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Extreme heat, pregnancy and women's well-being in Burkina Faso: an ethnographical study

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ABSTRACT

Climate change is an increasing threat to the health of populations in Africa, with a shift in seasonal temperatures towards more extreme heat exposures. In Burkina Faso, like other countries in the Sahel, many women have little protection against exposure to high temperatures, either outside or inside the home or place of work. This paper investigates how women perceive the impacts of heat on their physical and mental health, in addition to their social relationships and economic activities. Qualitative methods (in-depth interviews and focus group discussions) were conducted with women, community representatives and healthcare professionals in two regions in Burkina Faso. A thematic analysis was used to explore the realities of participants' experiences and contextual perspectives in relation to heat. Our research shows extreme temperatures have a multifaceted impact on pregnant women, mothers and newborns. Extreme heat affects women's functionality and well-being. Heat undermines a woman's ability to care for themselves and their child and interferes negatively with breast feeding. Heat negatively affects their ability to work and to maintain harmonious relationships with their partners and families. Cultural practices such as a taboo on taking the baby outside before the 40th day may exacerbate some of the negative consequences of heat. Most women do not recognise heat stress symptoms and lack awareness of heat risks to health. There is a need to develop public health messages to reduce the impacts of heat on health in Burkina Faso. Programmes and policies are needed to strengthen the ability of health professionals to communicate with women about best practices in heat risk management.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Epidemiological studies have shown that high ambient temperatures increase the risk of premature birth, low birth weight and stillbirth.
⇒ Qualitative studies describe how heat increases anxiety, irritability and sleep disruption in adults and children.
⇒ Many populations in the Sahelian region of Africa experience high indoor temperatures due to housing design, lack of access to electricity and lack of shade.

WHAT THIS STUDY ADDS

⇒ Extreme heat affects women's ability to care for themselves and their child, including reducing breast feeding and skin-to-skin care.
⇒ Extreme heat affects women's capacity for domestic and paid work (formal and informal) but there is little support for women even in late pregnancy.
⇒ Extreme heat interferes with personal and intimate relationships with negative impacts on well-being.
⇒ Cultural practices can exacerbate some of the negative consequences of heat.
⇒ Women often lack awareness of heat impacts and risks to maternal health and child health.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Guidance for infant care and breast feeding should be updated for awareness to consider the negative impacts of heat.
⇒ Programmes and policies are needed to build the capacity of health workers to communicate with women on good practices for managing heat risks.
⇒ Consideration of equity in access to cooler homes or health facilities should be part of adaptation planning for climate change.

INTRODUCTION

Climate change is one of the greatest global health threats of the 21st century, with implications both immediate and long term for the most vulnerable populations, particularly in the poorest countries that have the least means of adapting to climate change.[1] Mortality due to anthropogenic global warming is now geographically widespread.[2] Heat mortality is exacerbated by social, economic, geographical and age-related vulnerabilities, creating high-risk groups such as older people, people with disabilities or existing illnesses, outdoor workers and poor urban communities.[3–7]

African countries bear disproportionate consequences of climate change. Countries in the Sahel region will experience an

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estimated increase in temperature of at least 2°C by 2040, along with extreme climate hazards such as severe droughts, floods and heatwaves.[4] Like other countries in the region, Burkina Faso is highly vulnerable to climate change due to its dependence on agriculture and poor access to water and electricity. For example, changes in rainfall affect agricultural yields for over 70% of the population[8] who depend on small-scale subsistence farming.[9 10] An estimated in 2020, only 20% of the population (66% in urban areas, 3% in rural areas) had access to electricity and thereby cooling systems, and less than half of the population had access to safe drinking water.[11] Heat impacts can be exacerbated by a reduced supply of running water, lack of outdoor shade and frequent power cuts. In addition, tin-roofed dwellings and informal and precarious urban housing offer little protection against exposure to extreme heat, and many health centres also experience high indoor temperatures.[12] Pregnant women and newborns are increasingly considered vulnerable populations in the context of climate change.[13] Heat exposures in the first trimester are associated with an increased risk of maternal hypertension.[14 15] Epidemiological studies have documented the impact of heat on certain perinatal complications and on rates of premature birth, low birth weight and stillbirth.[9] For example, a link between high temperatures and low birth weight has been demonstrated in Uganda. Indeed, increases in average daily temperature during the third trimester were also associated with birth weight, with an increase of 41.8 g (95% CI 0.6 to 82.9 g) per additional degree Celsius.[16] High temperatures have been found to increase the risk of preterm birth and stillbirth in South Africa.[9] High ambient temperatures have also been associated with prolonged labour and an increase in the number of emergency caesarean sections.[17 18] In a US study, the risk of cardiovascular events during childbirth increased by 11% for every 1°C rise in temperature.[19] Heat also has a significant impact on mental well-being. Qualitative studies describe how heat increases anxiety, irritability and sleep disruption.

