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We had to bring the water in pain: Water and sanitation challenges among pregnant and postpartum women in Odisha, India

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Abstract

We had to bring the water in pain: Water and sanitation challenges among pregnant and postpartum women in Odisha, India

By Abena Afra Twumasi

Globally, women and girls bear the burden of poor access to water and sanitation. While the challenges associated with water and sanitation among adolescent girls have been well documented, there is a dearth of research that examines similar concerns among pregnant and postpartum women. Secondary analysis was conducted on a subset of qualitative data sourced from sanitation insecurity research among women from across different life stages (adolescent, recently married, married over 3 years, older than 49) in rural Odisha, India. Transcripts from one-on-one interviews (69) and focus group discussions (8) were eligible for analysis if they contained data on women's water and sanitation related challenges during pregnancy and up to 4 months postpartum. Data from 45 interviews and 4 focus group discussions were eligible for analysis. Analysis followed a thematic approach and yielded three key themes that represented pregnant and postpartum women's sanitation and water related concerns: socio-cultural, environmental and individual challenges. It was found that social support, access to functioning latrine and water facilities served to ameliorate pregnant women's challenges. Gender norms, the lack of social support and unfavorable seasonal weather events served to increase their burdens. Other studies should explore water and sanitation insecurities among pregnant and postpartum women in different contexts. Further research should examine the association between poor sanitation and water access and negative maternal and child health outcomes.

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Chapter 1: Literature Review

Women and Water Collection

According to global estimates from the World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) Joint Monitoring Programme (JMP) for Water Supply and Sanitation, 844 million people still lack access to a basic drinking water source (WHO & UNICEF, 2017). A basic drinking water source is defined as an 'improved source' of drinking water with collection time not exceeding 30 minutes for a round trip, including queuing (WHO & UNICEF, 2017). An 'improved source' of water refers to drinking water that is located on-site, available when needed and is free from contamination (WHO & UNICEF, 2017). In the developing world, the burden of poor access to water predominantly falls on women and girls. Data from the 2008 JMP report showed that in South Asia and Africa, women principally bore the responsibility for domestic water fetching (UNICEF, 2008). Among the countries with the highest percentage of predominantly female water fetchers were India (82%), Nepal (86%) and Bangladesh (90%) (UNICEF, 2008). In their 2011 analysis of UNICEF's Multiple Indicator Cluster Surveys, Sorenson and colleagues reported that in 44 developing countries, the proportion of women fetching domestic water was twice that of men (58.6% vs. 30.4%, respectively) (Sorenson, Morssink, & Campos, 2011). More recent estimates show similar trends: in 8 out of 10 households with water off premises, women and girls shoulder the responsibility for household water collection (WHO & UNICEF, 2017). Across 24 countries in sub-Saharan Africa (SSA), adult females were found to be the

primary water collectors in households with water collection times exceeding 30 minutes (Graham, Hirai, & Kim, 2016). Women often bear the brunt of this gender disparity because water fetching is often tied to other gendered household responsibilities such as cooking, cleaning, washing and caring for children (Sorenson et al., 2011) (Asaba, Fagan, Kabonesa, & Mugumya, 2013). Attempts to quantify the burden of water fetching have included the measurement of linear distance, time, opportunity cost and caloric expenditure (Sorenson et al., 2011).

Health Implications of Water Collection

Studies have linked water fetching to negative health outcomes, including implications for physical, emotional and mental health. Water fetching puts women and girls at a greater risk for water-based and water-related diseases such as schistosomiasis, ascariasis, trachoma and diarrhea through exposure to infectious agents in water bodies and poor hygiene practices (Graham, Hirai, & Kim, 2016; Schmidlin et al., 2013; Steinmann, Keiser, Bos, Tanner, & Utzinger, 2006). During times of water scarcity, water carriers may suffer malnutrition via excessive caloric expenditure (Buor, 2004; Sorenson et al., 2011). Research also suggests additional, yet largely unexplored cumulative damage to the musculoskeletal system which may be linked with carrying water containers on the head (Geere, Hunter, & Jagals, 2010). Using a mixed methods approach, Geere and colleagues found that spinal pain was the most commonly reported complaint among head loaders (persons who carry water containers on their head) in South Africa (Geere et al., 2010). In one of the few studies of its kind, domestic activities such as lifting and carrying water containers on the back or head was found to

be associated with an increased risk of lower back pain (Hoy, Toole, Morgan, & Morgan, 2003). In Mexico and Bolivia, water insecurity was linked with emotional distress due to unequal distribution of water resources among community members (Ennis-McMillan, 2001); (Wutich & Ragsdale, 2008). Women in Kenya who reported having to fetch water from far distances also had increased levels of hair cortisol, indicative of chronic stress (Henley et al., 2014). Pregnant women in India ranked carrying water as the most stressful out of 7 sanitation related activities (Hulland et al., 2015). The nature of the physical environment, including unfavorable terrains and the lack of pedestrian sidewalks, puts water fetchers at further risk for injury or even death (Asaba et al., 2013; Sorenson et al., 2011). In India and elsewhere, incidents of accidental injuries and deaths from drowning while attempting to fetch water from 'unimproved sources' are common (Fisher, 2008; Truelove, 2011).

Sexual and Social Violence

Water collection increasingly puts women at risk for incidents of social, physical and sexual violence. Several studies have highlighted women's water-related vulnerabilities to violence (Lennon, 2011; Sommer, Ferron, Cavill, & House, 2015). Truelove examines the gendered constraints of female residents in Delhi, India as they encounter emotional and physical violence while attempting to carry out everyday activities, such as washing their clothes. Women report being harassed and sexually assaulted by men living in and near their localities (Truelove, 2011). She describes how that despite seeming improvements in access to water, domestic activities that require water fetching still left "footprint[s]" on "economically disadvantaged women's bodies" (Truelove, 2011).

Although studies generally point to violence perpetuated by non-romantic partners, women in Uganda report being “abused and battered” by their husbands because they had taken too long whilst fetching water from sources outside the household (Ademun, 2009). Such women reported that lengthy queues were to blame for the amount of time (up to 2 hours) needed to fetch water (Ademun, 2009). In rural Uganda Asaba and colleagues describe the circumstances that led to physical altercations around water sources, citing arguments about who was entitled to occupy the first, second, third etc. positions in the long queues. There were also instances where women encountered reptiles such snakes and other wild animals near water points. Such fears drove them to refrain from collecting water at certain times in order to avoid confrontations with dangerous animals (Asaba et al., 2013; Sorenson et al., 2011).

Women and Sanitation

SDG Goal 6 explicitly calls for an end to open defecation and “attention to the needs of women and girls and those in vulnerable situations” in addition to universal access to drinking water, sanitation, and hygiene by 2030, (WHO & UNICEF, 2017). This language indicates that women and girls may experience sanitation constraints differently from men and boys. The evidence indicating that inadequate household sanitation is linked with non-partner sexual violence against women is growing (Jadhav, Weitzman, & Smith-Greenaway, 2016); (Winter & Barchi, 2016). Hullah and colleagues have described the environmental, social and sexual stressors women in India experience while attempting to attend to their sanitation needs (Hullah et al., 2015). Women may

be verbally or physically abused by men and other members of the community while seeking private spaces to tend to biological needs and as a result experience stigma, shame and fear (Truelove, 2011) (Jadhav et al., 2016). Research also illustrates how that the provision of physical structures alone are not sufficient to eliminate women's sanitation-related challenges (Caruso et al., 2017b) (Routray, Schmidt, Boisson, Clasen, & Jenkins, 2015). Many have highlighted the need for designing culturally acceptable facilities, with particular consideration for the sanitation needs of women (Caruso et al., 2017b) (O'Reilly & Louis, 2014; Sahoo et al., 2015).

