RESEARCH

Navigating Sociocultural Tensions in Prenatal Care: Opportunities for Digital Health from Diverse Stakeholders in Techiman, Ghana

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Abstract. Pregnant women in the Global South face significant challenges due to lack of resources and informational gaps. In this paper, we take an assets-based lens to examine the experiences of pregnant women in a low-resource setting in Ghana, focusing on the role of information and technology in prenatal care. Through interviews and co-design workshops, we sought to understand the perspectives of multiple stakeholders including pregnant women, their family members, and healthcare professionals. We highlight the complexities involved in making decisions during pregnancy, including the challenges arising from the tensions between traditional healthcare practices and modern Western health services. We discuss opportunities in digital maternal health where we argue for the importance of attending to local needs and values and advocate for recognising community strengths and integrating rural care practices as valuable assets in prenatal intervention design. Our work aims to bridge some of the gaps between the theoretical understanding of digital health and the practical realities of prenatal care in low-resource settings.

Key Words: Digital health, Information-seeking, Low-resource settings, Prenatal care, Digital maternal health, Ghana, Global South

1 Introduction

Pregnant women in low- and middle-income countries (LMICs), especially those in undeserved communities, face higher risks of poor health outcomes despite advancements in maternal healthcare. Access gaps persist, prompting the need

for an in-depth understanding of the complexities pregnant women face in low socioeconomic settings. Although research on digital health interventions in low-resource settings has been extensive in various countries including Ecuador, India, Pakistan, Bangladesh, United States, South Africa and Kenya (Verdezoto et al. 2020; Bagalkot et al. 2018, 2022; Perrier et al. 2015; Gui et al. 2017; Mustafa et al. 2020; Burleson et al. 2020; Coleman et al. 2023), Ghana remains relatively underexplored in the fields of Human-Computer Interaction (HCI) and Computer-Supported Cooperative Work (CSCW). In the complex landscape of maternal health in Ghana, which comprises 16 administrative regions and 216 districts, this study took place at the Techiman community. Located in the Akan community within the Bono East Region, Techiman is home to 366 health facilities. Although these community assets are part of a broader vision of enhancing the care of pregnant women, inherent socio-cultural and socio-technical tensions need to be balanced in ways that prioritise the well-being of pregnant women.

Contemporary pregnant women actively seek information to address gaps in their knowledge, adjust to changes in pregnancy, and confirm normalcy during the prenatal period (Gui et al. 2017; Burleson et al. 2020; Grönvall and Verdezoto 2013). However, this often leads to conflicting advice, resulting in tensions in decision-making and communication practices that can impact maternal health outcomes (Ganle et al. 2015; Sumankuuro et al. 2022). Previous research attributes these challenges to conflicting information between deeply rooted traditional care practices and Western medical approaches, particularly in low-resource countries such as Ghana (Baada et al. 2021; Banchani and Tenkorang 2014).

In this complex landscape, sociocultural beliefs play a crucial role in shaping prenatal care and decision-making practices. Pregnant women often turn to family relationships, herbalists, or religious leaders for advice, considering them as community assets (Ganle et al. 2015; Dako-Gyeke et al. 2013). However, these sources of information often provide guidance that is in conflict with mainstream medical care. Examples include the use of herbal medicines, food prohibitions, religious beliefs surrounding cesarean sections, and induced labor (Otoo et al. 2015; Ayelyini 2019; Sumankuuro et al. 2022). The delicate balance between cultural norms and Western medical approaches raises socio-cultural and socio-technical tensions, highlighting the need for a nuanced understanding of the lived experiences of pregnant women and the diverse stakeholders influencing their pregnancy care practices.

This paper presents insights derived from in-depth semi-structured interviews and co-design sessions conducted with pregnant women, families, and health professionals in Techiman. We aimed to explore the sociocultural dimensions that influence information-seeking practices to inform the design of digital maternal health interventions. The study identifies sources that facilitate or hinder health information and draws attention to tensions that must be carefully considered in the design of maternal health interventions. Importantly, it advocates for the systematic

integration of rural care practices, recognising them as valuable community-based assets that complement maternal healthcare services.

2 Background and related work

2.1 Prenatal care in HCI

The sensitivity of pregnancy has attracted the attention of public health, health informatics, HCI, and Computer-Supported Cooperative Work (CSCW) communities (LeFevre et al. 2017; Pagalday-Olivares et al. 2017; Grady and Bloom 2004; Hyzam et al. 2020). These studies have focused on three thematic areas of concern. First extending the reach of health and information services to deprived communities, leveraging existing practices of community health workers (Molapo et al. 2016; DeRenzi et al. 2017; Yadav et al. 2017). Second, the design of personalised digital tools for pregnant women (Perrier et al. 2015; Newhouse 2016; Vaira et al. 2018; Wierckx et al. 2014; Barron et al. 2018). Third, understanding the sociocultural influence on prenatal care and information-seeking practices (Bagalkot et al. 2022, 2018, 2020; Verdezoto et al. 2020). These researchers highlight the importance of considering the sociocultural contexts of pregnancy care to inform culturally-situated digital intervention design (Bagalkot et al. 2018, 2020; Verdezoto et al. 2020). Previous research further criticise the idea of designing universally usable interventions (D'Ignazio et al. 2016), particularly due to complexities such as inadequate information, low health literacy, and conflicting advice prevalent in low-resource settings (Dsane-nsor et al. 2019).

The HCI research community has shown a strong interest in the prenatal period, focusing on how HCI research and technology can improve the experiences of pregnant women. Various interventions and designs have been explored, such as the development of pregnancy apps (Smith et al. 2017; Chaudhry et al. 2019), the use of social media platforms to support pregnant women (Dsane et al. 2022), and the design of texting systems to provide stage-related information to pregnant women in Kenya and South Africa (Perrier et al. 2015; Barron et al. 2018; LeFevre et al. 2017). Building on these studies, we focus on providing a nuanced understanding of the sociocultural practices of pregnant women in Techniman to inform system design.

2.2 Maternal health in LMICs

Maternal health remains a pressing concern in low-resource settings, with an estimated 287,000 maternal deaths worldwide in 2020, 95% of which occurred in such contexts (WHO 2024; Mantey 2013). Maternal health encompasses the well-being of women during pregnancy, childbirth, and the postpartum period, extending up to 42 days after delivery. Despite global initiatives to reduce maternal mortality by 70% under Sustainable Development Goal 3, substantial disparities in

maternal health outcomes persist, particularly in low- and middle income countries (LMICs) (Tünçalp et al. 2017; Mantey 2013). For instance, in sub-Saharan Africa, only 14% of women receive the recommended services, including ANC and family planning counselling within one year of birth. In Ghana, although 86.1% undergo at least four ANC visits and 75.6% deliver, only 8.0% complete the care program.

According to the WHO, a positive pregnancy experience requires a responsive intervention aligned with individual's values, beliefs, and needs, highlighting the need for meaningful care for pregnant women. Thus, from a HCI perspective (Bagalkot et al. 2022, 2020), these considerations should be central in the design of a digital intervention to ensure optimal uptake and promote the health of women and children. Hence, we explore the lived experiences and the influence of sociocultural practices on Ghanaian pregnant women.

2.3 Prenatal care practices in Ghana

Despite initiatives such as the National Health Insurance Scheme (NHIS) and Mobile Technology for Health (MOTECH), rural communities in Ghana face persistently high mortality rates during pregnancy and childbirth. The NHIS aims to make healthcare more accessible to economically deprived citizens, providing registered pregnant women with free basic health services and antenatal care (ANC). Although this initiative is commendable, factors such as autonomy, transportation, and sociocultural norms still influence the decision to seek care (Banchani and Tenkorang 2014). To further improve accessibility, MOTECH was introduced to provide stage-related information to pregnant women, leveraging the increased mobile phone ownership in low-resource communities (Awotwi 2012; LeFevre et al. 2017). However, improving care for pregnant women requires more than access to free services; it requires understanding and addressing the complexities of daily practices to enhance responsiveness, adherence, and inform the prenatal design space. Deeply rooted traditional care practices and limited autonomy over reproductive health decisions contribute to these complexities.

In Ghanaian culture, pregnancy is considered a sensitive period that requires spiritual protection (Jesse et al. 2007; Aziato et al. 2016). In addition to their emotional, tangible, and informational needs, pregnant women often seek spiritual guidance, turning to herbalists, pastors, or traditionalists to protect against spiritual threats (Peprah et al. 2019; Jesse et al. 2007). Although some scholars have criticised these practices as potential risks to pregnancy (Sumankuuro et al. 2022), few studies have explored how these influential practices can be leveraged to promote adherence to maternal health guidelines and enhance digital maternal health initiatives for holistic care (Peprah et al. 2020; Shewamene et al. 2017). In health and social sciences, there is growing concern about the impact of familial relationships and the use of herbs in prenatal care. Ghana is known for its extensive use of herbal medicine, particularly among pregnant women, due to its deep cultural significance and his-

torical roots (Peprah et al. 2019; Kwame Ameade et al. 2018). Herbal practitioners in Ghana often combine herbs, spiritual beliefs, and indigenous knowledge from local communities into their healthcare practices. Pregnant women, especially in rural areas, rely on these remedies due to their accessibility, affordability, and trust in traditional healers (Kwame Ameade et al. 2018; Krah et al. 2017). The long-standing success and confidence in these practices have reinforced their continued use.

