Saharan Africa, where the disease is endemic. The primary objective of the present study was to examine the relationship between self-reported menstrual hygiene practices and prevalence of laboratory confirmed FGS diagnosis among high-risk women in Zambia. Based on past reports, we hypothesize that unhygienic MHPs may facilitate contact with schistosome eggs upon exposure to contaminated sources of water and explain some prevalent FGS outcomes. A second objective was to conduct an exploratory factor analysis to identify any relevant correlates of the relationship between MHPs and diagnosed GAs among high-risk women in Zambia.

Methods

Study development and design. This study was conducted in collaboration with our implementing field team at the Zambia Emory HIV Research Project (ZEHRP), an Emory University-affiliated NGO which has been operating in Zambia since 1994. The data for this report was collected through cross-sectional study based at two ZEHRP clinical sites located in Lusaka and Ndola, Zambia.

Through that broader cross-sectional study, our investigative team also aimed at developing a diagnostic algorithm for FGS based on its known risk factors (including unhygienic menstrual practices). In parallel, the present study aimed at bridging the gap in literature by exploring the potential link between MHPs and FGS [10].

A survey was designed to be administered to participants for descriptive purposes and for the development of the FGS diagnostic algorithm. The survey included previously validated questions geared towards collecting data relevant to all FGS-associated risk factors, including MHPs, which were considered for the purpose of this analysis. The ZEHRP clinics in Lusaka and Ndola were the two data collection sites where surveys were administered by trained clinical staff. FGS/GA testing and physical examinations were also performed at these sites.

Study Participants. Our study population was composed of women at high risk of HIV and GA. These women were all part of a previously established longitudinal cohort of HIV-negative female sex workers or single mothers in Zambia (N=703). All high-GA risk women in the cohort were $\geq$18 years of age and were regularly followed for sexual and reproductive health services at our research sites.

Study Sample: Survey data on participants were collected between February and April 2021 to serve as our analytic sample for the present study. These participants**,** recruited from our high-GA risk cohort, were surveyed on identified FGS risk factors, and tested for FGS and other GAs at our sites. Participation in the study involved the administration of the FGS risk factors survey, the collection of blood samples for HIV testing, the administration of gynecological exams to collect vaginal swabs and perform colposcopy, and the collection of urine samples for urinalysis. All survey and testing data were collected using standardized collection tools. Our research staff has decades of experience working in clinical settings and participating in clinical and human subjects' research. Gynecological exams were conducted by experienced senior Ob/Gyns on our clinical teams with decades of experience in clinical research settings.

Female Genital Schistosomiasis (FGS). FGS was clinically diagnosed by colposcopy, which was performed as part of the gynecological exam included in the study. All FGS-positive participants were referred for standard of care treatment. Additionally, Millipore urine filtration was used to detect any presence of schistosome eggs in participants' urine samples, and urinalysis was also performed to check for the presence of blood in the urine.

Other Genital Abnormalities (GAs)

HPV/Cervical cancer. It has been found that cervical schistosomiasis lesions could become co-factors for viral infections such as HIV and HPV [16]. Our study aimed to investigate the potential association between knowledge and presence of HPV or cervical lesions, and participant self-reported MHPs. HPV testing was performed using GeneXpert molecular testing. Screening for cervical cancer lesions was performed by visual inspection with acetic acid (VIA), which is a simple, inexpensive test with moderate sensitivity and specificity for screening cervical lesions.

Other GAs: Our study also aimed to investigate the relationship between the unhygienic menstrual practices identified from the literature and other GA symptoms such as Cystitis/dysuria (UTI), vaginal itching, abnormal vaginal discharge, dyspareunia (painful intercourse), bloody vaginal discharge, lower abdominal pain, acute genital ulcer, chronic/recurrent genital ulcer, unpleasant vaginal odor/malodorous discharge, pelvic/back pain, chronic/recurrent genital warts or growths (small bump, cluster of bumps, or stemlike protrusions) on the genitalia (vulva, vagina, or anus). All shared risk factors and symptoms of FGS and other GAs were included in the exploratory analysis performed as part of our secondary aim. GA testing for diagnosis confirmation was performed by our trained laboratory staff via microscopy examination of collected vaginal swabs.