Analyses of women's health suggests that life stage may influence the diversity and intensity of the challenges and health risks that make women and girls especially vulnerable while managing gendered sanitation needs (Caruso et al., 2017b; Hulland et al., 2015; Khanna & Das, 2016; Sahoo et al., 2015). Sahoo and colleagues report that newly married women in their study were particularly susceptible to gendered experiences of sanitation-related psychosocial stress due to social and cultural norms and controls (Sahoo et al., 2015). Caruso et al. described how married women in India may feel the need suppress their urges to urinate or defecate in order to attend to household responsibilities such as caring for young children or infants (Caruso et al., 2017b).

Among women across all life stages, sanitation-related challenges during adolescence may be the most documented. Adolescent girls in Kenya and India reported fear, shame, stress and embarrassment in relation to negative menstruation experiences (Girod, Ellis, Andes, Freeman, & Caruso, 2017; Thakur et al., 2014). Studies in India, Bangladesh and

Zambia have linked school absence among girls with barriers related to menstruation management including the lack of adequate sanitation facilities (Alam et al., 2017; Dambhare, Wagh, & Dudhe, 2012; Lahme, Stern, & Cooper; Mahon & Fernandes, 2010).

Maternal Health, Water and Sanitation

As early as the 18th century, the role of adequate water, sanitation and hygiene in safeguarding the health of women during delivery and postpartum was recognized (Benova, Cumming, & Campbell, 2014b; "Classic pages in Obstetrics and Gynecology," 1974; Gould, 2010). Since then, studies have explored potential links between water, sanitation and maternal health. In their review, Campbell and colleagues show how interactions between maternal health during pregnancy and water and sanitation can be conceptualized as occurring through two main vehicles: (1) 'in-water' agents, whether inorganic such as lead or biological or infectious agents and (2) behavioral mechanisms including hygiene (Campbell, Benova, Gon, Afsana, & Cumming, 2015). This framework will be used to illustrate the relationship between women's health during pregnancy and water and sanitation.

Inorganic and biological contaminants in water

Studies have illustrated the association between exposure to inorganic contaminants in water and adverse pregnancy outcomes. Among them is the evidence linking arsenic exposure and adverse pregnancy outcomes such as low birthweight (Rahman et al., 2008). A systematic review and meta-analysis by Quansah et al. reported negative associations between arsenic exposure and maternal mortality (Quansah et al., 2015).

Exposure to heavy metals in drinking water during pregnancy may be linked with subsequent developmental disorders in children (Caserta, Graziano, Monte, Bordi, & Moscarini, 2013). Pregnant women are more vulnerable to water-borne infections such as Hepatitis E (Rein, Stevens, Theaker, Wittenborn, & Wiersma, 2012) and hookworm-related anemia, both of which have been linked with adverse pregnancy outcomes including low birthweight (Larocque, Casapia, Gotuzzo, & Gyorkos, 2005); (Brooker, Hotez, & Bundy, 2008).

Behavior Mechanisms

The importance of infection control and hygiene in the birthing environment is well documented as a measure to prevent puerperal sepsis, recognized as one of the causes of maternal mortality (Ngonzi et al., 2016). Systematic reviews and ecological studies have found significant associations between both poor water and poor sanitation environments and maternal mortality (Benova, Cumming, & Campbell, 2014a; Cheng, Schuster-Wallace, Watt, Newbold, & Mente, 2012). The only known study to have quantified the relationship between open defecation and adverse pregnancy outcomes found that open defecation was associated with increased odds of adverse pregnancy outcomes, including low birth weight and preterm birth (Padhi et al., 2015).

Water and Sanitation in Rural India

In rural India alone, an estimated 330 million people live without access to latrine (WHO & UNICEF, 2017). This number represents about 15% of the total number of people worldwide who lack such services. Millions more continue to practice open defecation

despite having latrines (WHO & UNICEF, 2017). In an effort to address the country's sanitation problems and accelerate universal sanitation coverage, the Government of India has implemented a number of policies and programs over the years including the Total Sanitation Campaign (TSC) in 1991 (Government of India, 2012). The current campaign, the Swachh Bharat Mission (SBM), was launched in October 2014 (Government of India, 2012; Hueso & Bell, 2013). In keeping with its name "Swachh Bharat" or "Clean India", the campaign aims to eliminate open defecation by 2019, recognizing the importance of both infrastructure coverage and actual use of sanitation facilities. Among its aims, the mission seeks to "bring about an improvement in the general quality of life in the rural areas, by promoting, cleanliness, hygiene and eliminating open defecation". The campaign provides subsidies to households for the construction of individual household latrine (IHHL) units and includes a behavior change strategy where communities are encouraged to take the initiative towards becoming open defecation free (Government of India, 2014).

Odisha, India

Odisha is one of the 29 federally governed states into which India is administratively divided. Located in the east coast of the country, it is made up of 30 districts and Bhubaneswar is its capital city. Odisha is bounded by the Bay of Bengal to the east and Madhya Pradesh (a state) and Andhra Pradesh (a state) to the west and south respectively (Census of India, 2011). The climate is tropical with a monsoon season from July to September. Topography is diverse but includes coastal plains, mountain ranges and multiple rivers (Government of Odisha, n.d.). Odisha has an agriculture-based

economy with 61.8 percent of the working population engaged in the agriculture sector (Census of India, 2011).

According to the most recent census data, Odisha's population is close to 42 million. Hindus make up the majority of the population (93%) while 2.7% and 2.2% are Christian and Muslim respectively (IIPS & ICF, 2017). 42% of households possess Below Poverty Line (BPL) cards and are recognized by the Government as living below the poverty line (IIPS & ICF, 2017). Although 89% of households in Odisha use an improved drinking water source, only one-tenth have access to water piped into either their dwelling or compound (IIPS & ICF, 2017). 65% of households still lack sanitation facilities (IIPS & ICF, 2017). Open defecation in Odisha is more common among rural households (72%) compared to urban households (28%) (IIPS & ICF, 2017).

Marriage, Fertility and Pregnancy in Odisha

The median age at first marriage is 19.9 years among women age 20-49 years with 21 percent of women aged between 20-24 reporting that they got married before the legal minimum age of 18 (IIPS & ICF, 2017). The total fertility rate in Odisha is 2.1 children per woman and trends reported in the National Family Health Survey show that the fertility rate is declining (IIPS & ICF, 2017). Eighty-eight percent of pregnancies between 2011 and 2016 ended in a live birth, while the remaining 12 percent were terminated either through abortion, miscarriage, or stillbirth (IIPS & ICF, 2017). Miscarriage is most common and accounts for 7 percent of all pregnancy outcomes (IIPS & ICF, 2017).

Chapter 2: Current Study

Problem Statement

Upon extensive review of the literature, it is evident that inadequate access to water and sanitation disproportionately affects the health and well-being of women and girls. Life stage also influences the manner and intensity of challenges encountered by women and girls' while collecting water or tending to sanitation needs (Hulland et al., 2015; Sahoo et al., 2015). Much of the research on the intersections between gender and WASH, as it relates to inadequate access to water and sanitation, has focused on female adolescent health. Little is known about how limited access to water and sanitation may affect women's health during other life stages. Particularly, there is a dearth of research that seeks to report women's own perceptions about how water fetching and sanitation affect their well-being and health during pregnancy and postpartum. This study aims to contribute to current research seeks to understand the intersections between WASH and women's health during pregnancy.

Research Objective

The objective of this research is to understand women's concerns pertaining to water and sanitation during pregnancy and up to 4 months postpartum. Specifically the study aims to:

1. Document the breadth of voiced water collection, urination and defecation concerns among pregnant and postpartum women in Odisha, India.
2. Explore potential differences in responses given by women based on access to water source(s) within their household compounds.
3. Compare potential differences in responses given by women based on access to sanitation facilities within their household compounds.

Chapter 3: Introduction

Despite advancements towards improving access to basic water, sanitation and hygiene services under the Millennium Development Goals, 2.3 billion people remain without access to basic sanitation services, facilities that hygienically separate human excreta from human contact and are unshared between households (WHO & UNICEF, 2017). An estimated 800 million people worldwide still lack basic water services from improved sources where collection time is not more than 30 minutes round trip, including queuing (WHO & UNICEF, 2017). As the international community strives towards attaining the 17 Sustainable Development Goals (SDGs), the discourse on gender-based disparities related to WASH is gaining attention across research and development fora. SDG target 6 explicitly calls for an end to open defecation and ‘attention to the needs of women and girls and those in vulnerable situations’ in addition to universal access to drinking water, sanitation, and hygiene by 2030, (WHO & UNICEF, 2017).