Reducing maternal mortality and improving climate change resilience feature highly in the Sustainable Development Goals agenda.[20] Maternal deaths are only the 'tip of the iceberg' of the total burden of ill health associated with maternal morbidity.[21] Many women suffer morbidity and disability during pregnancy and childbirth, which has a considerable impact on their health and well-being later in life and that of their children.[22] A woman's well-being[13] can be defined as her quality of life in relation to health; in other words, it is the state of health felt or perceived in correspondence with the woman's expectations.[23]

Well-being, in this context, can be defined as the quality of life in relation to health; in other words, the state of health felt or perceived in correspondence with the woman's expectations.

Functioning status[13] is the opposite of disability. It describes an individual's ability to perform a task or activity in the social, economic and physical environment in which they live. This results from a dynamic interaction between health conditions and contextual factors such as housing characteristics and air conditioning, integrating the different dimensions of health (individual, biological and social).[24 25] The functioning status of pregnant and postpartum women can be defined as their ability to care for themselves and their newborns, and to carry out household, social, community and professional activities.[12 26]

There is an emerging evidence of how high temperatures interfere with formal and informal work and also domestic duties.[27] Research in other parts of Africa has shown that many women have little protection against exposure to high temperatures, both for outdoor and indoor work. Women remain physically active due to their responsibilities until late in the pregnancy. The division of labour within a household often obliges the pregnant woman to continue to bear heavy loads of domestic or income-generating work even in periods of high heat.[27–29]

Little has been documented about the negative effects of heat on the health, well-being and functioning status of pregnant women and mothers after childbirth in the Sahel, hence the relevance of this research. This article reports on research that sought to understand how women perceive the impacts of heat on their physical and mental health, and how heat affects their daily activities, including their ability to breastfeed and provide infant care, as well as their ability to work and interact with others.

METHODS

Study site

The study was carried out in two health districts in Burkina Faso: Bogodogo in the central region and Kaya in the central-northern region. In both districts, maximum temperatures can reach 40°C for several days. The long heat season lasts around 3.5 months, from early March to mid-June.[30 31] This period of extreme heat often coincides with little or no rainfall and precedes the rainy season, which lasts from July to September, with temperatures averaging 25°C–33°C (source: https://weatherspark.com/). Water resources decrease during this period, reducing access to safe household water in both urban and rural areas. High temperatures also occur in October, the short hot season, at times reaching 38°C. Data for this study were collected in October 2020.

Two criteria guided the selection of the two sites: contrast between urban and rural experiences and could easily be accessed. First, we selected one rural and one urban healthcare facility. Data collection took place at the primary healthcare centre, Centre de Santé et Promotion sociale (CSPS) de Wemtenga, in the primarily urban Bogodogo health district and at the CSPS de Delga in the more rural Kaya health district. Second, both sites are familiar to the institution leading the fieldwork (Institute de Recherche en Siences de la Santé; IRSS), which is

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Table 1 Summary of respondents who took part in the study

No of interviews per site	IDIs			FGDs				KIIs
	Pregnant women	Postpartum women	Total	Women of reproductive age	Mothers-in-law	Male Spouses	Total	Total
Bogodogo/Wemtenga	10	10	**20**	2	2	2	**6**	**9**
Kaya/Delga	10	10	**20**	2	2	2	**6**	**10**
Total	**20**	**20**	**40**	**4**	**4**	**4**	**12**	**19**

FGD, focus group discussion; IDI, in-depth individual; KIIs, key informant interviews.

located in the same district as the Wemtenga CSPS. The village of Delga falls within the catchment area for demographic observations carried out by IRSS.

Women accessing these health facilities generally have low to medium household incomes. In addition to housework, most women in urban areas engage in income-generating activities in the informal sector (eg, selling vegetables or braiding hair) while rural women are involved in agricultural work. In both urban and rural areas, women tend to work until the end of their pregnancy. After giving birth, there is a short period of time, varying from 7 to 40 days, during which they work less[32]

Study design

The study used a qualitative narrative approach involving women, healthcare professionals and community members. In-depth individual interviews (IDIs) were carried out with 40 women who had recently given birth, as well as 19 key informants (health personnel and community leaders) In addition, 12 focus group discussions (FGDs) (with 6–8 people per group) were conducted with women of reproductive age, mothers-in-law and male spouses. Table 1 provides a summary of respondents who took part in the study.