Sociocultural practices significantly impact the utilization of healthcare services by pregnant women. Maternity care initiatives could benefit from integrating these cultural assets, using them to encourage consistent use of conventional antenatal services. Throughout pregnancy, herbal medicines are highly valued for their nutritional benefits and perceived spiritual protection for both mother and child (Otoo et al. 2015; Okyere et al. 2010; Dako-Gyeke et al. 2013; Allman 1994; Krah et al. 2017). There is also a prevalent belief in spiritual forces causing neonatal illnesses, such as Asram, which many believe can only be treated with herbal remedies like Abemuduro, rather than in hospitals (Okyere et al. 2010; Geleto et al. 2018). Our study is situated within this context, aiming to understand the information-seeking practices of pregnant women in Bono (Techiman), explore the challenges they face, and identify innovative design opportunities to support maternal care accounting for their lived experiences.

2.3.1 Perception of sociocultural norms in prenatal care

Sociocultural perceptions significantly shape access to maternal care, often creating barriers that hinder the effective use of healthcare services (Dako-Gyeke et al. 2013; Sumankuuro et al. 2019). Despite the availability of free maternal and newborn healthcare services since 2003, challenges such as uneven distribution of skilled healthcare providers, intimidation by healthcare personnel, lack of privacy, and poor quality of care persist (Dickson et al. 2018; Dapaah and Nachinaab 2019; Barbi et al. 2020; Baada et al. 2021). These institutional barriers, coupled with sociocultural factors (e.g., pregnancy-related taboos), have been widely studied from various perspectives (Baada et al. 2021; Sumankuuro et al. 2019, 2022; Dako-Gyeke et al. 2013; Peprah et al. 2020), underscoring the need for community-level insights to inform targeted interventions for pregnant women in rural Ghana. Maternal mortality remains a significant issue, driven by both clinical factors such as hemorrhage, anemia, and obstructed labor, and sociocultural factors such as low socio-economic status, early marriage, and pregnancy-related taboos (Ganle et al. 2015; Otoo et al. 2015). The 'three delays' in recognising obstetric problems, deciding to seek care, and reaching health facilities, further exacerbate these challenges (Thaddeus and Maine 1994).

In Ghana, pregnancy-related decisions are deeply influenced by religious beliefs, sociocultural norms, and the choice between traditional herbal remedies and modern medicine (Aziato et al. 2016; Okyerefo and Fiaveh 2016; Gupta et al. 2015; Dako-Gyeke et al. 2013; Jesse et al. 2007). Similarly a review conducted

by de Diego-Cordero et al. (2020) revealed a strong association between cultural beliefs and food patterns and eating habits in pregnant women. Indeed, previous research highlights a complex relationship between these sociocultural practices and medical adherence, suggesting that a nuanced understanding could inform more effective strategies to mitigate potential risks in prenatal care (Barbi et al. 2020; Sumankuuro et al. 2022; de Diego-Cordero et al. 2020). The prevalence of herbal concoctions and childbirth-related taboos in many communities (Sumankuuro et al. 2022; Peprah et al. 2020; Barbi et al. 2020; Kwame Ameade et al. 2018; Asase 2023) points to the need to better understand these factors, particularly from rural and peri-urban perspectives, to guide practical improvements in healthcare access (Kwame Ameade et al. 2018; Dako-Gyeke et al. 2013). Furthermore, beliefs surrounding spiritual protection for pregnant women present additional challenges to healthcare access by causing delays in seeking care. Aziato et al. (2016); Mustafa et al. (2020). Addressing these complexities requires an in-depth understanding of everyday care practices to design culturally sensitive digital interventions, especially in under-researched and resource-limited areas like Techiman.

2.4 Motivating an asset-based approach to prenatal care

Asset-based approaches find application in community development, public health, and social services as tools to acknowledge local strengths and capabilities (Broadley 2020; Bhatti et al. 2022; Pei et al. 2022; Karusala et al. 2019; Cho et al. 2019). This involves re-aligning control over action, design and development to the community and individuals, reflecting a flexible procedure for community engagement (Broadley 2020; Gautam et al. 2020). The approach aims to make inherent community skills, knowledge, and capacity visible, fostering collaborative support for maternal health. In local communities, pregnant women access to diverse support structures, including grandmothers, herbalists, family networks, and public and private healthcare personnel (Till et al. 2023; Bagalkot et al. 2022; Verdezoto et al. 2021; Coleman et al. 2023), each considered a valuable asset encompassing tangible and intangible resources (Wong-Villacres et al. 2020).

Scholars emphasise assets' vital role in shaping community development (Gautam et al. 2020). They recognise that through asset-based approaches, low-resource communities cultivate resilient, culturally-situated social practices to navigate their world, aiming to enhance and amplify these inherent attributes rather than imposing a top-down, colonial, or preconceived intervention on the local community (Cho et al. 2019). Assets encompass "strengths, attributes, and resources that can be brought into relevance to satisfy the inherent tensions between a member of a population's needs, their understood or experienced aspirations, and the structural limitations of the system" (Gautam et al. 2020). In situations with limited infrastructure, assets gain value when put into action, addressing challenges and serving as valuable resources within the given context.

Recent studies suggest the potential of assets such as social capital for families in fostering resilience and improving health behaviors (Ganle et al. 2015; Prabhakar et al. 2021). Community assets include the knowledge of elderly women and herbalists, crucial for communities with limited healthcare infrastructure (Till et al. 2023; Coleman et al. 2023), recognising that assets go beyond traditional resources for a more holistic design approach. In our study, we emphasise understanding the assets available in pregnancy care to support pregnant women. In the process, we noted the significant roles of grandmothers and herbalists with expertise in traditional prenatal care practices. In addition, the assets-based approach allowed us to identify diverse intangible assets that form the basic support structure for prenatal care within the community.

3 Methodology

This study examines the tensions that pregnant women in Techiman, Ghana, face during their pregnancy journey. To better understand their experiences, we engaged with three key stakeholder groups: pregnant women, their families, and healthcare professionals providing direct care. The research involved one-on-one in-depth semi-structured interviews with pregnant women and medical staff, along with ten co-design sessions with their families, focusing on their limited decision-making autonomy. These activities provided nuanced insights into the prenatal care practices in Techiman. The demographic data of the participants are presented in Table 1.

The multistakeholder study was carried out through an interdisciplinary collaboration between Human-Computer Interaction (HCI) researchers and maternal health professionals. The fieldwork team consisted of a midwife and a gynaecologist (fourth author), each with over a decade of experience in the region, ensuring a comprehensive understanding of the local context. The lead author, an HCI researcher and mother residing in Ghana, contributed additional contextual insights (Denzin and Lincoln 2005). The primary data collection and initial coding were conducted by the first, and third authors (both HCI researchers), in collaboration with the fourth author (gyneachologist). The remaining authors helped develop the study protocols and collectively commented and reflected on the themes and data analysis. Throughout the research process, the team engaged in reflective practices to interpret and categorise the findings in relation to the local context (Whiteley and Whiteley 2006).

Ethical approval was obtained from three institutions namely; University of Cape Town, Koforidua Technical University, and Kintampo Health Research Center. In compliance with global codes of conduct and ICTD research ethics standards (ICTD 2009) following COVID-19 guidelines from both South Africa and Ghana (South African National Department of Health 2020; MOH 2020). By April 20, 2020, the Ghana government announced changes based on the pandemic's trajectory and the vaccination levels. These changes included lifting the curfew and removing movement restrictions (Africa 2020). The Ministry of Health (MOH) urged all to adhere

strictly to health protocols (MOH 2020). Infection rates had decreased to approximately 1045 cases nationwide amidst updates on SARS-CoV-2 variants (Africa 2020). All public agencies including hospitals were accessible amidst ongoing monitoring and response efforts, including vaccination, nose masks, and restricted access to public places. Hence, the research conducted between November and December 2021 was guided by strict adherence to the protocols stipulated by the Ghanaian Ministry of Health (MOH).

3.1 Study setting

The antenatal clinics in government hospitals follow a similar setup. Approximately one hundred and fifty pregnant women are attended to at Holy Family Hospital each day. This includes women with scheduled appointments, new visitors, and those facing health complications requiring expert guidance. The day's care procedures begin with a prayer and a health talk covering various topics such as nutrition, warning signs, birth preparedness, and immunisation. Subsequently, standard complete histories, physical exams, and lab tests are conducted. These tests include measuring blood pressure, weight, and performing urine analysis under the guidance of a midwife.

After these initial assessments, women are divided into sections to meet with their respective midwives. Here, they receive individual assessments such as measurement of fundal height, listening to fetal heartbeats, and engaging in approximately a five-minute discussion with the midwife. Depending on the results of the urine analysis or physical examination, some pregnant women may be referred to see a doctor for further examination, while others may be allowed to go home. However, due to the high volume of pregnant women, there is limited interaction time with healthcare professionals, leading to long waiting periods that can leave pregnant women feeling exhausted after their visit. However, certain women receive preferential treatment when attending the ANC with their husbands. This practice reflects the hospital's initiative to encourage male involvement in the prenatal care process (Ganle et al. 2016; Perrier et al. 2018; Peneza and Maluka 2018).