Globally, the burden of poor access to water and sanitation predominantly falls on women and girls. In 8 out of 10 households with water off premises, women and girls shoulder the responsibility for household water collection (WHO & UNICEF, 2017).

Water fetching puts women and girls at a greater risk for water-related diseases such as, ascariasis, trachoma and diarrhea (Schmidlin et al., 2013); attacks by humans and wild animals (Asaba et al., 2013) and malnutrition via excessive caloric expenditure (Buor, 2004; Sorenson et al., 2011). Research in Tibet and South Africa suggests additional, yet

largely unexplored, health implications for carrying heavy water containers over long distances including lower back pain (Hoy et al., 2003) and spinal injury and pain (Geere et al., 2010). Poor access to water may also lead to loss of potential income-generating hours (Lawson, 2007; Sorenson et al., 2011). Other studies have linked inadequate water and household sanitation to higher risk of non-partner sexual violence, (Jadhav et al., 2016); (Winter & Barchi, 2016) emotional distress (Wutich & Ragsdale, 2008) and psychosocial stress (Hulland et al., 2015; Sahoo et al., 2015).

In India, although a large proportion of the population (88%) have access to at least basic water services, sanitation remains one of the most significant developmental hurdles facing the country (Government of India, 2012). An estimated 65% of the population lack adequate sanitation while millions more continue to practice open defecation despite having latrines (Government of India, 2012; WHO & UNICEF, 2017).

Analyses of women's health suggests that life stage may influence the diversity and intensity of health risks and challenges women and girls encounter while collecting water, urinating, defecating, or managing menstruation (Caruso et al., 2017b; Hulland et al., 2015; Sahoo et al., 2015). Sahoo and colleagues report that newly married women in their study were particularly susceptible to gendered experiences of sanitation-related psychosocial stress due to social and cultural norms and controls (Sahoo et al., 2015). Caruso et al. described how married women in India may feel the need suppress their urges to urinate or defecate in order to attend to household responsibilities such as caring for young children or infants (Caruso et al., 2017b).

Among women across all life stages, sanitation-related challenges faced by adolescent girls may be the most documented. Adolescent girls in Kenya and India report fear, shame, stress and embarrassment in relation to negative menstruation experiences (Girod et al., 2017; Thakur et al., 2014). Again, studies in India, Bangladesh and Zambia have linked school absence among girls with physical, economic and sociocultural barriers related to menstruation management (Alam et al., 2017; Dambhare et al., 2012; Lahme et al.; Mahon & Fernandes, 2010). While many studies have examined the dynamics of female adolescent health as it relates to water and sanitation, there is a dearth of research that explores similar needs, experiences and concerns among pregnant and postpartum women.

Pregnancy and the months, sometimes even years, following childbirth present a unique set of risks to the health and emotional well-being of women and girls that may be linked with water and sanitation according to an emerging body of research. Pregnant women are more vulnerable to water-borne infections such as Hepatitis E (Rein et al., 2012) and hookworm-related anemia, both of which have been linked with adverse pregnancy outcomes including low birthweight (Larocque et al., 2005); (Brooker et al., 2008). Beyond increased susceptibility to infectious diseases, in a systematic review, Benova and colleagues found significant independent associations between poor water and poor sanitation and maternal mortality (Benova et al., 2014a). Evidence from India indicates that open defecation is associated with adverse pregnancy outcomes (Padhi et al., 2015)

While these studies emphasize the health risks associated with poor water and sanitation environments during pregnancy and postpartum, minimal focus has been placed on women's own concerns about their health and perceptions of risk that influence sanitation behavior. Avotri and Walters noted that issues around women's health, especially reproductive health, have been largely influenced by policy makers and subject matter experts, with insufficient focus on the perspectives of women themselves and their lived experiences (Avotri & Walters, 2001). Understanding women's perceived health risks and challenges related to WASH during pregnancy and postpartum is important particularly in developing settings where women are often expected to fetch water regardless of potential physical constraints presented by pregnancy (Watt & Chamberlain, 2011). As part of the call to improve synergy between the WASH sector and maternal and child health sector under the SDGs, it is important to highlight women's concerns about their health as it relates to WASH. Particularly, it is important to understand women's WASH-related needs and concerns during pregnancy and the postpartum period as they are especially vulnerable to unsafe WASH at this time. This is necessary for policy-making and intervention design that are gender-responsive and give attention to the needs of women at varying life stages.

Previous work in Odisha, India sought to generate a definition and a scale for measuring sanitation insecurity (Caruso et al., 2017a; Caruso et al., 2017b). The research reported here aims to document the full range of concerns related to water collection, urination and defecation as reported by pregnant and postpartum women in Odisha, India. The study also aims to explore potential differences in responses between women who have

access to water sources and/or sanitation facilities within their household compounds and women who lack such facilities.

Chapter 4: Methods

Overview of Study Design

Secondary analysis was conducted on a subset of data from a study aimed at defining and measuring sanitation insecurity across life stage among women in Odisha, India (Caruso et al., 2017b) . Specifically, this project sought to understand the water and sanitation-related experiences and challenges of pregnant and postpartum women in Odisha, India. The study followed a cross-sectional design and data were collected via focus group discussions (FGDs) and semi-structured, one-on-one interviews which incorporated verbal free-lists. Free-listing is a data collection technique used to elicit emic perspectives about a particular topic from a group of individuals (Borgatti, 1998). The semi-structured interviews and free-listing technique together shall be referred to as ‘free-list interviews’ (FLIs) for the remaining sections. FLIs were used to identify the range of individual water and sanitation concerns held by women, while FGDs served to determine whether concerns expressed during the interviews were common to women in the study communities.

Study Setting and Population

The study was conducted in Odisha, India, within the rural communities of Puri district between March and April 2014. Communities in the district had previously been engaged in a cluster randomized controlled trial evaluating the impact of a rural sanitation intervention, an effort within the Government of India's Total Sanitation Campaign (Clasen et al., 2012). As part of the trial, some communities had received the intervention: government subsidies for latrine construction, while some had not (and served as controls) (Clasen et al., 2012; Government of India, 2015). Sampling participants from both former control and former intervention communities enabled the study to explore potential differences in the experiences and challenges of pregnant and postpartum women depending on latrine and household water point access.

According to the most recent census data, Odisha's population is close to 42 million, of which approximately 4% (1.7 million) reside in Puri (Census of India, 2011). 42% of households possess Below Poverty Line (BPL) cards and are recognized by the Government as living below the poverty line (IIPS & ICF, 2017). Although 89% of households in Odisha use an improved drinking water source, only one-tenth have access to water piped into either their dwelling or compound (IIPS & ICF, 2017). 65% of households still lack sanitation facilities (IIPS/ICF, 2017). Hindus make up the majority of the population (93%) while 2.7% and 2.2% are Christian and Muslim respectively (IIPS/ICF, 2017).

Participant Recruitment and Eligibility

Purposive recruitment was used to select study participants in order to achieve variation across age and marital status. Women were eligible to participate if they identified as belonging to one of the following categories: unmarried woman less than 18 years (UMW) living with parents, recently married woman (RMW)-married 3 years or less, married woman (MW)-married for over 3 years and woman older than 49 years (OW). FLI participants were sampled from 8 communities purposively selected to reflect differing access to sanitation and water facilities (5 former intervention communities and 3 former control communities). 4 (2 former intervention and 2 former control) communities were purposively selected for the FGDs.

Data Collection

Data were collected through free-list interviews (FLIs) and focus group discussions (FGDs) which are described in the following sections. The process of data collection, as reported by (Caruso et al., 2017a; Caruso et al., 2017b), is described in the following section.