FGS Risk Factors Survey. The data collection tool developed for this study was a structured questionnaire adapted form similar studies in the literature, and other appropriated validated tools. The survey comprised demographic, menstrual hygiene practices, WASH, water contact behavior, and reproductive health disturbances variables, among other FGS-related risk factors. The MHP questions, derived from the MPNS-36, were used as a standardized measure for some MHPs found to be relevant to female reproductive tract health in the literature.

Self-reported menstrual hygiene practices (MHPs). MHPs were recorded using the FGS risk factors survey. According to the WHO and UNICEF Joint Monitoring Programme for Drinking Water, Sanitation, and Hygiene (JMP), MHM refers to the ability for Women and adolescent girls to use a clean menstrual management material to absorb or collect menstrual blood that can be changed in privacy as often as necessary for the duration of the menstrual period, using soap and water for washing the body as required, and having access to facilities to dispose of used menstrual management materials [17]. Validated questions from the Menstrual Practices Need Scale (MPNS-36) were used to gather data based on several high-risk MHPs identified from the literature. The MPNS-36 is a set of self-report questions that work together to measure women and girls' menstrual experiences. The scale focuses on respondents' experience of their last menstrual period and captures the menstrual practices undertaken, and the environments used to manage menses [15].
Participants were asked to report on their menstrual hygiene practices during their 6 last months of menstruation. Participants who were not menstruating at the time were instructed to report their practices for their six last menstruating months.

- Type of absorbent used (Absorbent Type)

The type of absorbent material used to manage menstruation flow, whether it is disposable pads, tampons, reusable materials, or alternative absorbents, was ascertained through the risk factors survey. All participants were asked "What was your most commonly used absorbent material during the last 6 menstrual cycles", and those who selected reusable materials were asked to specify said materials, as well as their reusable absorbent washing habits.

- Frequency of absorbent change (Changing frequency)

Frequency of absorbent change can have a harmful effect on the risk of RTI symptoms in women [14]. Frequency of absorbent change was measured by asking participants how many times a day they change their absorbent material during their menstruating periods.

- Absorbent change location (Changing facility)

Studies have shown that lower frequency of absorbent change has a significant harmful association with RTI prevalence[14] compared to increased changing habits. Data on the location of absorbent material change were also collected through the risk factor survey.

- Self-wash habits during menses (Self-wash frequency)

Studies have shown that washing the genital area only once per day has a significant harmful association with RTI prevalence[14] compared to increased self-wash habits. Self-wash habits were ascertained through the risk factors survey. Participants were asked how many times they engage in self-washing on their heaviest day of menstruation.

Other FGS risk factors (covariates). Relevant demographic and exposure variables were included in our analysis to account for the effect of these constructs in FGS prevalence. Data on water sourcing, water contact behavior, tobacco use, smoking status, reproductive health history, method of contraception, and number of parity (live births**)** was collected and will be considered for future adjusted analyses.

Analysis

The data analyzed for this study was consolidated in one access database, and data management was performed weekly to maintain a clean dataset. Descriptive statistics for demographic and risk factor prevalence were reported; the overall sample descriptive characteristics of the sample obtained through the risk factors survey are summarized in **Table 1 (Appendix)**. The prevalence and distribution of FGS risk factors, including our MHPs of interest, were determined using SAS.

This manuscript focuses particularly on addressing our secondary aim; we examined the correlates of self-reported MHPs, including demographic factors, FGS risk factors, and symptoms of other GAs of interest using bivariate analyses (Fisher's exact test, 2-tailed p-values reported.) We performed this data exploration in SAS and to determine whether any correlates to particular MHPs arise from the FGS risk factors data.

Results

Sample characteristics. The sample of 101 high-risk Zambian women (single mothers and sex workers) reported an average Age at first sexual intercourse of 17 (IQR=3), and an average Age at first pregnancy of 18 (IQR=3) for an average of 2 pregnancies (IQR=1). 55.45% of our sample had never used oral contraceptives (OC), while 31.68% had used OCs for over 5 years. The age difference between 23.76% of our participants with their oldest sexual partner was 10 years or more. 3.96% of our sample consumed tobacco, 12.87% reported having experienced pregnancy disturbances (miscarriage, stillbirth), and 18.81% reported living in a rural area before the age of 16. This suggests an appreciable prevalence of several FGS risk factors. Furthermore, our participants reported histories of infertility (22.77%), irregular bleeding (7.92%), contact pain during intercourse (6.93%), bloody urine (1.98%), and genital ulcer (1.98%). Overall, when asked if they had ever heard of FGS (Bilharzia), 44.55% of our sample has any previous knowledge of FGS. (see **Table 1**, Appendix)