3.2 Participants recruitment

A total of 66 participants were included in the study. 30 pregnant women, 10 medical staff, and an additional 26 relatives of pregnant women involved in the co-design process. Table 1, provides the unique characteristics of participants. For example, the age range of participants by gender, their marital status, phone ownership, employment status, and educational levels. The recruitment, data collection, and analysis for each group are detailed in the next subsection.

3.2.1 Interviews with pregnant women
The interview process consisted of two stages, involving the recruitment of thirty pregnant women from the ANC unit, focusing specifically on those above 28

Table 1. Participants demographics.

Participants Characteristics	Household (HH00X)		Medical Staff (MS00X)		Pregnant Woman (PW00X)
	Male	Female	Male	Female	
Participants age by gender	24–54	18–67	25–46	31–57	23–39
Marital status					
Married	10	12	2	7	26
Single	1	3	1	0	4
Phone ownership					
Smart phone	10	8	4	10	19
Feature phone	2	6	0	1	13
No phone	0	1	0	0	1
Employment categories					
Formal	3	4	3	7	7
Informal	6	9	0	0	19
Student	1	1	0	0	0
Unemployed	1	1	0	0	4
Education					
No formal education	1	3	0	0	3
Grade 1 to 9	4	4	0	0	15
Diploma to postgrad	5	8	4	6	12
Total participants by gender	11	15	4	6	30

weeks gestation. The recruitment was conducted during routine health screenings by nurses and midwives on duty at the hospital. Participation was entirely voluntary, with no obligation to take part. To ensure informed participation, both oral and written informed consent were obtained from each participant prior to the beginning of the interviews. Each pregnant woman received a brief overview of the study explaining the objective of the study and why the participant's input was valuable to the overall study. This was done orally alongside providing a printed flyer with the same details. Finally, to ensure the health safety of pregnant women and research team, each participant received protective items (such as nose mask, wipes, and sanitisers) and a copy of the written consent for their records.

Semi-structured interviews were conducted in the local language (Twi) (Smith et al. 2017; Adam et al. 2019) with interpreter assistance, touching upon demographic context, socio-cultural influences on care practices, access to pregnancy care information, and digital resource use. The interviews, lasted 30 to 45 minutes on average, prioritised the comfort of pregnant women. Only three participants self-identified as single. None of the pregnant women were staying with their mothers.

3.2.2 Interviews with medical staff
In addition to recruiting pregnant women, we used snowball sampling to enlist ten medical staff directly involved in prenatal care. This group included four midwives, three community health nurses, two obstetric gynaecologists, and one public health nurse. Each medical staff, like the pregnant women, was provided with protective

items, an overview of the study, and asked to give both oral and written consent before participating in the interviews. Before conducting the interviews, participants were informed of their rights, including confidentiality of their responses and their ability to withdraw from the study at any time. These semi-structured interviews were conducted in English, aimed to triangulate initial findings and provide a deeper understanding based on insights from earlier interviews. Held in their respective offices, each interview lasted approximately 60 minutes and focused on health communication practices with pregnant women, identifying communication gaps in prenatal care, and exploring the use of digital tools in this process.

3.2.3 Co-designing with families

The co-design process involved ten families of pregnant women from previous interviews, aimed to understand sociocultural and technical factors that influence prenatal care experiences in Techiman. The iterative sessions engaged family participants in identifying their challenges and possible digital solutions for improving prenatal care guided by lessons from scholars in prior studies (Steen et al. 2008). Insights and feedback, obtained through debriefing discussions and recorded field notes, contributed to refining the process and generating collaborative solutions. The multi-stakeholder approach captured diverse needs and intra-familial perspectives of care. The workshop sessions took place within households courtyards to reduce the risks of exposure to COVID-19. Each session lasted approximately two hours.

The study's purpose was explained in either Twi or English, prioritising the participants' language preferences. Similar to the interviews, all participants within the household were individually provided with informed consent explained in English or Twi according to the household's language preference. We applied various elicitation techniques to ensure active participation of all participants, creating a safe space for collective idea generation.

3.3 Data analysis

Data analysis involved verbatim transcription of audio recordings in Twi, translation into English, and thorough review by the first author for linguistic accuracy. This was done by reviewing each transcript alongside the audio recordings in the local language. A subset of the transcripts was then sent out to the participants for verification and validation. We conducted a thematic inductive analysis following the six-step procedure by Braun and Clarke (Braun and Clarke 2006). The iterative process of reading and listening to the audio recordings facilitated data familiarisation and the initial generation of ideas. These preliminary insights informed the design of the co-design workshops, highlighting three key areas: the information needs of pregnant women, their use of digital tools, and specific information requirements. The interviews were transcribed, and we applied reflexive thematic analysis (Braun and Clarke 2006, 2020) to systematically explore and organise the

data. Through multiple readings of the transcripts, we engaged in a deep, reflective process to identify initial patterns and generate codes. These codes evolved as we immersed ourselves further in the data, leading to the development of preliminary themes and sub-themes. Through iterative refinement, these were condensed into three central themes (see Table 2).

Table 2. Thematic analysis table.

Excerpts	Initial Codes	Themes
'leg swelling'	Discomfort and Illness Narratives	Information Needs of Pregnant Women
'I vomit a lot' 'I was getting very sick' 'I was not feeling good'		
'it just felt normal' 'They say it is normal' 'I tell them but they always say it is normal for most pregnant women' 'The doctor said it was normal in pregnancy' 'And I realised that it is normal'	Seeking Normality	
'how to give birth to twins online'	Technology as a source of information	Navigating the Multifaceted Information Sources
'I learnt' I searched' 'I just google' 'I googled'		
'I believe what the midwives tell us is the best' 'I mostly adhere only to what doctors say' 'I listened to a doctor.'	Medical Staff as a Source of Prenatal Information	
'I informed my mother,'	Elderly women as trusted sources of prenatal information	
'My mother-in-law also guided me' 'My mother advised me.' 'My mother told me'		
'As for pregnancy, you need your husband' 'I feel for her during those times.'	Intra-Familial Support Structures Spiritual Support in Prenatal Care	Social Support Structures for Pregnant Women
'The herbalist gave me some herbs to and drink' 'Some of the herbal preparations also have spiritual connotations'		

The analysis explored sociocultural factors influencing prenatal care practices and diverse sources of prenatal care information. Themes, including 'Discomfort and Illness Narratives', 'Household Communication Tensions', 'Spirituality and Community Support', and 'Digital Tools and Pregnancy Support', were developed through iterative discussions among co-authors. Table 2 shows some extracts from the transcripts, the initial NVivo codes, and the final themes after several iterations and constant comparisons.

4 Findings

The findings reveal a complex interplay of prenatal care practices, highlighting the unique contributions of the community as an asset in the care and support of pregnant women. We emphasise the key roles and interactions of different actors and unpack the information needs, cultural context, and the rich complexities of prenatal care practices that influence the decision-making practices of pregnant women. In particular, we observe that within the Techiman context, prenatal care decisions are influenced by sociocultural norms. The subsequent subsections reveal the tensions within the prenatal care ecosystem, encompassing contrasting approaches, conflicting sources of knowledge, and the delicate balance between tradition and modern care.

4.1 Information needs of pregnant women

The findings indicate that pregnant women have specific needs and desires for information related to their pregnancy, health, and overall well-being. Two primary aspects of information needs among pregnant women are evident from our findings. Firstly, there is a need for information, guidance, or advice when faced with illness or discomfort during pregnancy. Secondly, while the prenatal journey is perceived as unique for each pregnant woman, there is a concurrent need for information to confirm normalcy. This arises from uncertainties about whether certain symptoms require immediate medical attention or are considered 'normal.' In this context, 'normalcy' denotes experiences anticipated or commonly encountered by most women during pregnancy, and obtaining information serves to confirm that the symptoms are not life-threatening.

4.1.1 Discomfort and illness narratives
The distinctive challenges and ill health experienced during pregnancy prompted the need for information. Pregnant women required information as a means of making sense of and finding meaning in their unique experiences. At various stages of pregnancy, they described diverse health challenges or ill-health experiences. During the interviews and co-design sessions, most pregnant women (27 out of the 30) shared stories about the discomforts and illnesses they encountered. Their narratives highlight the physical hardships and the emotional and psychological

discomforts experienced during pregnancy, prompting the need for information. Participants characterised this discomfort as suffering and, in some cases, as an illness. Some of the pregnant women expressed that they had accepted the reality of becoming ill at some point during pregnancy, a participant commented:

> What I know is that when someone gets pregnant, they spit a lot, vomit when they eat, and they can fall sick until they deliver. The pregnant woman here is suffering; she has waist and abdominal pains and she will continue to suffer until she delivers. She also has swollen feet. (HH001, Relative)

Pregnant women participants described their sicknes as a hindrance to fully embracing and enjoying the prenatal experience. The discomfort manifested in diverse forms, including altered sleep patterns, and morning sickness such as nausea, vomiting, abdominal pains, and loss of appetite. One pregnant woman commented:

> It has not been easy. For the first six months, I was sick. I could not eat well... I was admitted to the hospital about three times. I could not cook and could not do most of my house chores. My husband thought I was being lazy at that time. (PW007)

This participant's story also indicated how beyond the physical and practical challenges; the discomfort also created communication tensions within the household. The interpretation of her husband about laziness indicates an information gap husbands may have about health discomforts during pregnancy. Although these discomforts prompt the need for information, for others, it sparked a search for normality and adjustments.