Free-list Interviews

Two bilingual (English and Oriya speaking) interviewers collected the data as part of the sanitation insecurity study mentioned above. The interviewers were female to ensure gender-matching with participants and both had prior qualitative research experience. The project aimed to interview 2 women per category (UM, RMW, MW and OW) in each

community, a total of at least 64 women. This is about twice the recommended number (30) of participants for free-listing (Borgatti, 1998), however, this larger than average sample size was necessary in order to ensure that all categories of women were included across all study communities. Interviews were conducted in a private setting, often in the participant's homes. The interviewers obtained oral consent from each participant prior to each interview. All interviews were conducted in the local language, Oriya.

An interview guide with free-list questions that asked women to verbally list concerns pertaining to water and sanitation during pregnancy was used to obtain data for this study. The interview guide included the following topics: concerns related to water, concerns about defecation, concerns related to urination and concerns related to menstruation. Participants who were not currently, but had ever been, pregnant answered pregnancy-related questions based on memory.

Focus group discussions

FGD's were moderated by the same interviewers previously described under 'free-list interviews'. Two FGDs were conducted in each of the 4 of the communities sampled for data collection. A total of 8 FGDs enabled the research team to achieve data saturation due to variation across sites. Discussion groups consisted of 5-7 participants and were stratified by marital status: four groups with unmarried women (UMW) and four groups with married women regardless of marriage duration (RMW, MW and OW). Oral

consent were obtained from participants prior to each discussion. FGDs were conducted in schools, temples or homes. All FGDs were conducted in Oriya, the local language.

The FGD discussion guide included the following topics: women's urination-related concerns, women's defecation-related concerns and concerns related to menstruation. FGD questions were designed to explore whether views expressed during the one-on-one interviews were common to women in the communities of interest.

Data Management and Data Selection Criteria

Audio files from interviews and FGDs were prepared for analysis by translating and transcribing verbatim from Oriya into English. All transcripts were also de-identified. To select the data relevant to the research question, a series of key terms commonly used by women when referring to their experiences during pregnancy and postpartum were generated from extensive reading of the data. The key terms generated were "pregnant", "birth", "born", "stomach", "son" and "daughter". Transcripts were searched using the key terms and were eligible for analysis if they contained any data pertaining to water and sanitation concerns during pregnancy or up to 4 months postpartum. 45 out of 69 FLI transcripts, (7 RMW, 19 MW, 19 OW) and 4 out of 8 focus group discussions (5 –7 participants each; married women) met the eligibility criteria. Eligible transcripts were then uploaded into MAXQDA version 12.3.2 (VERBI Software Consult).

Data Analysis

Data analysis followed a thematic analysis approach proposed by Braun and Clarke and included memo and code development, line-by-line coding, identification of relevant categories or themes, comparisons based on participant group characteristics and generation of thick descriptions (Braun and Clarke, 2006). Thematic analysis is appropriate based on the study aim to explore women's voiced pregnancy-related water and defecation concerns and to gain an understanding of the context of concerns raised. Data were read extensively and analytic memos were developed based on reflections on the data. Analytical memos aided inductive code development. The final codebook consisted of all codes and their definitions.

Next, codes were applied line-by-line to each interview transcript. Coding was done by the author and code definitions were iteratively expanded and refined throughout the coding process. Segments of the data relevant to each code were then retrieved, aided by MAXQDA, and analytical notes based on the data were generated. Through this process, a number of patterns emerged from the data regarding pregnant and postpartum women's water and sanitation concerns. Relationships between issues that emerged from the data were illustrated using diagrams. These diagrams were refined until a final thematic map, showing patterns in the data, was actualized. Data were then searched by topical themes and compared by life stage (recently married, married over 3 years with children and older than 49), toilet ownership and presence of a water

source within the household to identify differences in women's experiences. Finally, a description encompassing the context, depth, and breadth of core themes in the data was developed.

Ethical Considerations

All data were de-identified prior to analysis. For the larger project, the Emory University Institutional Review Board (Atlanta, Georgia, USA) and the KIIT University Ethics Review Committee (Bhubaneswar, India) approved study protocols.

Chapter 5: Results

Participant Characteristics

100% of FLI participants were Hindu, 67% had at least some primary education, 7% were currently pregnant, 9% were within 4 months of the postpartum period, 51% had a toilet and 64% had a water source within their household compound (Table 1). 100% of FGD participants were Hindu, 95% had at least some primary education, and 57% had a toilet in their household and 70% had a water point within their compound.

Recently married women were far more likely to have latrines and water sources within the household than married women and women over 49 or older women. However, about half of all married and older women had latrines in their households.

Table 1: Demographic information for participants in free-list interviews(N=45) and focus group discussions (N=23)

	All		1.Recently Married (RMW)		2. Married (MW)		3.Over 49 (OW)	
Free-List Interview Participants	45		7		19		19	
Intervention Community (vs. Control)			16%		42%		42%	
Age ¹	43.6	(20-75)	23.4	(20-27)	33.4	(24-47)	61.3	(50-75)
Education								
None	15	33%	0	0%	3	16%	12	63%
Some Primary	14	31%	1	14%	6	32%	7	37%
Some Secondary	15	33%	6	86%	9	47%	0	0%
Some Tertiary	1	2%	0	0%	1	5%	0	0%
Below Poverty Line Card ²	0	0%	7	100%	13	68%	16	84%
Hindu	45	100	7	100%	19	100%	19	100%
Caste ³								
Brahmin	3	7%	0	0%	2	11%	1	5%
General Caste	28	62%	5	71%	11	58%	12	63%
Scheduled Caste (SC)	4	9%	0	0%	2	11%	2	11%
Other Backward Caste (OBC)	8	18%	1	14%	4	21%	3	16%
Scheduled Tribe	1	2%	0	0%	0	0%	1	5%
Children	42	93%	4	57%	19	100%	19	100%
Pregnant	3	7%	3	43%	0	0%	0	0%
Postpartum	4	9%	2	29%	2	11%	0	0%
Water Source within Compound	29	64%	5	71%	13	68%	11	58%
Toilet within Compound	23	51%	6	86%	8	42%	9	47%
Focus Group Discussion Participants	23				16		7	
Intervention Community (vs. Control)	12		52%		7		44%	
Age ¹	42.7	(20-70)			34.8	(20-48)	59.7	(51-70)
Education								
None	1	4%			0	0%	1	14%
Some Primary	13	57%			8	50%	5	72%
Some Secondary	7	30%			6	38%	1	14%
Some Tertiary	2	9%			2	12%	0	0%
Below Poverty Line Card ²	13	57%			10	71%	3	50%
Hindu	23	100%			16	100%	7	100%
Caste ³								
Brahmin	0	0%			0	0%	0	0%
General Caste	18	78%			11	69%	7	100%
Scheduled Caste (SC)	3	13%			3	19%	0	0%
Other Backward Caste (OBC)	2	9%			2	13%	0	0%
Scheduled Tribe					0	0%	0	0%
Children	23	100%			16	100%	7	100%
Pregnant	0	0%			0	0%	0	0%
Postpartum					0	0%	0	0%
Water Source within Compound	16	70%			11	69%	5	71%
Toilet within Compound	13	57%			8	50%	5	71%