In-depth interviews

Respondents for individual IDIs were selected to include both pregnant and postpartum women. Women were consecutively recruited from the postpartum consultation services and immunisation clinics of the two study centres, approved by the site manager, until a target sample size of 40 was reached (n=10 pregnant women, n=10 postpartum women, per site). IDI participants were divided into two categories, based on the timing of childbirth: (1) women who had given birth in June or August 2020 and (2) women who had given birth between March and May 2020. The first category had been pregnant during the hot period, so the focus of these interviews was on the experience of pregnancy and heat. The second category was interviewed about their postpartum experience and early infant care in the hot period. Two separate IDI topic guides of interviews were developed, one for each group. Interviews focused on their perceptions of adverse risk, the influence of extreme heat on daily activities, mobility and well-being, and access to resources such as water and food.

Focus group discussions

Snowball sampling was used to recruit participants for the FGDs, with IDI participants suggesting people in their households to invite for the group discussions. These included other women of childbearing age (co-wives or neighbours), older women (mothers-in-law or aunts, elderly relatives) and male partners of women who had recently been pregnant or given birth. The FGD guide explored the following themes: knowledge and beliefs about how heat affects pregnant and postpartum women, the developing fetus and the newborn; local norms regarding strategies and practices for managing heat stress during pregnancy, the postpartum and newborn period; the role of men and other family members in supporting pregnant and postpartum women and their newborns, and in insulating the home against heat.

Key informant interviews

Key informants were purposively identified in each research site for interviews. These included the head nurse of the dispensary, the midwife and the health workers working in maternal and child health. In addition, community representatives were identified through the advice of health workers and community health workers. Interview guides developed for the key informant interviews (KIIs) addressed perceptions of the impact of heat on pregnancy, childbirth and newborns; and how health facilities are affected by high indoor temperatures, particularly with respect to health service delivery and quality of care. Table 2 shows the eligibility criteria for each participant category.

Data collection

All interviews and FGDs were conducted in a private room within the healthcare facility, under a tree or in a shed outside the healthcare facility, or at the participants' homes. Each participant was reimbursed for travel expenses. The interviews were conducted by four social science research assistants, trained in the use of qualitative interviewing and FGD facilitation. The IDI, FGD and KII topic guides were open and flexible to encourage a fluid dialogue with participants and allow for the emergence of unexpected themes. Questions in the guides were tested on pregnant and breastfeeding women during a 1-day pretest of the tools that formed part of the training of research assistants. Thereafter,

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Table 2 Eligibility criteria

Collection method	Respondent category	Eligibility criteria
In-depth individual interviews (IDIs)	Pregnant women (category 1)	► Have given birth in June or August 2020. ► Primiparous or multiparous. ► Eligible regardless of place of delivery (home or CSPS). ► Not participating in the FGDs.
	Postpartum women (category 2)	► Have given birth between March and May 2020. ► Either primiparous or multiparous. ► Eligible regardless of place of delivery (home or CSPS). ► Not participating in the FGDs.
Focus group discussions (FGDs)	Women of reproductive age	► Younger than 40 on their last birthday. ► Have had at least one pregnancy in their lives. ► Eligibility does not require the birth of a live child. ► Not participating in the IDIs.
	Mothers-in-law	► Older women fulfilling the role of mothers-in-law or aunts in households where a woman has recently (within the last 2 years) given birth. ► Currently living in the same household as a woman who has recently (within the last 2 years) given birth.
	Male spouses	► Male. ► Being a spouse of a woman who has recently been pregnant (within the last 2 years).
Individual interviews with key informants	Health workers	► Working as a nurse, midwife or doctor. ► Working only in the two research CSPSs (Wemtenga and Delga). ► Not participating in the IDIs or FGDs.
	Community health worker	► Working community health worker.
	Community representatives	► Former traditional birth attendants/village masters, religious and community leaders, youth and women leaders. ► Not participating in the IDIs or FGDs.

CSPS, Centre de Santé et Promotion sociale.

they were revised to avoid terms that were confusing for participants. Individual interviews and discussions were conducted in the language chosen by the participants (French and/or Mooré) and were audiorecorded with the respondents' consent.