4.1.2 Seeking a sense of normality: experiences and challenges
On the one hand, pregnant women shed light on the multifaceted nature of the pregnancy experience and the need for normality. They explained normality as the ability to return to their routine, as portrayed in the following excerpt: 'I am eight months pregnant. In the early stages of my pregnancy, I am usually weak and can't eat or do much. After five months, I am able to do everything normally' (PW026). For pregnant women, a sense of normality is associated with regular routines or lifestyles prior to life disruption (i.e., pregnancy). Participants view normality as a continuation of routine activities without significant interruptions caused by pregnancy.

On the other hand, normality means experiencing anticipated or commonly encountered symptoms during pregnancy. For example, loss of appetite. In a household (HH004), the husband commented: 'Loss of appetite, which is the first complication we experienced. We brought it to the hospital and the doctor said it was normal in pregnancy and advised me not to worry.' (HH004, Husband). Seeking a sense of normality is a critical aspect of pregnancy and is instrumental in adjustments. It serves as a mechanism that aids pregnant women in adapting to

the changing physiological, emotional, and lifestyle changes associated with pregnancy. According to our participants, seeking normality helps integrate the experience of pregnancy into their existing life structure, facilitating the adjustment to the complexities that pregnancy may bring. A participant commented:

> I recently also saw that someone was asking about stretch marks on her belly. Some people prescribed ointments, while others also said it was normal to have it after pregnancy. I also asked my mum, and she said it was normal so I became okay with it. (PW014)

As the pregnant women explained, the physiological changes prompted information search practices, typically to determine whether their experiences were considered normal. The information they encountered frequently reassured them that the discomfort or illness they were experiencing was a typical aspect of pregnancy. As mentioned by the following participant: 'I asked family members ... about waist pains. They told me that is normal with pregnancy' (PW013). Similarly, another participant (PW009) also explained:

> 'Initially, I thought I was going to have a miscarriage since it was a very unfamiliar experience. Upon inquiry, I was informed that every pregnancy has its own peculiar challenges. Some pregnancies render pregnant women hospitalised till they deliver' (PW009).

Although these challenges are perceived as unique and commonplace during pregnancy, the participants expressed a notable degree of reassurance, recognising that they are not alone in facing these issues. The motivation of this participant (PW009) to seek answers, triggered by a health issue during her pregnancy, exemplifies the need for information to better adjust, as observed by another participant (PW025): 'I am seven months pregnant. I have become weak and am unable to do much. I'm not able to cook for myself or wash my clothes. I can hardly walk. I think it's normal in pregnancy' (PW025). Our interactions with pregnant women revealed an active search for information, driven by the need to understand their unique pregnancy experiences and, in many cases, to find remedies.

> 'This pregnancy is quite difficult so I ask why it is so and they tell me it's because it's the third, the higher you go, the more difficult it becomes. And every pregnancy is different. I asked about nausea and they advised me to chew groundnut.' (PW004)

The findings indicate that the quest to seek relief and ascertain normality is common during pregnancy. Pregnant women are driven to seek information as a means of alleviating cognitive and emotional challenges related to the discomforts they experience, mainly related to health, pregnancy changes, and overall well-being.

4.2 Navigating the multifaceted information sources

In navigating these challenges, pregnant women rely on the expertise and experiences of a diverse range of stakeholders, both formal and informal, to establish a sense of normality and gain guidance in negotiating these complexities. We explore this web of information sources, examining how pregnant women navigate and utilise various channels to access knowledge and support. We present the multifaceted nature of information resources and the diverse ways in which they interact with them. One participant highlighted the significance of these interactions, stating:

> I used to vomit yellowish substances and asked a colleague from work. She said the yellowish substance makes you feel better. She also mentioned that the drugs we get from the antenatal clinics give us loose bowels, and it was all true. She advised on my sleep position, and the same advice was given at the antenatal clinic. (PW028)

Pregnant women rely on both informal and formal support networks for information and advice. The significance of informal discussions within the local community extends beyond information exchange, emphasising the role of a supportive network in the interpretation of information. These evidence-based interactions are exemplified by a participant (PW030): 'I get my information from my elder sister, friends who gave birth before me, and colleagues at work too. If I feel something I have not felt before, I discuss it with others with more experience than me' (PW030). Her reliance on her elder sister, friends, and colleagues provides a meaningful context for pregnancy narratives. These personal networks within the local community offer valuable experiential knowledge, demonstrating the interconnectedness between personal stories and collective experiences. These discussions provide personalised insights and first-hand narratives around pregnancies and sources of trusted care.

4.2.1 Elderly women as trusted sources for prenatal information

Elderly women (e.g., mothers) emerged as pivotal figures within these informal networks. They were seen as trusted sources of information. This trust emanated from the longevity of their relationships, rich experiential knowledge, and cultural wisdom. As a result, pregnant women placed a significant trust in the counsel and experiences of their mothers and other female family members. As expressed by a participant, who shared, 'I talk a lot to my mother about my pregnancy and all' (PW017). The inclination to seek advice and prenatal information from elderly women stems from the widely held belief in their extensive knowledge and expertise about pregnancy and traditional care practices, as articulated by a participant, 'I prefer to listen to my mothers because they have the experience' (PW007). In this context, informal interactions with elderly women are assets in preserving and passing on cultural wisdom and traditional care practices. As one participant mentioned, 'She (mother) also taught me that pregnant women must not eat anyhow

especially buying food from the street... can make the baby prone to acquiring diseases, especially Asram' (PW029). The existence of strong bonds nurtured within the family network formed the foundation of trust and reliance on elderly women for information and support. We also note that reliance on these informal sources sometimes creates tensions, particularly if it contradicts information from doctors. For example, we heard from a pregnant woman (PW009) that she prioritised her mother's advice, which led to a better result:

> My mother's herbal medicine helped me to deliver my secondborn safely without an operation when the due date was delayed by about two weeks. Doctors of Holy Family Hospital suggested that I go in for an operation (cesarean section), but when I informed my mother, she made me take herbal medicine for about one week, which made me deliver without the proposed operation by the doctor. (PW009)

This participant's expression illustrates the dynamic interplay between traditional practices and medical expertise during the prenatal period. The clash between the medical recommendation of a cesarean section, aligned with contemporary healthcare norms, and the preference for herbal medicine rooted in cultural wisdom reveals a tension in decision-making. This highlights the cognitive complexities of health decision-making, as pregnant women navigate and reconcile spiritual guidance with medical recommendations. These tensions are reflected in the frustration expressed by one healthcare professional as follows:

> For CS (cesarean section), we have so many instances that they (pregnant women) delay in decision-making, so we have to counsel them severally, and by the time they agree for the procedure to be done, the baby is sometimes asphyxiated (MS008, Obstetric-Gynaecologist)

These findings reveal the complexities surrounding prenatal decision-making and emphasise the need for careful guidance and education to alleviate fears related to cesarean sections.

4.2.2 Medical staff as sources of prenatal information

During hospital visits, pregnant women sought general health information encompassing mental, physical, and psychological well-being, as summarised by a doctor: 'I see myself as a doctor that takes care of women and their health, not only their obstetric and gynecological needs but also including their mental, physical, as well as psychological well-being' (MS008, Obstetric-Gynaecologist). This participant affirmed receiving medication and health advice from healthcare professionals. According to them, pregnancy care involves physical health and well-being. Alongside, participants also required herbal treatment and remedies for spiritual protection. Employing both care practices, according to the women, served a common purpose, enhancing their health and well-being. The traditional and herbal care

practices were for spiritual protection, while the antenatal and health professional's advice was for their physical health, as echoed in the following quote:

> I will say about 60 to 70 percent (pregnant women) take some herbal preparations as part of their pregnancy medication. They (pregnant women) will always say they need to do the spiritual aspects to balance their life... they come here for the physical and go to the herbalists for the spiritual. (MS003, Midwife)

However, administering both types of treatment simultaneously may sometimes pose a potential risk of developing pregnancy complications due to their conflicting nature, as one doctor explained:

> Many times, for example, there's this herbal preparation that they (herbalist) claim enhances uterine contractions. So, you have women who are not in labor take some of these herbal preparations and it leads to the rupture of the uterus and some complications that come with a ruptured uterus. (MS010, Obstetric-Gynaecologist)

Due to the sensitivity of the prenatal period, doctors are hesitant to recommend herbal treatments during pregnancy. A doctor further explains how some women with high-risk pregnancies are exposed to other complications as they access traditional treatments or medications:

> And you can also have some pregnant women who have been diagnosed with diabetes or hypertension seeking help from these herbal practitioners instead of coming to the hospital. They (pregnant women) go to the herbal practitioners, and when complications set in, they come to the hospital without giving us the full history. We lose patients because of these issues, and they often blame us. (MS010, Obstetric-Gynaecologis)

A critical aspect of prenatal care is that doctors are held responsible for actions taken without them. Integrating traditional herbal practices with modern medical care is crucial for addressing these situations.