1 Not all women know their age; some guessed

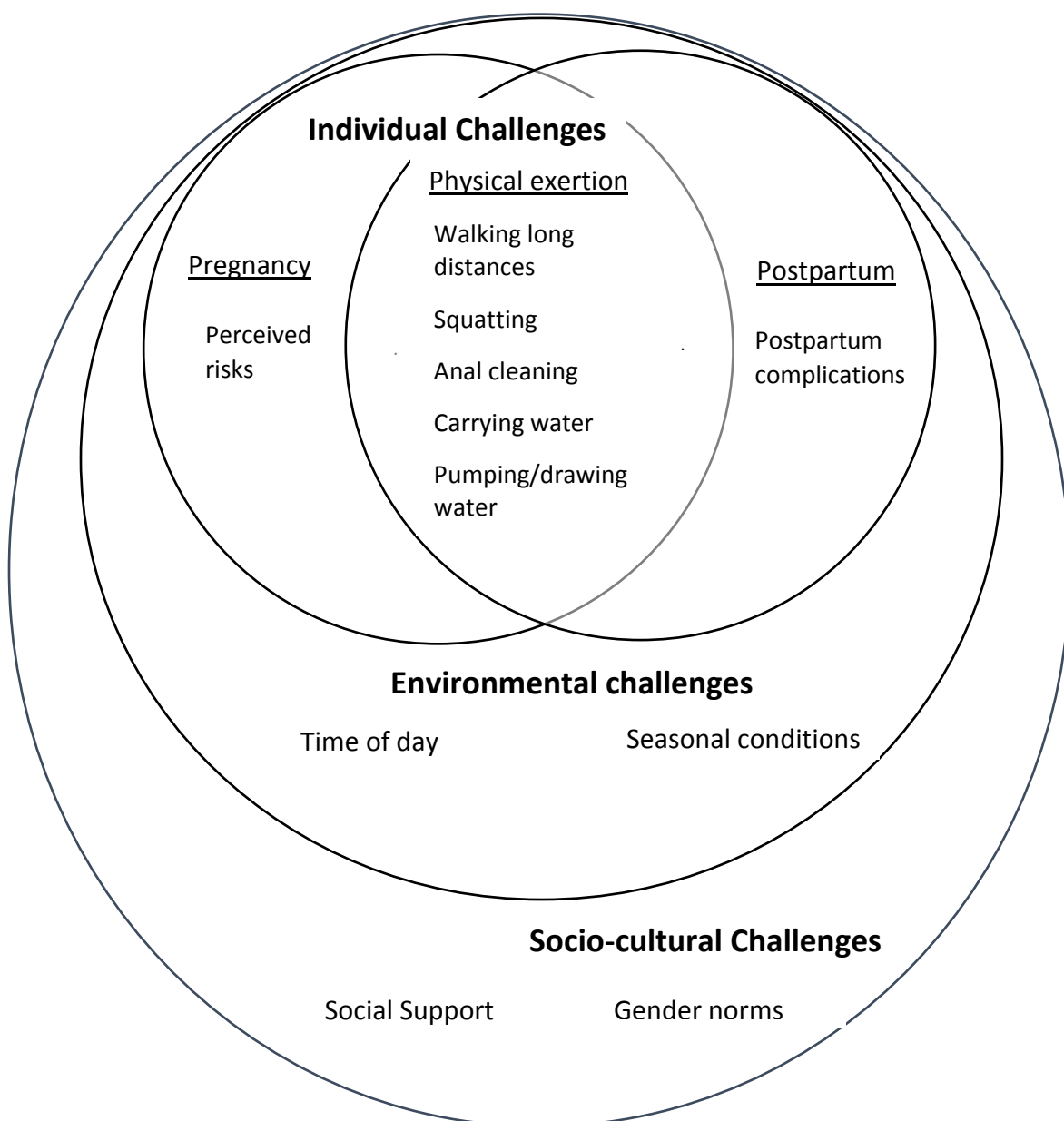
2 Missing data for 4 FLI women; Missing data for 3 FGD women

3 Missing data for 1 FLI woman.

The Scope of Women's Challenges

Pregnant and postpartum women's challenges related to defecation, urination and water fetching were categorized into three areas: individual challenges, environmental challenges and socio-cultural challenges (Figure 1).

Figure 1. Challenges Constraining Water Fetching and Adequate Sanitation among Pregnant and Postpartum Women in Odisha, India



As seen in figure 1 above, both pregnant and postpartum women's concerns were either directly or indirectly associated with the socio-cultural context. Gender norms dictated that pregnant and postpartum women had to fetch water, which for some meant they had to walk long distances. Seasonal conditions, such as heavy rains resulting in flooding, further increased women's burden as when necessary, women would have to walk through the floods to obtain water.

The following sections describe in detail the findings from this study: first, individual challenges common to both pregnant and postpartum women will be presented, highlighting specific concerns raised by each group of women. They include: strain associated with walking long distances to fetch water or tend to biological needs, inability to squat properly or pain while squatting during urination and defecation, difficulty performing post-defecation cleaning, and discomfort and pain from pumping water and carrying water vessels. A challenge reported exclusively by pregnant women was their perception of risk associated with urinating under certain conditions, while postpartum women worried about complications resulting from childbearing that hampered their ability to tend to sanitation needs. This will be followed by an account of environmental challenges: seasonal conditions and time of day and how these acted to either ameliorate or exacerbate women's worries. Seasonal conditions, in particular presented a succession of barriers that made it difficult and dangerous for pregnant women to access suitable locations for open defecation. Socio-cultural challenges

presented by gender norms and postpartum restrictions will be discussed at the end of the section.

Individual Challenges Experienced by Pregnant and Postpartum Women

Many of the concerns raised by pregnant and postpartum women related to constraints caused by changes in their bodies. Such changes made it physically exerting for women to carry out daily activities associated with water fetching and urination such as walking long distances and squatting (Fig. 1). Many concerns raised by pregnant women were also common to postpartum women (Fig. 1). Additionally, pregnant women perceived that they were susceptible to acquiring infections via the urine of others which had the potential to harm their unborn child. Postpartum women were concerned about painful urination and fecal incontinence related to childbirth.

Walking Long Distances

Having to walk long distances to defecate, urinate or fetch water presented a considerable challenge to pregnant women (see figure 1). This was not only a concern during summer due to high temperatures and excessive heat, but also during the monsoon season when there was a constant fear of slipping and falling. Swelling in the feet, which was reported by a few women, further increased the hardship they experienced while walking to fetch water or tend to sanitation needs. Pregnant women who did not have latrines were especially concerned about the long distances they had

to walk to defecation sites, especially during their third trimester of pregnancy. In addition to distance, they reported that it took longer to walk to suitable open defecation sites in order to tend to needs. Such trips often left them out of breath, with “itchiness” and pain in the legs and hands. For pregnant women who had latrines in their households, although walking remained difficult, having toilets within a walking distance eased this burden considerably. Many older women complained about having to traverse long distances to defecate while pregnant during their reproductive years. One older woman describes how the absence of a toilet had affected her when she was pregnant:

Woman: Yes that inconvenience, have to go far. From my experience we did not have a toilet then, now we have toilets. ...would be having pressure [urge] to defecate...it took one hour to go and one hour to come. By the time I go and come I would have lost all energy.”

(FDG, MW, No Toilet, Water outside HH)

Many women used drains, large open gutters, for urination. As such, women who did not have drains in or near their household also worried about the inconvenience of having to find private spaces to urinate, out of sight from male family members . When fetching water, having to carry water containers over long distances also presented challenges for pregnant women. They reported having sore joints, arms and legs due to the time-consuming, burdensome task. Women were exposed to harsh weather conditions while carrying water. Some pregnant women had no alternative as they bore sole responsibility for providing water for domestic purposes. Water fetching

when pregnant also took additional time as women reported that the weight of the water in addition to the weight of the unborn child slowed them down.

Postpartum women expressed concern about the length of time required to walk long distances in order to wash soiled baby clothes in ponds or rivers. Having access to a tube well in the household was not considered to be a solution to this challenge, as washing such items in water sourced from tube wells was deemed unacceptable. Some mothers described that in such situations, they would leave children in the care of family members or neighbors. Having to leave children was described as problematic for some recently married women as they could not leave the household unless a family member who could care for the children was present.

Squatting

Many pregnant women cited the inability to squat properly as one of the main challenges constraining urination and defecation during pregnancy. This concern was raised both by women who owned (and used) latrines and those who did not, as latrines also required the user to squat. Reasons for this difficulty included pain in the waist and knees, “squeezing” of the abdomen between the legs while squatting and the feeling of heaviness in the abdomen due to the additional weight of their unborn child. Due to the added weight, women reported that they were unable to rise to their feet quickly if ever a male relative or non-relative chanced upon them while urinating or defecating in the open. Being seen urinating or defecating by a male violated social norms regarding

female propriety and was often described by women as a source of shame and embarrassment.