Menstrual Hygiene Practices. The most reported absorbent type was sanitary pads (79.21%), followed by 11.88% of participants reporting using reusable cloths or towels to manage and absorb their menses in the last 6 cycles; 4.95% of participants reported using baby diapers, only one participant reported using cotton wool. When asked how often on average they changed their absorbent on their heaviest day of menstruation, 17.82% of women reported changing at most twice a day, and 75.25% reported changing their absorbent three times or more. When asked how often they practiced self-washing of the genital area during menses, 21.78% of participants reported self-washing at most twice a day, and 73.17% three times a day or more. About changing facilities participants used to manage their menses, 45.54% of women reported changing in a private room in the house, versus 51.49% reporting changing in a household toilet (with access to water). (see **Table 2**, Appendix)

Water contact and sourcing behavior and GA symptoms. Overall, less than 5% of participants reported living within 10 minutes of any open body of water such as rivers or streams (4.95%) and canal or drainage ditches (1.98%). Also, 4.95% of participants reported entering nearby bodies of water every day. In terms of their water sourcing habits, a total of 76.24% of participants reported having access to public or private piped water/standpipe for their daily water use (61.39% public, 14.85% private), while 1.98% reported using surface water or rainwater collection.

The main self-reported GA symptoms included vaginal itching (4.95%), abnormal vaginal discharge (4.95%) and pelvic/back pain (3.96%), followed by Cystitis/dysuria (UTI, 2.97%), Dyspareunia (painful intercourse, 2.97%), and lower abdominal pain (2.97%). Unpleasant vaginal or discharge odor (1.98%) was also reported, as well as one (1) report of bloody vaginal discharge (see **Table 3**, Appendix.)

Exploratory analyses: associations between MHPs and other FGS risk factors.
Significant associations were found between several of the following FGS risk factors and MHPs through the exploratory analysis. Two-tailed p-values obtained from Fisher's exact test are reported in Tables 4a and 4b. The data was analyzed using SAS.

Of those who reported using reusable cloths or towels as their main menstrual absorbent, 16.67% reported having vaginal itching compared to 3.85% of those who used sanitary pads (p=0.0274), 25% reported having abnormal vaginal discharge compared to 2.56% of those who used sanitary pads (p=0.0159), and 58.33% reported having a history of infertility compared to 18.75% for those who reported using sanitary pads (p=0.0066). These results suggest that there is a significant association between absorbent type and self-reported vaginal itching, abnormal discharge, and self-reported history of infertility.

Of those who reported practicing self-washing twice or less during their menses, 27.27% reported obtaining their daily water from a private, piped water source (standpipe) compared to 8.11% for those who reported self-washing three times or more a day on their heaviest menstruation day (p=0.0339). This suggests that there is an association between daily water sourcing habits and the frequency at which participants practice self-washing during their menses.

Of those who reported changing their absorbent material twice a day or less, 33.33% reported obtaining their daily water from a private piped source (standpipe) compared to 7.89% for those who reported changing their absorbent three times or more on their heaviest menstruation day (p=0.0104). These results suggest a significant association between daily water sourcing habits, and the frequency at which our participant changed their absorbent materials on their heaviest menstruation day.

None of the considered risk factors were statistically significantly associated with changing facility. (see **Tables 4.a and 4.b**, Appendix)

Stigma related to menses and GA symptoms, and self-reported history of infertility.
Women were asked if they had experienced 4 forms of stigmatization or social exclusion based on their menses or the GA symptoms they had: Having to isolate from household/sexual partner, and not being allowed to handle food and/or drinks, enter religious or culturally sacred spaces, or participate in social activities such as community gatherings, commerce, etc.