4.2.3 Technology as a source of prenatal information

Beyond the socio-cultural dynamics, technology also emerged as a source of prenatal advice. According to participants, the pervasive characteristic of mobile phones is integral to the pregnancy journey, particularly as a tool for disseminating prenatal health information. A participant described this pervasiveness as:

> 'Phones are common. For the TV's, you can't carry them around but the phones now everyone has access to them'. (PW014)

Pregnant women also described their use of mobile apps, such as videos for pregnancy-related information. A participant stated:

> 'I watch videos as well. In terms of pregnancy-related videos. I watched one white lady delivering through the water bath system'. (PW025).

From their narratives, it was clear that the use of technologies such as mobile phones provided information in diverse forms to meet varying needs. We identified three types of technology-mediated prenatal support. The first is direct personalised interaction with family or health professionals through phone calls. The second is community-based interaction using broadcast media, and the third is internet-based interaction using smartphones.

4.2.4 Personalised prenatal care

Almost all pregnant women in the study had phones, a unique characteristic of a contemporary woman. The availability of mobile phones enabled pregnant women and health professionals to request or provide more personalised guidance through phone calls. For instance, during the interviews, a midwife described how some husbands occasionally called for personalised guidance similar to pregnant women:

> 'We know some men who cannot follow their wives to the hospital but occasionally google and educate their wives. Some men even call us through our contacts in their ANC books to inquire' (MS003, Midwife).

According to health professionals, the use of phone calls can boost the provision of personalised care and enhance the reach of prenatal education even for those with feature phones. A participant stated, 'We can also use technology by calling them on the phone for their appointment... even for those with limited functionalities' (MS009, Community health nurse).

The health professionals emphasised the need to extend personalised care through phone calls to address the information gap and other health challenges that pregnant women may encounter, especially for those using feature phones. A participant further suggested:

> 'There should be a toll-free line where pregnant women can call and express their concerns and have a medical practitioner attend to them anytime of the day' (MS008, Obstetric-gynecologist).

Beyond interactions with healthcare professionals, the study revealed a common practice among pregnant women sharing and seeking information from intra-familial relations through phone calls such as husbands.

> My husband does not stay with me but I inform him of all issues about my pregnancy... Now, he is not around; everything depends on me. Sometimes he asks me about what I learned (from the antenatal visit). I explain to him on the phone. (PW029)

We noted that these mediated communications were essential for decision-making and sharing of experiences among couples.

4.2.5 Community-based interaction

Our study revealed that within the collectivist society of Techiman, broadcast media played a pivotal role in preventive health education including prenatal health talks

leveraging radio, and television broadcasts. We also discovered the use of simple technologies such as megaphones installed on the rooftops of cars, trucks, or vans that periodically patrol the community disseminating diverse community-related information including herbal remedies for pregnancy called information vans. Our observation revealed that herbalists within the community primarily used the information van, to advertise their products and services. Observations show that these strategies are effective, as echoed by one of the midwives: 'Because they live with them (herbalists)... so they listen to them' (MS002). She noted that constant exposure to the same information leads to a perceived sense of truthfulness.

In addition, a fixed communal space with large megaphones called the information center was available at the community. These two mechanism were the available public strategies used for disseminating essential information to residents. The pregnant women acknowledged the center's significance, with one explaining that: 'In my community, nurses deliver talks (health) at the information center' (PW018).

4.2.6 Internet-based interaction

Beyond personalised communication and community-based interaction, we noted that the use of the internet was predominant among pregnant women for accessing diverse prenatal tips and guidance. For instance, one pregnant woman explained, 'I also searched for healthy foods for pregnant women. Beans were the first on the list' (HH006, Pregnant woman).

From their narratives, we noted that the Internet provided more than just health information about pregnancy. During the co-designing sessions in a household (HH004), the husband picked a pictorial of a phone as he reflected on their pregnancy journey as a couple. He explained,

> I choose the smartphone because she (wife) is always on her phone. Looking at, pregnancy content on IG (Instagram), the things they use. I feel like I am competing with the phone for her attention. I believe she is doing this because this is her first pregnancy. Sometimes I just sit by her and watch her scroll through pictures on her phone... Sometimes she tries to find out the sex of the baby. The things she is supposed to do and the things to watch out for in pregnancy. (HH004, Husband)

Our findings highlight the integral role of the internet as a learning tool, alongside pregnancy apps, for getting diverse information including regular stage-related guidance. These digital tools proved valuable in helping pregnant women navigate the complexities and uncertainties of the prenatal journey. Exemplified in the following excerpt 'I was looking for information about pregnancy. I downloaded the pregnancy app. The app gave me regular updates on what to expect and what to do. It guided me' (PW007). Our findings show the reliance of pregnant women on technology as a source of information for pregnant women. However, beyond the sources, pregnant women also highlighted the need for support structures.

4.3 Social support structures for pregnant women

Within collectivist societies like Techiman, prenatal care is of community interest. According to the pregnant women they enjoyed certain privileges from community members because of their identity, including random kind gestures:

> They (community members) are supportive of pregnancy and see it as a blessing. It is something they also pray for every woman to experience. Though they know it's stressful, it's also beautiful and exciting. Even where I stay, when they see me carrying a load or something, they easily come to assist me to reduce my stress. (PW030)

Similarly, another pregnant woman shared;

> My community really cares about pregnant individuals. The mere sight of you being pregnant offers you a lot of favour before others. I quite remember one time I was walking through a certain cocoa farm. I felt for a ripped one. When I requested one from the farm owner, he happily plucked two for me but was quick to add that he did it for me because I was pregnant. For me, I have noticed that all the communities I have lived in care about pregnant women. So long as they see your protruding stomach, they are ready to assist you. They give me words of encouragement. (PW029)

The women further emphasised the influential role of intra-familial relations such as partners and mothers, particularly their involvement in the prenatal decision-making process.

4.3.1 Intra-familial support structures

While pregnant women acknowledged the supportive role of their partners, concerns about the lack of emotional support led to communication tensions. For instance, opinions about antenatal visits varied among partners creating tensions. According to fathers, delays, work commitments, and gender imbalances at the antenatal clinics were a deterrent. During the co-designing session, one of the husbands explained: 'The delay in the ANC when we follow our wives because we have to go to work too. Also, there is an imbalanced gender at the ANC some of the men become shy' (HH007). The study revealed a notable discrepancy between pregnant women's expectations and their partners' perceptions of emotional support. While financial and logistical support was acknowledged, pregnant women expressed a need for mandatory antenatal education for partners to enhance their understanding of pregnancy challenges and discomforts. This education, they believed, would foster empathy and create a more supportive environment for expectant mothers. The women highlighted the need for comprehensive education, emphasizing pregnancy as a shared responsibility. A pregnant woman, HH007, shared that educating men about the diverse aspects of pregnancy changes, such as mood swings would enable their partners to better support them during pregnancy: 'There should be the sensitization that pregnancy is a shared responsibility and also teach the changes

pregnant women experience, such as mood swings so that men will learn how to deal with them' (HH007, Pregnant woman).

The pregnant women explained that many men did not attend antenatal visits with their wives. This according to them creates communication tensions because their spouses have limited information on how to support women during pregnancy. Women participants further emphasised the importance of their partners understanding the dynamics involved. In a household (HH007), a pregnant woman explained,

> They (husbands) need to learn how to support their wives during pregnancy. And women should also know how to communicate effectively to encourage their husbands to attend ANC with them. (HH007, Pregnant woman)

Another participant narrated her experiences of the communication challenges among couples,

> Last week, a woman shared her experience with me. She said, whenever she is tired during pregnancy, she had to pretend to be sick. Because her husband would not understand that she is too tired to cook. In my case, my husband did not believe me when I told him I was sick initially till I was admitted. (PW007)

While these tensions were evident, some pregnant women also acknowledged the instrumental role of their husbands in helping with chores at home. More broadly, all couples during the co-design sessions recognised the importance of supporting their spouse by easing her workload to ensure she rests. This proactive approach demonstrates an understanding of the physical strain pregnancy can bring, highlighting the partner's commitment to providing valuable support during this time.

4.3.2 Spiritual support in prenatal care

The study reveals a significant reliance on traditional herbal preparations among pregnant women, with 25 out of the 30 pregnant women incorporating traditional treatment into their regimen alongside modern medicine. This dual approach reflects a deeply ingrained belief in balancing physical and spiritual health. Traditional practitioners often link their herbal treatments to spiritual practices, advising women to use concoctions to protect against evil and ensure good health.