During the later stages of pregnancy, women were concerned about being unable to rise to their feet at all after relieving themselves. Women needed to have family members, typically their husband or mother-in-law, accompany them to provide support after defecating or urinating in the open or at home. When there was no one to help them, women found ways to adapt:

“Woman 3: So after defecating... don’t we have more weight during pregnancy

Woman 4: We become heavy

Woman 3: After defecating the thing is don’t we have problem in getting up.

Don’t we feel it [is] a problem

Facilitator: Hm hm

Woman 2: If there is a family member at home, you will hold them and get up or else you will have to rest your hand on the floor as support and get up”

(FDG, MW, Varied Toilet and Water Access)

A few women adapted by either assuming a partially bent position or leaning backwards while squatting to urinate:

“Woman: Hmm, during pregnancy...umm...my waist...It was very painful...I wasn’t able to sit [squat], so, I somehow managed to lean backward or half bend my body and sit [squat].”

(FLI, RMW, Toilet, Water point inside HH)

Some women in early stages of pregnancy reported that they had not yet experienced such difficulties associated with squatting:

“Interviewer:Okay in sitting and standing up?

Woman: No it is early stages of pregnancy, do not have much [difficulty]”

(FLI, RMW, Toilet, Water Point inside HH)

Anal Cleaning

Pregnant women also found it challenging to perform anal cleaning after defecating. In the study context, the anal area is washed with water after defecation. Women found it difficult to reach across the width of their abdomen in order clean their anal area. They adapted by either reaching from behind to clean themselves or washing themselves by immersing in a pond. A married woman describes her concerns regarding anal cleaning and how she adapted:

“Interviewer: Okay when you were pregnant, did you face any inconvenience for [related to] water?”

Woman: It is difficult/painful to clean anus...The water does not reach the anus.

Interviewer: ...Oh ho. So there is inconvenience

Woman: The tummy becomes big towards the front. So I put water from the back side...Cannot wash with water from the front side. My hand does not reach the anus

Interviewer: Hm

Woman: So if we go to the pond, will take a dip, clean the anus and come.”

(FLI, MW, No Toilet, Water Source inside HH)

Although some women had tube wells in their homes, they preferred to use pond water for anal cleaning. Pumping water from the tube well was described as difficult, especially during pregnancy. Women worried that they would not be able to pump sufficient water from the tube well each time they had to defecate and therefore much

preferred the convenience of “taking a dip in the pond”. A married woman who had a tube well inside her household gives more insight:

“Woman: Isn’t it nice to clean anus with the pond water. I like cleaning anus with pond water...How much water can we pump and clean anus.

Interviewer: Okay...what is the inconvenience?

Woman: Who will pump that much water and carry and clean anus. [We] can run and go and clean anus inside the pond and come. That is the thing.”

(FLI, MW, No Toilet, Water Source inside HH)

Burden of Carrying Water Containers

Regardless of whether a source of water was present within their household compound or not, many pregnant women reported pain in lifting and carrying water buckets and pots during pregnancy. Women shared how that they experienced pain in the waist as a result of bending. They also found it strenuous to lift pots or buckets unto the hip. Women who had to walk long distances for water fetching and women who were in later stages of pregnancy reported experiencing additional pain in the waist, legs and hands as a result of carrying water vessels. Some women reported carrying as many as 12-13 buckets of water in the morning and again at night as they were the sole providers of water for household purposes. One woman preferred to pay others to fetch water for her use.

Pregnant women adapted by reducing the number of pots or buckets carried per trip, albeit this increased the total amount of time spent carrying water:

“Woman: ...we bring [water pot/bucket] one by one. We cook and give food to our family. If we bring them one by one, then it is lighter. But bringing those 2

[water pots/buckets] at a time is a burden...how can we bring that burden when already have this burden in our stomach [?]... So we bring them one by one. "

(FLI, OW, No Toilet, Water point outside HH)

Others used smaller containers and refrained from fetching large amounts of water at one time:

"Interviewer: Okay you are pregnant now, so now when you are pregnant do you have to worry about fetching water?

Woman: I am not carrying/lifting buckets or pots. I am going there and drinking water and coming.

Interviewer: Okay

Woman: I fill a glass and drink, to cook I get a little...I do not fetch in buckets and pots."

(FLI, RMW, Toilet, Water Source inside HH)

It's important to note that older women expressed the greatest concern about the physical burden related to carrying water vessels, partly due to the absence of water sources in their households when they were pregnant and the lack of social support from other household members at that time. Recently married women had comparatively less concerns about household duties. Many recently married women shared household chores with other female household members including sisters-in-law. For some recently married women and married women, during pregnancy other female relatives took over strenuous tasks such as pumping water.

Drawing or Pumping Water

Pregnant women who drew water for domestic needs from wells described having an additional level of difficulty drawing water (vertically) upwards from the bottom of wells. Due to the size of their abdomen, women were unable to position their legs

properly near the edge of the well in order to apply maximum effort to draw water.

They also complained they often felt unwell and tired from drawing multiple buckets of water but, at the same time, felt compelled to fetch water regardless. For pregnant women who accessed water mainly from tube wells, pumping water manually was cited as the primary concern. They most often complained about pain in their arms and waist as a result of the effort needed to pump the water.

Postpartum women who had undergone caesarian sections also complained about pain while pumping water from tube wells.

The only group of women who expressed no concern regarding pumping water were those who had electric tube well pumps in the household. However such women still had to pump water manually during power outages and reported that they found it difficult doing so.

Perceived Risks

Women had the perception that failing to rinse an area with water prior to urinating would put them at risk for acquiring infections borne in the urine left by others. One woman described how she had stopped using the toilet in the household while pregnant for fear of acquiring an infection. Pregnant women especially believed that such infections would harm their unborn children (Fig.1), citing friends and family members who believed that their children had fallen ill from such infections. Very few women who owned toilets actually used them for urination, majority of them preferring to use open drains in the household or backyard.

Postpartum Complications

As shown in figure 1, postpartum women were concerned about physical changes in their bodies post-childbirth which made urination painful. For some women, complications during childbirth had led to long-term fecal incontinence. Women described how they experienced stinging pain during urination due to vaginal and perineal stitching. One older woman shared that, as a result of childbirth, she had suffered from fecal incontinence for years. She described how that she could no longer control urges to defecate and often soiled her clothes with fecal matter.

Environmental challenges Experienced by Pregnant and Postpartum Women

Temporal changes in women's environment, especially those caused by seasonal conditions (Fig. 1), served to either ameliorate or worsen pregnant and postpartum women's water and sanitation challenges. Environmental challenges include time of day and seasonal conditions. Pregnant women especially worried about slipping and falling during the monsoon season. Regardless of toilet access, both pregnant and postpartum women were fearful of venturing outside the home by themselves at night to urinate or defecate.

Seasonal Conditions

Seasonal conditions caused considerable challenges for pregnant women who did not have water points and sanitation facilities inside their household compound. Across life stage, such women bore the brunt of negative sanitation experiences exacerbated by

the monsoon season. They found it difficult to find a suitable, dry place for defecating during the monsoon season, expressing disgust at the possibility that human excreta would be mixed with the mud on the ground over which they had to defecate. Slipping and falling on the muddy terrain was also common among pregnant women:

“Even if it rains, we will have to go to the field. Whenever we have to go, we will have to go to the field. When I was pregnant and it was monsoon... The difficulty is it will be muddy everywhere, where will we sit to defecate? There will be water everywhere,... I slipped near the pond and fell with my face down. I was seven months pregnant then...I hurt my waist and got scratches in the hands...This is the problem”

(RMW, No Toilet, Water point inside HH)

Although concern about falling was reported more widely among pregnant non-toilet owners, toilet owners also worried about falling during the monsoons. Some toilet owners reported that they could not use their toilets when it rained during the monsoon season. Flooding, lack of walls and roofs were some of the reasons cited for non-use during this season. Regardless of toilet ownership, women expressed disgust about having to defecate in the open during the monsoon. However, women who owned and used toilets during all other seasons of the year more commonly expressed this disgust about having to engage in open defecation during the monsoon season. Some pregnant toilet owners who used their inadequately roofed latrines while it was raining, found it cumbersome to maintain their squatting position while simultaneously holding an umbrella to avoid getting wet inside the toilet.