Of those who reported a history of infertility, 52.17% reported having to isolate from their household or their sexual partner when on their period, compared to 15.38% of those who reported no history of infertility (p=0.0007); 26.09% reported not being allowed to enter religious or culturally sacred spaces when on their period compare to 0% for those who reported no history of infertility (p=<0.0001); and 13.04% reported not being allowed to participate in social activities (community gatherings, commerce, etc.) when on their periods compared to those who reported no history of infertility (p=0.0360). These results suggest a significant association between self-reported history of infertility, and experiences of stigma related to meses.
Additionally, of those who reported a history of infertility, 17.30% reported having to isolate from their household or their sexual partner when on their period, compared to 2.56% of those who reported no history of infertility (p=0.0231) and 13.04% reported not being allowed to enter religious

or culturally sacred spaces when on their period compare to 0% for those who reported no history of infertility (p=0.0106). These results suggest a significant association between self-reported history of infertility, and some experiences of stigma related to having GA symptoms for the women in our sample. (see **Table 5**, Appendix)

Discussion

This document complements the FGS literature, which lacks investigations pertaining to the potential association between FGS outcomes and menstrual hygiene practices, both in adult women, and in sub-Saharan Africa, the most affected endemic region. In fact, only a few studies in Africa[14] have investigated the connection between MHPs and some RTIs, and to date, researchers have yet to define or quantify the potential association between MHPs and FGS, which Stothard et al. (2020) recommended for a better integration of MHM constructs to urogenital and intestinal schistosomiasis control efforts. Previous studies that investigated the connection between menstrual hygiene and select RTIs have some limitations that our study addresses; for instance, in their most recent study (2020), Ademas et al. reported that presence of RIT was presumed if one or more of the following signs occurred: vaginal discharge, itching/irritation or ulcers/lesions around the vulva, pain during urination and sexual intercourse, and lower abdominal and lower back pain [14], suggesting that presence of RTIs and FGS was not effectively confirmed. Our study addressed this issue by including laboratory and clinically confirmed diagnoses of our disease outcomes of interest. These results, which pertain to our primary research aim, will be explored in future manuscripts.

This document will also support global efforts for an integrated response within sexual and reproductive health services that will addresses FGS along with other issues coherently (including menstrual hygiene management), as suggested by the 2019 UNAIDS report[6]. Furthermore, the exploration of FGS risk factors performed as part of our analysis allows for a better understanding of the possible dynamic between the nodes of the wide net of FGS risk factor variables we cast.

The findings of this study are extremely relevant for public health, as they help guide our recommendations for better management of FGS in endemic regions such as sub-Saharan Africa; this study also allows us to make tailored recommendations to improve affected population's knowledge of other HIV epidemic drivers such as Cervical Cancer. In fact, examining figures 1 and 2 below, which summarize qualitative answers obtained from asking participants if they knew what diseases one could get from contact with freshwater (**fig.1**, Appendix) and what they thought were the causes of Cervical Cancer (**fig 2,** Appendix). While some participants had accurate knowledge about the possibility of contracting Bilharzia (schistosomiasis) from contact with freshwater n=14 (13.86%), 54.45% of participants reported never having heard of FGS before. This may be due to the fact that women rural areas (with more open bodies of water) may be more informed about FGS (often considered a rural disease) than women living in urban and peri-urban areas, who have a significant but underrecognized vulnerability to infection. We notice that many participants only had anecdotal information about the ways one can contract Cervical Cancer; while some responses can be connected to existing literature[18], participants overall displayed higher levels of misinformation. For instance, one participant reported one of the causes of Cervical Cancer as "when you wash the genitalia with soap"; that information could potentially lead to the abandonment of protective health behaviors such as washing the genitalia with soap. We recommend improved health communication interventions around menstrual hygiene, MHM, FGS, and its associated HIV co-infections (HPV/Cervical Cancer.)

Another relevance of this study underlies the results obtained on experiences of stigma around menstruation and GA symptoms, and their association with self-reported infertility. This association calls for the consideration of stigma around reproductive health outcomes in Zambia, which are crucial to guide the development of culturally and contextually adapted sexual and reproductive health interventions and communication campaigns in Zambia for better urogenital schistosomiasis control.

This study has a number of limitations. First, data collection was considerably slowed by the effects of the COVID-19 pandemic on our activities. Given the study timeline, our team was unable to secure a full dataset of laboratory-confirmed diagnosis data to address our primary research question. However, the results of the data exploration on MHPs and FGS risk factors reported in this document will inform further studies and support the production of more literature focusing on the connection between MHPs and FGS.