> The women who come here, I will say about 60 to 70 percent take some herbal preparation as part of their pregnancy drugs. They will always say they need to do the spiritual aspects to balance their life. And lately what the traditional practitioners are doing is linking their herbs to a spiritual side and they tell the women to bathe their concoctions for deliverance from evil and good health and the women around here also go to get these things. So they come here (hospital) for the physical and go to the herbalists for the spiritual. (MS001, Midwife)

Consequently, pregnant women seek both medical care for their physical health and herbalists for spiritual support. This practice is believed to influence various

aspects of pregnancy, including the method of delivery, with some women fasting and praying for a safe delivery. Indeed, spiritual aspects were often attributed to the health outcome, as seen in a case involving a woman who died from childbirth complications despite medical intervention. The outcome was attributed to a family curse linked to spiritual beliefs:

> There was a banker whom I attended to, she had fibroids but they were not big enough for her not to have vaginal delivery so when she was almost due we counselled her on all the options and she chose vaginal delivery. A short while after the delivery a doctor friend of hers as well as myself showed up beside her and we realised that she was bleeding. We took her to the theatre and did everything we could but she would not stop bleeding so we called for a helicopter to take her to 37 Military Hospital for dialysis and further treatment but unfortunately, we lost her. It was later that the midwife who was attending to her said that the lady always feared she was going to die during delivery because she had two sisters who also died the same way. She further added that they hailed from the Volta region and one of their parents had offended somebody or a deity and a curse had been placed on the family that they would die during childbirth but the midwife never told me this until after the death of the lady. After that incident, I really take the spiritual concerns of the patients at heart and try to find out if they are happy, have any prophecies, and try to help them holistically. (MS008, Obstetric-Gynecologist)

However, the integration of spiritual beliefs into pregnancy care poses challenges for healthcare providers. Instances of emergencies arising from these practices are not uncommon, as illustrated by cases of delayed medical intervention due to reliance on spiritual solutions. For example, one woman, who had a history of stillbirths following cesarean sections, delayed her scheduled procedure to attend a prayer camp, resulting in a risky delivery. The medical doctor (MS008) narrates this incident:

> ... there was a patient who had a bad obstetric history, she had done two CS and they both turned out to be still birthed so when she conceived again, I made it a point to see her more often. In her ninth month I scheduled a CS for her only for the date to go past by two weeks before she showed up begging when I enquired where she was she said she had gone to a prayer camp. I put everything aside and luckily when we did the procedure this time the baby was okay. These spiritual aspects keep occurring. (MS008, Obstetric-Gynaecologist)

These incidents highlight the need for holistic prenatal care that respects and incorporates patients' spiritual concerns. To this end, below we describe several different aspects of traditional and spiritual care that we uncovered during our study. Central to these are three distinct herbal blends used at different periods: during pregnancy, when at labor, and after birth. The first is the intake of "Abemuduro" during pregnancy. This herbal blend is prescribed by herbalists or family members

for spiritual protection and good health. The second herbal blend, called "Awomrɛ", is taken to induce labor. The third is for spiritual protection against "Asram", a neonatal illness.

4.3.3 Spiritual protection during pregnancy

The pregnant women described the use of "Abemuduro," believed to offer protection against spiritual attacks, specifically targeting neonatal illness called Asram. Participants in household HH003, described the preparation of Abemoduro as follows; '...boil seven palm fruits, pound. and then sieve. Add "Adwen" (local name for catfish), to prepare soup. The soup can be used to eat fufu or any meal. The preparation of this soup is done once a month to protect the fetus from evil eyes' (HH003, Pregnant woman). According to participants, there are specific periods for consuming "Abemuduro." 'The preparation and consumption of Abemuduro' typically commence in the fifth month of pregnancy. Abemuduro can be taken from the fifth month upwards. You cannot take it at the onset of pregnancy because it can terminate the pregnancy (HH001, Relative). Participants explained the reasons they consumed Abemuduro, as a participant explained, 'This (Abemuduro) is to be consumed once a month to protect the fetus from evil eyes' (PW012).

For other participants, the consumption of Abemuduro enhances the well-being of the growing fetus and it is a common practice among women, driven by the perception that these remedies, can address obstetric issues and making the baby beautiful and strong. For example, one participant stated. 'I used to go for Abemuduro every month (from the herbalist). They (herbalists) said it makes the babies clean and beautiful' (PW028). The belief in herbal treatments often leads women to trust herbalists, who are seen as reliable sources of spiritual protection within their communities. This trust is rooted in cultural norms that value traditional knowledge and practices, even in the face of potential risks associated with unregulated herbal use.

4.3.4 Herbal practice for inducing labor

The second notable herbal medicine used within the Techiman community is "Awormrɛ" for inducing labor. This herbal remedy is used when a woman is post-term (i.e., the pregnancy has gone beyond the expected due date and there is no sign of labor). According to participants in household HH001: The preparation involves boiling yɛmdua leaves, pounding them, and combining them with any type of meat or fish... After all the ingredients are combined, they are boiled again, and allowed to cool before consumption. This concoction initiates labor and cleanses the womb by removing impurities. However, this practice faces disapproval from healthcare practitioners, contributing to the complexities that pregnant women navigate in balancing conflicting recommendations between cultural beliefs and modern prenatal care.

A specific example illustrating the use of this herbal medicine comes from a participant who recounted her experience with delayed labor.

My mother's herbal medicine ... helped me to deliver my secondborn safely without operation. When my due date delayed for about two weeks. Doctors of Holy Family Hospital suggested that I go in for a cesarean section (CS). But when I informed my mother, she made me take the herbal medicine for about one week which made me deliver without the proposed operation (CS) by the doctor. (PW021)

This testimony illustrates the dynamic interplay between cultural assets, herbal practices, and individual pregnancy experiences. Although the efficacy of such herbal medications has not been scientifically assessed, there are anecdotal evidence and testimonials within these communities, such as PW021's experience.

4.3.5 Spiritual protection against asram

Within the Techiman community, "Asram" is a neonatal illness marked by distinct physical symptoms and deeply rooted in traditional and spiritual beliefs. Participants described infants diagnosed with Asram as small (underweight), malnourished, despite frequent breastfeeding, having protruding stomachs, or greenish veins on their body. A relative in household HH008 explained, 'So when you see that greenish veins on the baby it indicates; Asram'. In another household (HH001), a woman explained:

We call it "Asram aboa". It makes the baby small with a protruding stomach. They (baby) are always breastfeeding but never satisfied and look sickly like an HIV patient... When you give birth and the baby cannot eat, abdomen looks shinny, and also has a temperature (fever). (HH001, Relative)

The condition is believed to be caused by various factors, such as evil spirits, witchcraft, and exposure to specific animals or environments during pregnancy. Diagnosis relies on physical signs and cultural interpretations, with treatments predominantly involving herbal medicines.

Preventive measures are also culturally prescribed, such as using herbs to protect pregnant women and their babies from Asram. In a household (HH001), one of the relatives who self-identified as a herbalist describes the treatment practice:

All you need to do is bathe the baby with the medicine (herbal concotion) and breastfeed him (baby), and he will be fine. It is the same thing we have done here and we are using it to bathe the baby. We mix blue, Paa Kwesi, Paracetamol, and the little perfume with the yellow cover that has the three horses on the label to bathe the baby (HH001, Relative)

The beliefs associated with Asram are diverse and influential, guiding many traditional practices aimed at prevention and treatment. Pregnant women are advised to avoid eating in public and to dress appropriately to prevent exposing themselves and their unborn children to harmful influences.

The pregnant woman should take very good care of herself, eat in her house, and dress properly. Some pregnant women like tying cloth as a way to cover

themselves but a pregnant woman is not supposed to be seen that way. Someone can infect her unborn baby with the sickness. (HH008, Relative)

Similarly, one of the pregnant women also narrated, 'Yes, they see you wearing a short dress and they say a pregnant woman is supposed to wear gowns/ clothes that cover up entirely... There are beliefs that someone (evil) can harm the unborn child just by exposing your body.' (PW002)

Herbalists play a crucial role in diagnosing and treating Asram, providing specific concoctions and guidance based on traditional knowledge. Charms, like wrapping chameleon skin around a baby's arm, are also used to protect against the condition. A participant (PW022) shared how the charms are used:

The only one I believe and might do is put the cloth around my baby's arm. We wrapped a part of a chameleon's skin put it in a cloth and tied it on the hands of the baby to sack any evil eye away from the baby. (PW022)

However, we uncovered conflict within the community, as some individuals reject these traditional methods due to adverse effects, such as elevated blood pressure from herbal medicines, and misinformation spread by traditional healers. Another participant (PW022), explained why she prefers charm over herbal medicine as protection against Asram, 'With my first baby, they gave me herbal medicine to protect my baby against Asram. But that medicine elevated my blood pressure so I stopped taking it' (PW022).

In all of these, we note that pregnant women navigate a delicate balance between cultural beliefs and the healthcare system. It is thus essential to understand the interplay of these multiple forces. Understanding these complex dynamics can help inform holistic maternal health strategies and policies, one that honors traditional knowledge while promoting safe, evidence-based care practices.