Monsoon season also affected water fetching activities, making it more difficult for pregnant women to navigate slippery roads and muddy paths in order to collect water for domestic use. This concern was most often expressed by women who either did not have a source of water inside their household or who only had access to water they perceived as unsuitable for drinking and cooking. Women often referred to such water as “hard” water. An older woman illustrates how she felt compelled to fetch water regardless of flooding in her village:

“With the child in the stomach, we had to go to bring water. Even if a flood comes, we had to go to bring water in that flood. We had to go in that mud to bring water.”

(FLI, OW, NO Toilet, Water point outside HH)

Time of day

At night, both pregnant and postpartum women felt the need to be accompanied by family members while tending to sanitation needs. Typically, women would ask their husbands or mothers-in-law to accompany them. Regardless of toilet access, pregnant and postpartum women feared attacks by humans and encounters with wild animals, witches or “ghosts”.

Pregnant women also believed that any sudden fright could harm their unborn child:

“Woman 3: If we go to urinate at night...And see an animal will it not be inconvenient

Facilitator: You will be frightened

Woman 1: Yes

Woman 3: If we get frightened will the child not be killed”

(FGD, MW, Varied Toilet and Water Access)

Among toilet owners, there was a particular fear of using the latrine at night and women preferred to urinate in the open:

“Interviewer: Why don’t you go to the latrine then?”

Woman: I feel little scared in the latrine.

Woman: What kind of fear?

Interviewer: Fear is if any ghost would appear there. This kind of a fear.”

(FLI, RMW, Toilet, Water point inside HH)

Pregnant women who did not own toilets feared they would slip while attempting defecate in the open at night. Women worried that falling would harm their unborn child. For this reason, many expressed that they would have preferred to use latrines at night. Many pregnant women without latrines described that they made sure to attend to urges to urinate or defecate before nightfall since they feared venturing out at night. Such women suppressed any sudden urges at night, preferring to wait till morning to relieve themselves.

Socio-Cultural Challenges Experienced by Pregnant and Postpartum Women

Both pregnant and postpartum women expressed concerns that were directly related to the social and cultural context and the associated gendered household responsibilities. These were gender norms and the availability of social support (Fig. 1). Gender norms constrained their ability to defecate and urinate at their preferred convenience. Postpartum women especially, were concerned about leaving small infants in the household while they went for urination or defecation. This was reported both by women who had latrines in their household but still practiced open urination and

women with no household latrine, who practiced both open defecation and open urination.

Gender Norms

Many pregnant women were expected to perform household tasks such as cooking, cleaning and washing which are inherently tied with water fetching. Due to these gendered expectations, women would often force themselves to fetch water regardless of pregnancy-related pain or pain resulting from transporting water vessels to the household. Some older women described that they had been so afraid of their fathers-in-law that they had been unable to inform them whenever they had experienced such pain which made water fetching difficult. Since household members depended on them for domestic water, many felt that they had no choice but to provide it. Many women who did not have tube wells during pregnancy reported that fetching water was a constant worry due to the associated pain. An older women describes her feelings of distraught and helplessness while fetching water during pregnancy:

“Woman: Even if we have problem...we have to go... we have to bring [water]...so, you are forced to go even if your head, leg or waist must be paining...Gerasta (husband),...Sasura (father-in-law) will consume water... So, we are forced to go...Even if we are in pain, then to whom will we tell?”

(FLI, OW, No Toilet, Water point outside HH)

In terms of urination and defecation, both pregnant and postpartum women felt obligated to suppress urges to urinate or defecate in order to complete household tasks. This was the case particularly among recently married women. Such women were wary

of incurring the displeasure of their parents-in-law, especially their mothers-in-law, for temporarily abandoning household duties in order to urinate or defecate.

Recently married women and married women who were postpartum and caring for young infants worried most about leaving them unattended:

“Woman: I have to wait till the family members comes...Hmmm, we are advised not to leave kids alone at home...This is a baby and the other is also small. May create some trouble...we have to wait for someone to come home. Only when someone is here we can go out for urination.”

(FLI, RMW, Toilet, Water Source inside HH)

In addition to suppressing needs, other norms regarding postpartum restrictions constrained women’s liberty to urinate wherever they pleased after childbirth. Women were confined to the household compound in keeping with traditional beliefs that postpartum women were to be considered “unclean” or “polluted” for a prescribed period after delivery. One older woman shared:

“Woman: When I was pregnant and delivered, till 21 days of [after] delivery when I have to take bath, there are restrictions in touching/not touching, so they do not let me go out. If I get scared, so they do not let me go out...I urinate in a corner at one place....they bury a pot or anything in a corner after digging a hole...there at the courtyard I urinate”

(FLI, OW, No Toilet, Water point inside HH)

Social Support

Women who received regular assistance with household duties either from members of their family of origin (if women lived in their parent's home) or members of their husband's household, such as sisters and mothers-in-law often described that they had no or fewer concerns regarding water collection.

"Woman: I do not carry water from the fifth month...If I have a child in the womb, my stomach becomes big and by the time it is 10 months it becomes huge...so big that I cannot walk or do any work. I had sisters-in-law who managed the work"

(FLI, OW, No Toilet, Water Source outside HH)

Whenever individuals who played such supportive roles were absent from the household, women were compelled to fetch water for themselves. Fetching water was described as painful as it required pumping:

*"Interviewer: Okay when you were pregnant, was there any problem for water?
Woman: My mother-in-law (MIL) was there then, she used to fetch water. And if mother-in-law has gone somewhere, I take the pain and go to fetch water...what will I do. I will also have to drink. "*

(FLI, MW, No Toilet, Water Source outside HH)

When the household did not own a tube well or when they became dysfunctional, recently married women and some married women worried about obtaining sufficient water for domestic purposes. This is because social norms dictate that they cannot leave the household compound:

“Woman: [we] will have to fetch water from that far, I do not go out and if mother-in-law is not there, how will I fetch water?”

(FLI, RMW, Toilet, Water Source inside HH)

Chapter 6: Discussion

This study found that the water and sanitation related concerns among pregnant and postpartum women in Odisha, were composed of individual, environmental and socio-cultural challenges. Having to walk long distances to fetch water and attend to sanitation needs, difficulties with squatting, anal cleaning, pumping and carrying water constrained women's ability to easily navigate water fetching and access adequate sanitation. These individual challenges relating to physical exertion were shared by both pregnant and postpartum women. Each group of women expressed additional constraints that were peculiar to their current physical condition. Pregnant women believed that they were at risk for, what they perceived to be, urine 'borne' infections which could harm their unborn child. Postpartum women worried most about incontinence as a result of childbirth and related complications. Concerns among both pregnant and postpartum women did not depend solely on tube well or latrine access but also on underlying social norms and pervading weather and seasonal conditions. When sanitation facilities were poorly constructed, as was the case with many latrines, it put pregnant women at a disadvantage when tending to needs, particularly during the monsoon season.

Women perceived that during pregnancy, they were particularly at risk for acquiring infections they believed were borne in the urine of others. Women believe that such infections would harm their unborn child. This knowledge drove some women to avoid

using their latrine in attempt to safeguard the health of their unborn child. While studies to date have examined women's increased susceptibility to infectious diseases during pregnancy (Rein et al., 2012) (Brooker et al., 2008), to the author's knowledge, this is the first study that gives attention to pregnant women's own perceptions of risk as it relates to water and sanitation. The study's findings point to how strongly perceived risk can influence behavior. In this case, women's perception of risks associated with latrine use, influenced them to engage in even more risky behaviors including open defecation and urination. A novel study investigating the potential link between open defecation and adverse pregnancy outcomes (APOs) found that women who practiced open defecation during the early stages of pregnancy had higher odds of experiencing an APO, including preterm birth and low birth weight. The authors called for further studies to examine the underlying drivers of sanitation behavior among this population, particularly as it relates to open defecation. Perceptions of health risks associated with latrine use could be one such underlying driver of sanitation behavior among pregnant women.