MHPs were measured via self-report by the participants; stigma and recall bias may have affected the accuracy of the self-report data. However, since these practices would be used as a matter of routine for our participants, we anticipated that participants would remember the methods they use recurrently accurately. Local staff was also trained to administer the survey, to minimize errors in reporting. Furthermore, based on lengthiness concerns, our questionnaire did not include questions about the use of soap for genital cleaning during menses, which is an added layer of menstrual hygiene management (per the WHO definitions) which could be assessed for gaps in knowledge. This limitation was partially addressed by the examination of qualitative data obtained from our questions geared towards assessing participant's knowledge of FGS and Cervical Cancer.

The sample we obtained our cross-sectional data from is a High-GA risk women cohort. Thus, it is possible for there to be a significantly different prevalence of FGS and other GAs among our cohort than in the general population (lower or higher).

To produce this document, we examined cross-sectional data, which will give us a snapshot of the prevalence of the FGS risk factors of interest; based on that aspect and on the lack of confirmed outcome data, our analysis cannot establish a relationship or temporality between our exposure (MHPs) and our outcome of interest (FGS). However, given that we were aiming to investigate potential associations rather than trying to infer causation, this limitation should not impact the validity of our interpretations and recommendations for future research, based on our exploratory analysis.

Conclusion

Our study reported on the prevalence of MHPs and FGS risk factors based on survey data and explored the potential associations between MHPs, select FGS risk factors, and self-reported GA symptoms. We found that absorbent type was significantly associated with self-reported history of infertility, vaginal itching, an abnormal vaginal discharge. Self-wash frequency and changing frequency were found to be MHPs associated with daily water sourcing. Finally, self-reported history of infertility was significantly associated with stigma around reproductive health. Interventions aimed at urogenital schistosomiasis control should integrate support of adequate MHM to their approaches (including WASH and menstrual absorbent provisions). Future studies should aim to define and quantify the relationship between MHPs and laboratory confirmed FGS (and other GA) outcomes, and to investigate new associations such as that of self-reported infertility with menses- and GA-related stigma.

Appendix

Table 1. Characteristics of the study sample – FGS risk factor history	Total (N=101)	
Sample Characteristics	**Median**	**IQR**
Age at first sexual intercourse (Median, IQR)	17	3
Number of pregnancies (Median, IQR)	2	1
Age at first pregnancy (Median, IQR)	18	3
History of FGS-associated risk factors	**N**	**%**
Use of Oral Contraceptives		
Used for > 5 years	32	31.68%
Used for < 5 years	13	12.87%
Never used	56	55.45%
Age difference with oldest sexual partner		
< 10 years	77	76.24%
>= 10 years	24	23.76%
Tobacco use (Yes, %)		
Smoking	2	1.98%
Chewing	2	1.98%
History of Pregnancy disturbances (Yes, %)		
Miscarriage	11	10.89%
Stillbirth	2	1.98%
Lived in rural area before age 16 (Yes, %)	19	18.81%
Self-reported history of infertility (Yes, %)	23	22.77%
Irregular bleeding/spotting (Yes, %)	8	7.92%
Self-reported history of bloody urine (Yes, %)	2	1.98%
Self-reported history of genital ulcer (Yes, %)	2	1.98%
Self-reported history of contact pain during intercourse (Yes, %)	7	6.93%
Ever heard of FGS (Yes, %)	45	44.55%

Table 1 presents the overall prevalence of demographic and select FGS-risk factor data. We elected to present these variables primarily because of their established connection to FGS in the literature, and to define the general characteristics of our analytic sample in terms of exposure to FGS risk factors. This list is non-inclusive of MHPs, which will be examined separately and with greater focus.

Table 2. Characteristics of study sample – Menstrual Hygiene Practices	Total (N=101)	
Menstrual Hygiene Practices (MHP)	**N**	%
Absorbent type		
Disposable sanitary pads	80	79.21%
Reusable cloths/towel	12	11.88%
Baby diapers	5	4.95%
Cotton wool	1	0.99%
Frequency of change		
Twice a day or less	18	17.82%
Three times a day or more	76	75.25%
Frequency of self-wash during menses		
Twice a day or less	22	21.78%
Three times a day or more	74	73.27%
Changing facility		
In a household toilet	52	51.49%
In a private room in the house	46	45.54%

Table 2 presents a summary of the prevalence of the MHPs of interest in our analytical sample. These variables were chosen to represent the four dimensions of the WHO definition of MHM: "*the ability for Women and adolescent girls to use a* ***clean menstrual management material*** *to absorb or collect menstrual blood that can be* ***changed in privacy as often as necessary*** *for the duration of the menstrual period,* ***using soap and water for washing the body as required****, and having* ***access to facilities to dispose of used menstrual management materials***"[17]