5 Discussion

This paper extends the current understanding of pregnancy care (Bagalkot et al. 2020; Mustafa et al. 2020; Peyton and Wisniewski 2019; Smith et al. 2017), digital maternal health (Balaam et al. 2013; Batool et al. 2017; Kumar et al. 2015; LeFevre et al. 2017; Gao et al. 2014), and the cultural dynamics shaping the experiences of pregnant women in Ghana (Ganle et al. 2016; Dako-Gyeke et al. 2013; Otoo et al. 2015; Sumankuuro et al. 2019). Peyton and Wisniewski (2019) contends that existing designs focus on elevating pregnant women as a vulnerable group, aiming to empower them with digital tools, but often neglect the broader support infrastructure (Thomas et al. 2017). This design perspective (Awotwi 2012; Perrier et al. 2015; Barron et al. 2018; Chaudhry et al. 2019; Almeida et al. 2016) may not be as effective in communal societies like Techiman, where pregnancy is perceived as a shared responsibility, shaped by the involvement of elderly women, relatives, and herbalists in the decision-making process, and critical contextual factors such as socio-economic status, cultural norms, and beliefs systems (Chaudhry et al.

2019; Sumankuuro et al. 2019; Dako-Gyeke et al. 2013). Thus we draw attention to design considerations that emphasise asset-based approaches through broader engagement. Further, we emphasise the complexity of navigating conflicts between cultural beliefs and medical advice during pregnancy generating decision-making tensions (Bagalkot et al. 2020, 2022; Mustafa et al. 2020).

5.1 Navigating the tensions of decision-making

The journey of pregnancy presents women with the challenging task of ascertaining what is considered normal during the prenatal period. This challenge unfolds through the diverse decisions pregnant women must make, encompassing both medical and spiritual practices aimed at enhancing and protecting both the mother and the developing fetus. The tension emerges as these women grapple with the contradictions between opting for medical interventions and choosing more natural or traditional approaches aligned with cultural practices (Shewamene et al. 2017). The influence of cultural and societal expectations further complicates the decision-making process, as pregnant women navigate conflicting norms and expectations from intra-familial and community sources. The subjective nature of risk perception adds another layer of tension, with pregnant women weighing potential risks and benefits based on their unique experiences, beliefs, and available information as they experience pregnancy changes amidst the stress of comprehending what is normal.

Designing within this context entails navigating tensions while capitalizing on synergies inherent to the community's assets, such as elderly women, herbalists, and medical staff. The findings delve into the delicate equilibrium between these forces, emphasizing the role of human-centred design in prenatal care (Coleman et al. 2023). In the following, we highlight the tension of navigating medical care and advice alongside the spiritual dimension of prenatal practice present in herbal care. The second tension concerns the interplay between traditional and modern care practices, emphasizing the value of the spiritual and cultural aspects integrated into herbalist care. Lastly, we explore the pivotal role played by elder women as indispensable assets within the prenatal care ecosystem, showing their importance in providing support and guidance.

5.1.1 Balancing the tensions between modernity and spiritual care

Pregnant women in Techiman grapple with the tension between scientific and spiritual care, valuing medical services for physical well-being evident in their utilisation of antenatal services (Korsah 2011; Atif et al. 2020). Despite active involvement with antenatal services, they also embrace other sociocultural practices for spiritual protection, such as herbal guidance (Peprah et al. 2020). We explore this intersection, extending the discourse from Bangladesh and Pakistan (Sultana and Ahmed 2019; Mustafa et al. 2020), by highlighting the unique tensions in Techiman as

pregnant women navigate the integration of modern healthcare with culturally significant spiritual practices. This tension illuminates new design opportunities (Tatar 2007) in maternal healthcare, suggesting the need for culturally sensitive interventions that harmonise conflicting perspectives (Peprah et al. 2020).

The tension in care decisions is rooted in their cultural identity and beliefs (Castells 1998; Kannabiran et al. 2012). However, existing digital maternal and child health (MCH) interventions, often designed with a Western scientific framework, overlook these sociocultural practices of care, potentially resulting in non-responsiveness (Peyton and Wisniewski 2019). Complex choices, such as opting for a cesarean section over herbal labor-induced medication, may not align with the societal expectations of labor. There are calls (Templeman and Robinson 2011; Shaikh and Hatcher 2005; Kwame Ameade et al. 2018; Peprah et al. 2020) for regulation of alternative medicine and collaboration among traditional leaders, healthcare providers, and relevant bodies to ensure safe and effective integration of traditional and modern practices. Others within the HCI scholarship have also suggested integrating aspects of these unique cultural practices in the design of digital interventions to support care (Sultana et al. 2020; Verdezoto et al. 2020). Building on these studies, we re-emphasise the imperative for a specific focus in the design of interventions for prenatal care in rural communities and low-resourced contexts. For example, pregnancy apps can include culturally relevant dietary practices and address street food risks linked to spiritual ailments like Asram in newborns.

Further, the tragic incident recounted by medical doctor MS008 illustrates the intricate decisions pregnant women face during childbirth, impacting maternal access to care (Thaddeus and Maine 1994). The fear of spiritual consequences, conflicting medical options, and cognitive complexities are heightened challenges. However, prevalent maternal and child health (MCH) digital interventions often prioritise managing medical risks, neglecting cultural and spiritual considerations associated with pregnancy. We advocate for future research to explore and integrate the social and spiritual dimensions of the pregnancy experience, recognizing the sociocultural collaborative potential to support women in their pregnancy journey. It is crucial to respect and acknowledge the roles of both modernity and spirituality in pregnancy.

5.1.2 Cognitive challenges of prenatal decision-making

The decision between cesarean section and herbal labor induction is a profound dilemma for pregnant women in Techiman, involving intricate medical, cognitive, and social considerations. Rooted in experiences and beliefs, the tension between traditional practices like Awomrɛ and modern medical advice underscores the complexity of this choice. Understanding the medical intricacies of a cesarean section, including health effects, financial burden, and social implications, is challenging. Pregnant women often express fear, driven by surgery apprehension, potential complications, and limited healthcare access (Dako-Gyeke et al. 2013). This complexity is compounded by the use and affordability of herbal-based approaches aligned

with social norms, making the decision exceptionally challenging, especially for those inclined towards a cesarean procedure

Effectively addressing these tensions necessitates the design of technological solutions that foster a shared experience among multiple stakeholders within the care network (Grönvall and Verdezoto 2013). This facilitates open communication with pregnant women, reducing the cognitive challenge of balancing the tensions. The social dimension adds another layer of complexity to the decision-making process. It involves the potential for judgement or acceptance within the community based on the chosen approach to childbirth. Within this community, societal expectations, community norms, and the opinions of their peers and family members often impact prenatal decision-making. Thus, the fear of being stigmatised or judged creates additional stress for pregnant women.

5.1.3 Prioritizing support structures in intervention design

Elderly women similar to partners play a pivotal role as sources of wisdom, support, and guidance for pregnant women, transcending cultural boundaries and finding prominence in various contexts, including Techiman, Ghana (Korsah 2011; Gupta et al. 2015; Ganle et al. 2015, 2016; Mustafa et al. 2020; Kumar et al. 2015). Their significance lies in the intangible resources they offer, rooted in their extensive experience and knowledge of pregnancy care. This wealth of wisdom remains highly relevant and advantageous even in contemporary times (Gupta et al. 2015; Bagalkot et al. 2020). Recent calls for a paradigm shift in the CSCW community have emphasised a novel approach, focusing on identifying and harnessing existing community resources and strengths (Wong-Villacres et al. 2020), such as the knowledge possessed by both the pregnant women and the elderly women in the family. This shift is pertinent in collectivist societies like Techiman, where pregnancy is not an isolated concern. Rather than isolating interventions exclusively for pregnant women, the strategy involves enhancing and integrating these traditional support structures into modern prenatal care practices. The coexistence of traditional practices upheld by elderly women and herbalists with modern medical approaches presents unique opportunities for innovation. From an HCI perspective, these tensions should be perceived as catalysts for creativity, not as hindrances (Tatar 2007). From a design tension perspective, the approach to intervention design is to leverage these social structures, resulting in a balanced and comprehensive maternal healthcare solution.

Furthermore, intervention design should place a priority on enhancing and strengthening these existing support structures, aligning with the community's interdependence and shared decision-making processes. This approach enables the development of culturally sensitive interventions that cater to pregnant women's needs while respecting the community's values and practices. However, it is crucial to acknowledge that these support structures, despite their significance, can be vulnerable and may not always be entirely reliable. Therefore, while we consider the knowledge of elderly women as a valuable asset in prenatal care, it is

essential to recognise that they may also entail inherent risks. One example is the potential conflict between traditional food restrictions and the nutritional needs of pregnant women (Otoo et al. 2015; Bagalkot et al. 2022). The interplay between deeply rooted customs and contemporary medical advice presents a substantial design challenge (Peprah et al. 2019; Bidwell and Winschiers-Theophilus 2012; Winschiers-Theophilus 2022). Thus, embracing these tensions and drawing upon the collective wisdom and experiences of the community can lead to innovative and effective solutions in maternal healthcare.