Also from this study's findings, pregnant women who possessed toilets in their homes and who had the agency to use their facilities, were compelled to practice seasonal open defecation during the monsoon. Many cited poorly constructed latrines, which were rendered dysfunctional during the monsoon, as the underlying reason for the non-use. Specifically, some latrines became flooded and unusable, while others did not protect users from getting soaked in the rain as roofing was either incomplete or nonexistent. These findings resonate with results from other studies regarding

underlying reasons for the persistence of open defecation in India despite the ongoing succession of sanitation campaigns in the country. Routray and colleagues report that many owners of Government subsidized latrines cited poor construction as the reason why their facilities remained unused by household members (Routray et al., 2015). Facilities lacked walls, roofs and some had pits that were too small (Routray et al., 2015). Although the Swachh Bharat Mission and other campaigns before it have laudable aims to improve sanitation coverage in rural India, simply increasing sanitation coverage without subsequent increase in latrine usage may prove futile towards achieving long term sanitation goals.

Lastly, it's important to examine women's gendered roles and how it relates to physical exertion in this study. Walking long distances in order to fetch water was not only a concern among pregnant and postpartum women for the purposes of tending to biological needs (urination and defecation) but was also tied to gendered household responsibilities. Such roles included water fetching and cleaning of infant clothes soiled with fecal matter. While pregnant, some women had little or no assistance and bore the burden of domestic water fetching regardless of their physical condition. In their review, Watt and Chamberlain noted that this is common and culturally acceptable in some contexts (Watt & Chamberlain, 2011). In addition to the experience of pain and discomfort as a result of walking long distances to obtain water, there is evidence that lifting heavy objects and carrying heavy loads may be associated with spontaneous abortion and low birth weight, especially among women who are already at risk for negative pregnancy outcomes (Figà-Talamanca, 2006; Taskinen, Kyyrönen, & Hemminki,

1990). This evidence stems from occupational health studies in developed countries, and there is a dearth of research investigating this issue (Porter et al., 2013), particularly in the context of water fetching (Rao et al., 2003). Rao et al. reported that pregnant women in Maharashtra, India found water fetching to be the most strenuous of all their domestic tasks and this was inversely associated with their child's birthweight upon delivery (Rao et al., 2003).

Strengths and Limitations

Purposively sampling women with differing access to toilet and water facilities enabled the study to compare differences in pregnant and postpartum women's experiences based on access to facilities. Using qualitative data collection methods allowed women to voice challenges from their own perspective and enabled the study to capture socio-cultural influences that shaped women's experiences. Employing one-on-one interviews with free-lists allowed the study to capture a wide range of issues from a relatively large number of women. FGDs enabled the study to capture women's collective voices about pertinent defecation, urination and water-related concerns.

One of the main limitations of this study is that women who were currently pregnant or 4 months postpartum made up a relatively small proportion of the study sample.

However, the inclusion of older women and married women who had ever been pregnant in their lifetime gave women the opportunity to reflect on their experiences during pregnancy. As evidenced by the various quotes from women in each life stage, even women who answered pregnancy-related questions based on memory shared a

great deal of detail pertaining to the nature of the water and sanitation challenges they faced while pregnant. Recently married women were not allowed to participate in FGD, and thus their voices are not captured in the discussion. Despite this set-back, one-on-one interviews with them allowed for their perspectives to be captured for analysis. FGDs sessions included women from different castes which may have had an influence on what participant's ability to share freely during the sessions and not all caste categories were represented in each life stage (Caruso et al., 2017b) .

Public Health Implications

Findings from this study present a number of implications for further research on women's health during pregnancy and maternal health programming.

Implications for Public Health Research

Findings from this study show that context is key to understanding the challenges associated with water collection and sanitation among pregnant and postpartum women. Other studies should explore water-related and sanitation constraints experienced by pregnant women in different contexts including urban areas, other parts of India and the developing world.

Overall, there were varied reports from pregnant women regarding tendencies to reduce water consumption during pregnancy. Women at the FGDs reported that they did not reduce water intake when pregnant, while during one-on-one interviews some women hinted that they did. Since others have demonstrated that women in this context have been known to reduce food and water consumption in order to avoid frequent urges to urinate and defecate (O'Reilly, 2010) (Khanna & Das, 2016), further research should examine women's food and water consumption habits during pregnancy. Reducing food and water intake has been implicated as a risk factor for

maternal underweight and undernutrition (Mara, Lane, Scott, & Trouba, 2010).

Maternal nutrition is critical during pregnancy and several studies have drawn attention to the potential implications of maternal undernutrition on child development including stunting, delayed cognitive development and possible obesity in later years (Black et al., 2013) (Victora et al., 2008). It would also be worth exploring the factors that inform women's decisions regarding altering their water and food consumption behaviors during pregnancy and whether this extends to the postpartum period.

Current research on physical activity and birth outcomes focuses on the effects of exercise versus inactivity during pregnancy on maternal and child outcomes (Bisson et al., 2017; Jukic et al., 2012). While some studies have showed potential links between vigorous activity during pregnancy and low birth weight, such studies are conducted mostly in developed countries (Bisson et al., 2017). Therefore, further research is needed examine the association between strenuous activity among pregnant women in the context of developing countries and birth outcomes.

Implications for Public Health Programming

As the WASH sector and the maternal and child health sector seek to build synergy under the SDGs, it is important for government agencies in India and non-governmental organizations to incorporate context specific and evidence backed strategies to promote health among pregnant women. This study found that pregnant women perceived that latrines were unsafe because they exposed women to infections via the urine of other users, choosing instead to urinate in open spaces. India's current sanitation campaign is

focused on providing latrines to households, however, the most vulnerable household members may not be benefitting from improved sanitation facilities. Therefore, there is the need to focus public health education campaigns and education given to mothers at antenatal visits to encourage women to engage in safe sanitation practices when they have access to the facilities to do so.

Findings from this study show the importance of investing in WASH technologies to improve the water fetching experience of women in developing contexts. Technologies such as the 'back-happy' tap stand, which features a raised platform for buckets to eliminate the need to bend at the waist in order to lift water reportedly improved the quality of life of women in Tibet (Hoy et al., 2003). Pregnant women in this study who had access to tube wells with pumps mentioned that they did not have difficulties pumping water from the tube wells unless there was a power outage. Though electric pumps may be too expensive to include in government campaigns, other, more affordable technologies like the 'back-happy' taps stand may be explored.

Whether they owned and used a latrine or practiced open defecation, pregnant women in this study complained that they were unable to or found it painful to squat for defecation. This finding can be used to improve current and future sanitation campaigns in India in a two-fold manner: (1) latrine designs can incorporate adaptations such as raised seats to accommodate the needs of pregnant women and others needing such facilities (e.g. the elderly population) and (2) campaigns can leverage the raised seat adaptation to encourage latrine usage among pregnant women who already have

access to latrines in their households. Research and pre-testing should be employed to ensure that raised latrine seats are culturally acceptable among the populace.

Chapter 7: Conclusion

Study findings showed that pregnant and postpartum women in Odisha experienced three types of water and sanitation related challenges. Many individual challenges were common to both pregnant and postpartum women and were characterized by physical exertion. Regarding environmental challenges, during the monsoon season both latrine owners and non-owners worried about slipping and possibly harming their unborn child while fetching water or attending to sanitation needs. However, pregnant women with no latrines and those with unusable latrines were more often worried about slipping because they had to practice open defecation. While gendered household responsibilities constrained women's ability to attend to defecation and urination urges at will, social support or the lack thereof from other household members had the potential to ameliorate or exacerbate both pregnant and postpartum women's challenges. Pregnant and postpartum women who did not have tube wells in their homes or assistance with water fetching from other household members worried more often about water fetching than women who had access to water in their household and/or who had support with water fetching.

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