Table 3. Self-reported water contact behavior and current GA symptoms	Total (N=101)	
Water Contact behavior	**N**	%
Nearby bodies of water		
River/Stream	5	4.95%
Canal/drainage ditch	2	1.98%
Dug well	1	0.99%
Frequency of water contact (physically entering bodies of water)		
1-3 days a week	1	0.99%
Every day	5	4.95%
Daily water sourcing		
Protected dug well	8	7.92%
Hand pump/tube well/borehole	4	3.96%
Public piped water/tap/standpipe	62	61.39%
In home piped water/tap/standpipe	15	14.85%
Surface water (river/stream, dam, lake/pond, canal/drainage ditch, irrigation channel)	1	0.99%
Rainwater collection	1	0.99%
Self-reported GA symptoms - (Yes, %)	**N**	**%**
Cystitis/dysuria	3	2.97%
Vaginal itching	5	4.95%
Abnormal Vaginal discharge	5	4.95%
Dyspareunia (painful intercourse)	3	2.97%
Bloody vaginal discharge	1	0.99%
Lower abdominal pain	3	2.97%
Acute genital ulcer	0	-
Chronic / Recurrent genital ulcer	0	-
Unpleasant vaginal odor/malodorous discharge	2	1.98%
Pelvic/back pain	4	3.96%
Chronic/recurrent genital warts/growths on genitalia (vulva, vagina, or anus)	0	-

Table 3 summarizes the prevalence of additional FGS risk factors in the analytic sample. These water contact behavior and sourcing exposures are crucial to consider, to effectively address the more direct causes of FGS, such as contact with schistosome eggs in infested water (WHO, 2017 #8366). The table also presents the prevalence of self-reported GA symptoms.

Table 4.a	MHP: Changing Facility (private room vs. hh toilet)					MHP: Absorbent Type (reusable vs. disposable)				
FGS Risk factor (yes vs no)	hh toilet	%	Private room	%	p-value (2-tailed)	Disposable pads	%	Reusable cloth	%	p-value (2-tailed)
SR History of infertility	34	45.33	12	52.17	0.6366	15	18.75	7	58.33	**0.0066****
Ever heard of FGS	26	50.00	16	34.78	0.1547	8	15.09	4	33.33	0.5490
Ever heard of Cervical Cancer	8	84.62	38	82.61	0.7922	3	20.00	9	75.00	0.4063
Cystitis/dysuria	1	1.92	2	4.55	0.2075	2	2.56	1	8.33	0.3524
Vaginal itching	2	3.85	3	6.82	0.7948	3	3.85	2	16.67	**0.0274****
Abnormal vaginal discharge	2	3.85	3	6.82	0.3297	2	2.56	3	25	**0.0159****
Bloody vaginal discharge	0	0.00	1	2.27	0.4583	0	0.00	1	8.33	0.1333
Lower abdominal pain	0	0.00	3	6.82	0.0927	2	2.56	1	8.33	0.3524
Unpleasant vaginal/discharge odor	1	1.92	1	2.27	0.7092	1	1.28	1	8.33	0.2502
Daily water sourcing is private or piped	5	9.62	8	17.39	0.3721	9	11.25	4	33.33	0.0631

**** significant association at the alpha=0.05 level of significance** **hh = household**

Table 4.b	MHP: Changing Frequency (< 2x vs. 3x or more)					MHP: Self-wash frequency (< 2x vs. 3x or more)				
FGS Risk factor (yes vs no)	3x or more	%	< 2x	%	p-value (2-tailed)	3x or more	%	< 2x	%	p-value (2-tailed)
SR History of infertility	18	23.68	5	27.78	0.6252	17	22.97	6	27.27	0.6783
Ever heard of FGS	10	43.42	8	44.44	0.5738	34	45.95	7	31.82	0.3840
Ever heard of Cervical Cancer	3	81.01	15	83.33	0.8028	4	85.14	18	81.82	0.7769
Cystitis/dysuria	2	2.67	1	5.88	0.4623	2	2.70	1	5.00	0.5164
Vaginal itching	5	6.67	0	0.00	1.0000	5	6.75	0	0.00	1.0000
Abnormal vaginal discharge	5	6.67	0	0.00	1.0000	5	6.76	0	0.00	0.6814
Bloody vaginal discharge	1	1.33	0	0.00	1.0000	1	1.35	0	0.00	1.0000
Lower abdominal pain	2	2.67	1	5.88	0.4623	2	2.70	1	5.00	0.5164
Unpleasant vaginal/discharge odor	1	1.33	1	5.88	0.3371	1	1.35	1	5.00	0.3821
Daily water sourcing is private, piped	6	7.89	6	33.33	**0.1040****	6	8.11	6	27.27	**0.0339****