5.2 Implications for designing support for maternal health

Given the tensions we have found, the following design considerations emerge as focal points in the discussion (see Table 3): incorporation of evidence-based testimonials, the utilisation of diverse media forms for education, the balance between societal norms and medical advice, and a focus on sustained engagement with interventions.

5.2.1 Incorporating evidence-based testimonials

Incorporating testimonials and narrative storytelling represents an inclusive and naturalistic strategy for deepening engagement (Denzin 2017), enhancing the infor-

Table 3. Design considerations for digital maternal interventions for rural and collectivist societies.

Design Considerations	Description
Incorporating Evidence-Based Testimonials	Digital solutions should integrate evidence-based testimonials, recognising the diverse viewpoints pregnant women leverage in their decision-making processes.
Leveraging Varied Media Forms for Education	Beyond apps and text messaging, other media forms such as broadcast media should be utilised, to emphasise community interdependence and shared decision-making, enhancing existing support structures.
Balancing Societal Norms with Medical Advice	A good balance between societal norms or customs and medical advice is crucial to mitigate tensions arising from prioritising one over another to mitigate persistent colonial approaches to design.
Focusing on Sustained Engagement with Interventions	Design efforts should prioritise sustained engagement, ensuring continuous involvement with maternal health interventions for long-term positive outcomes

mational value, and establishing more empathetic connections towards pregnant women (Dimond et al. 2013; Antoniak et al. 2019). As we saw in our findings, testimonials and narrative storytelling create a conducive, supportive, and empathetic environment that facilitates trust and learning (Naseem et al. 2020; Michie et al. 2018). Participants placed significant reliance on the wisdom of elderly women which was built on trust in the elderly women's testimonials on their experiences of going through pregnancy. For example, PW007 viewed her mother's past navigation of similar situations as evidence, highlighting the comforting assurance that comes from knowing someone else has undergone the same experiences and can relate (Younas et al. 2020; Ramachandran et al. 2010; Gupta et al. 2015). Moreover, we observed how herbalists seamlessly integrated evidence-based testimonials into their daily broadcasts of services and products. Critically situated, such strategic approaches, featuring testimonials from women in surrounding towns, proved locally relevant and fit within the cultural nuances within the community.

By leveraging evidence-based testimonials, digital solutions can provide a more comprehensive understanding of the challenges and choices confronted by pregnant women (Burleson et al. 2020; Verdezoto et al. 2020; Bagalkot et al. 2022; Gui et al. 2017). These testimonials, rooted in real lived experiences, offer a diverse perspective that considers cultural backgrounds, socioeconomic status, and personal preferences, contributing to a richer representation of the multifaceted nature of pregnancy experiences. Serving as a valuable resource for expectant mothers seeking information and support, evidence-based testimonials inspire confidence, offer practical insights, and foster a sense of community (Leahy-Warren et al. 2011; Koushede et al. 2013). It empowers pregnant women in their decision-making and contributes to a more informed decision.

Furthermore, integrating evidence-based testimonials aligns with the principles of empowerment and self-efficacy, emphasising the need for tailor-made solutions that adapt to the diversity of perspectives within the target population.

5.2.2 Balancing societal norms with medical advice

Achieving a good balance between cultural norms and medical intervention is critical for reducing tensions caused by colonial methods in design that prioritise medical care over traditional forms. Based on our findings, we argue that cultural norms and customs still have value and could contribute to community responsiveness (Dsane-nsor et al. 2019). Hence, we draw attention to the concerning historical prevalence of colonial influences shaping digital maternal health interventions overshadowing indigenous care practices (Winschiers-Theophilus and Bidwell 2013). Recognising the importance of striking this balance is crucial for designers to embrace other approaches to design beyond the persistent colonial approaches that depict digital maternal health interventions as exclusively centred on medical care within the HCI and CSCW domain (Mburu et al. 2018; Molapo et al. 2016; Perrier et al. 2015; Sowon and Chigona 2020; Awotwi 2012; Barron et al. 2018). We note with concern how designs have often imposed external frameworks with

minimal consideration for local norms, resulting in a disconnect and often non-responsiveness.

Designing digital maternal health interventions requires a nuanced approach that harmonises cultural norms with medical advice, making the design more contextually relevant and responsive. Balancing these elements is crucial to improving health outcomes and promoting culturally situated community-centred care. However, designers must be mindful of potential tensions that may arise if one perspective is favoured over the other, as this could lead to cultural resistance or unresponsiveness.

When considering the pregnancy journey as a shared commitment rather than an individual experience, it becomes imperative to counteract persistent colonial approaches embedded in digital design practices. Within this collectivist society, cultural practices are crucial in shaping the health decisions of pregnant women (Ng and Indran 2021; Dako-Gyeke et al. 2013; Sumankuuro et al. 2022; Ganle et al. 2015). Disregarding these norms may lead to tensions and resistance to digital maternal health interventions, while solely prioritising cultural practices may clash with medical guidance, presenting potential risks. Striking a balance ensures a shared community responsibility and checks excesses in both approaches.

5.2.3 Designing for shared responsibility in the prenatal journey

This study highlights pregnant women's emphasis on viewing pregnancy as a shared responsibility, especially with their partners. As technology transforms, their design also warrants continuous reconsideration in terms of the experiential qualities and the social constructions that they produce (Homewood et al. 2019). Using digital tools or media, partners and families can better support pregnant women physically, emotionally, and intentionally (Grönvall and Verdezoto 2013; Svenningsen and Almeida 2020; Ismail et al. 2018). For instance, our study revealed other cost-effective strategies using low-tech broadcast media, such as information centres and vans, to extend maternal health services in rural communities. Integrating broadcast media according to the pregnant women affords an opportunity to directly engage with the community around the pregnant woman. This shared experience highlights synergies between digital tools and media, fostering a supportive care network and enhancing gender-neutral MCH interventions through sociocultural practices (Peyton et al. 2014; Grönvall and Verdezoto 2013; Peyton and Wisniewski 2019).

This builds on recent discourse that delves into the critical aspect of collaborative social support for pregnant women within the context of CSCW and pregnancy app design, highlighting the need to consider social ecologies and partner dynamics for effective support systems (Peyton and Wisniewski 2019). Drawing insights from Homewood et al. (2019), prenatal intervention design can utilise community resources to create opportunities for shared interactions with partners regarding

pregnancy health and clinical care. This approach enhances the prenatal experience as a shared responsibility.

5.3 Study limitations

While the learning from this study is transferable, the findings may not be generalisable. Our work focuses on the particularities of Techiman, Ghana, which may limit the applicability of the findings to other geographical and cultural contexts. We acknowledge sampling bias due to underrepresentation of Northern Region migrants, influenced by language barriers. Researching sensitive pregnancy and healthcare topics also limited the study's scope. Notwithstanding these limitations, our study possesses significant potential for informing the design of interventions to support pregnant women in rural communities. Its in-depth exploration of the complex interplay between cultural beliefs, traditional practices, and modern healthcare approaches offers valuable insights that can be applied to various contexts. By recognising the pivotal role of elderly women and other community assets, designers and healthcare professionals can develop more effective and culturally sensitive interventions that resonate with pregnant women's needs and values.

6 Conclusion

Pregnant women in communities like Techiman, Ghana, and others with similar contexts navigate a landscape where age-old traditions, contemporary healthcare practices, and essential community support structures coexist. This study presents the existing tensions and advocates for a fundamental shift in the approach to designing digital maternal health interventions. Rather than narrowly focusing on facilitating access to scientific care, these digital interventions should embrace the community's deeply rooted values, beliefs, and traditional practices. This approach recognises the influence of these community assets on prenatal care and the decision-making processes of pregnant women. By adopting this holistic perspective, designers have the opportunity to create solutions that are culturally sensitive and effective. These interventions, attuned to the pregnant women's perspectives and the inherent complexities of their care practices, can potentially enhance maternal healthcare in such settings, improving the well-being of pregnant women in low-resource collectivist societies.

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Author Contributions

S.D.N: Conceptualisation, methodology, data collection, analysis, original draft preparation A. G, N. V. D: Review and editing C. F. T: Data analysis Y. J and M.D: Supervision, reviewing, funding acquisition, resources, validation G.K.T: Data collection and conceptualisation.

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Data Availability

No datasets were generated or analysed during the current study.

Materials Availability

Not applicable.

Code Availability

Not applicable.

Declarations

Competing interests

The authors declare no competing interests.

Ethics approval and consent to participate

This study received Institutional Review Board (IRB) approval from three institutions. The first approval came from the research institution of the lead author at the University of Cape Town, specifically the Faculty of Science Research Ethics Committee (Protocol: FSREC 057 - 2021). The second approval was obtained from the health directorate where the field study was conducted, namely the Kintampo Health Research Centre Institutional Ethics Committee (Protocol: KHRCIEC/2021-25). The third approval was granted by the Directorate of Research and Innovation at Koforidua Technical University (Protocol: KTU/DRV21/010), which is the affiliated university of the lead author in Ghana. The study observed strict adherence to ethical guidance and COVID-19 protocols for field studies, confidentiality, and data protection.

Consent for publication

Not applicable.

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