Tables 4a and 4b summarize the results of **two-tailed Fisher's test of association** between select FGS risk factors, and MHPs of interest. Variables not included in this table were not found to be significantly associated with <u>any</u> of the MHPs in our analysis.

Appendix

Table 5. Association of menstrual and GA stigma with self-reported infertility	Self-Reported History of Infertility				
Stigma indicators (yes)	**Infertility (no)**	**%**	**Infertility (yes)**	**%**	**p-value (2-tailed)**
Stigma related to menses					
Having to isolate from household/sexual partner	12	15.38	12	52.17	0.0007**
Not allowed to handle food and/or drinks	19	24.36	9	39.13	0.1898
Not allowed to enter religious or culturally sacred spaces	0	0.00	6	26.09	<0.0001**
Not allowed to participate in social activities (community gatherings, commerce, etc.)	1	1.28	3	13.04	0.0360**
Stigma related to having GA symptoms					
Having to isolate from household/sexual partner	2	2.56	4	17.39	0.0231**
Not allowed to handle food and/or drinks	0	0.00	3	13.04	0.0106**
Not allowed to enter religious or culturally sacred spaces	0	0.00	2	8.70	0.0501
Not allowed to participate in social activities (community gatherings, commerce, etc.)	0	0.00	1	4.35	0.2277

Table 5 summarizes the association between self-reported history of infertility (having had unprotected sex – that is, without a condom or other form of contraception – during 12 or more months without successfully getting pregnant [cite]), and the prevalence of experiences of stigma among our participants

Appendix

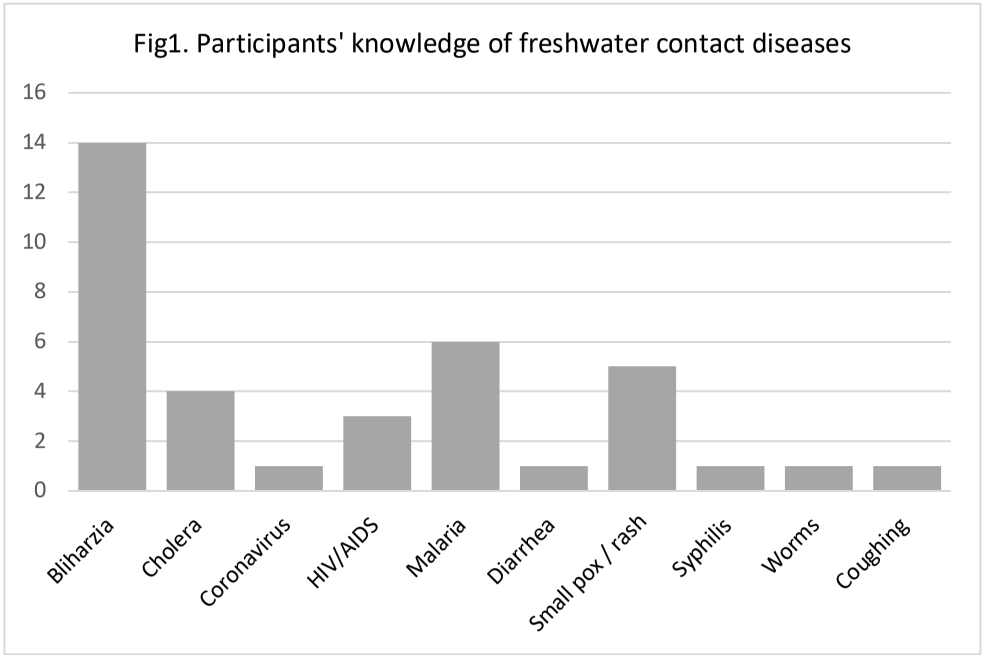

Figure 1 summarizes participants' answers to the questions "What diseases do you think you can get through physical contact with freshwater (for example, lakes, rivers/streams, dams, canals)?", and reflects the level of general knowledge of schistosomiasis (bilharzia) in our sample.

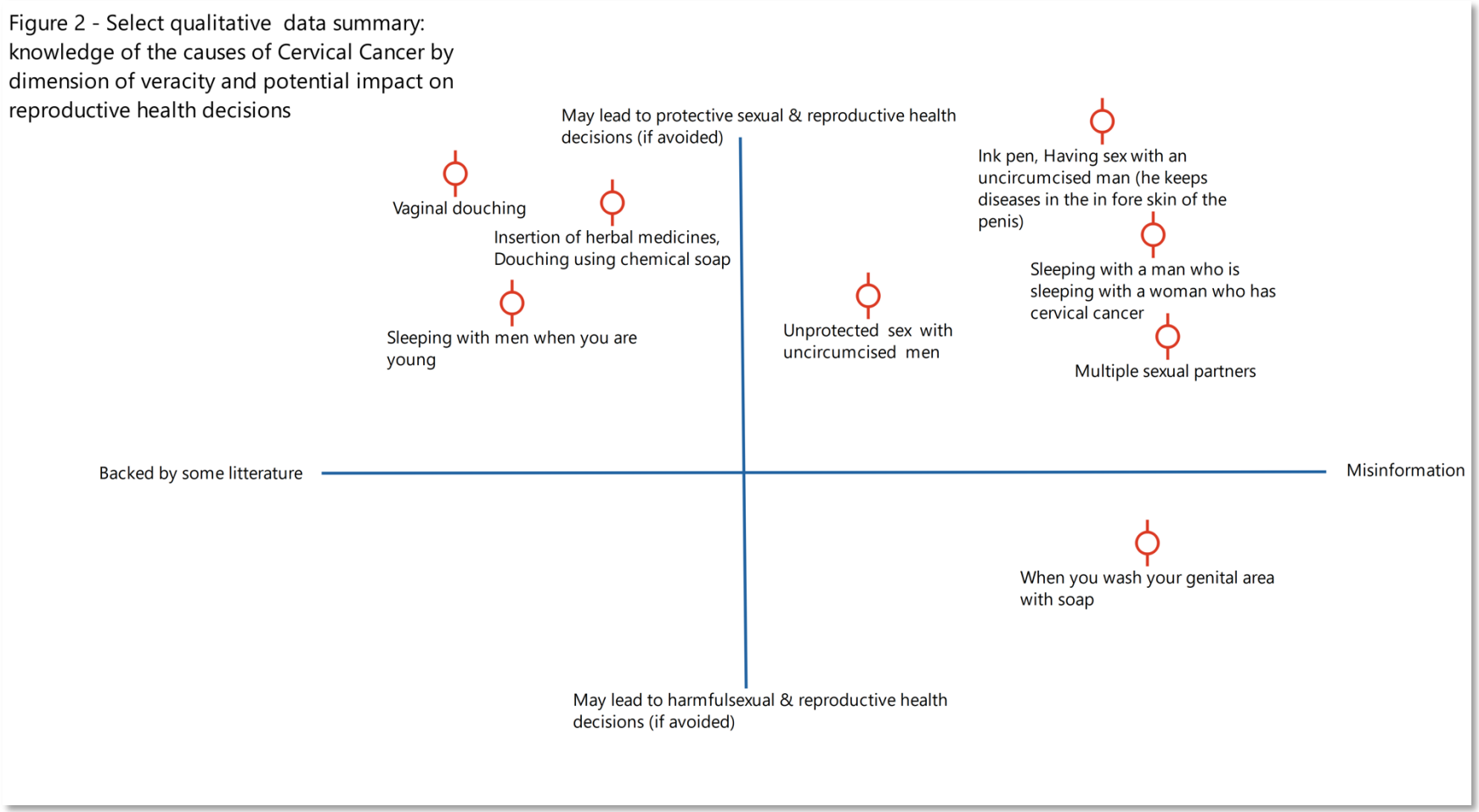

Figure 2 summarizes some select qualitative responses to the question "do you know the causes of cervical cancer" included in the FGS risk factors survey. This qualitative analysis visualization tool allows us to summarize the data by the dimension of veracity and potential impact on participants reproductive health decisions (based on the reported disease causes)

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