We carried out a total of 59 individual interviews (IDIs and KIIs) and 12 FGDs involving 91 participants. Pregnant and postpartum participants in the IDIs ranged in age from 20 to 40 years. Twelve out of these 40 participants were farmers, and 18/40 were engaged in informal sector activities. All 32 women of reproductive age who took part in the FGDs were living with a partner and ranged in age from 21 to 39 years. In addition, 16 were farmers, 13 worked in the informal sector, such as dressmaking, and selling vegetables and other merchandise, and 3 had salaried jobs (primary school teacher or preschool educator, pharmacy auxiliary). Thirty-two older women took part in the group discussions, ranging in age from 42 to 80 years. The male spouses ranged in age from 25 to 64; half were farmers and half worked in jobs such as welder, driver, bricklayer, janitor or butcher.

Data analysis

The interviews transcribed in French were reviewed together with the audiorecordings to check transcription accuracy and to ensure that certain expressions in the local language had been correctly translated. Our data analysis approach was guided by inductive thematic analysis without a pre-established analytical framework,[33 34] drawing on the approach described by Braun and Clarke.[35] In concrete terms, we followed four steps: (1) data familiarisation and systematic data coding and codebook development, (2) non-rigid coding guided by the codebook, (3) codebook refinement and main theme development and (4) report writing with careful reading of the interview transcripts was first used to develop an open, non-rigid coding grid. Two analysts (KK and MC) developed a codebook following inductive open coding of a small sample of transcripts using NVivo V.11 software.

After review and discussion of these initial nodes, the codebook was consolidated and adjusted where necessary, and the remainder of the data set was coded by one member of the team (MC). The third step consisted of codebook refinement and main theme development. This stage involved redefining and refining the initial themes and subthemes based on our analysis, that is, identifying the essence of each theme and subtheme. This involved a careful reading of the data underlying each NVivo node, followed by a merging of redundant

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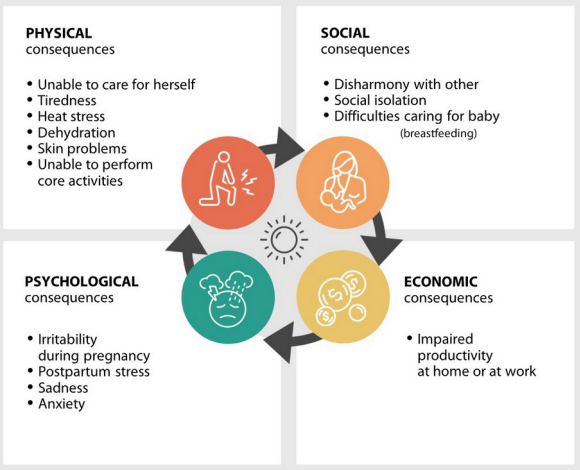

Figure 1 Consequences of extreme heat on the well-being and functioning status of pregnant and postpartum women. Adapted from Filippi *et al*.[23]

nodes and a grouping of related nodes into broader categories. KK reviewed the coded speech extracts for each theme and subtheme through a careful reading of the nodes and subnodes.

The refinement allowed us to restructure the codebook, clearly define the themes and subthemes, and then to describe the content of each theme, subtheme and the relationship between them, and to produce a coherent narrative. The text of the manuscript was developed by identifying key themes emerging from these categories and establishing links between them. In this article, we present only the results relating to pregnant and postpartum women's perceptions of how heat affects them.

Based on the results of this analysis and drawing inspiration from the recent WHO conceptual framework for maternal morbidity,[23] we have organised the results according to four types of consequences (physical, social, psychological and economic) for the well-being and functioning status of pregnant and postpartum women (figure 1).

RESULTS

The results suggest that high ambient temperatures affect women's well-being and functionality, particularly the ability to care for themselves and their children, the ability to work and to have good relationships with their partners and family. We present the physical, psychological, social and economic consequences of heat on women's well-being and functionality.

Physical consequences of heat on well-being

Several physical consequences of heat were mentioned: fatigue, and physical discomfort, dehydration, skin problems, inability to perform basic daily physical activities, and an inability to take care of oneself.

Fatigue and physical discomfort

High temperatures are associated with a range of symptoms and discomfort, with reported impacts by pregnant women including a lack of sleep, exhaustion, heavy sweating, excessive thirst and the sensation of the body heating up.

Women who have been pregnant described their experiences of the changes that happen when it is hot compared with when it is cooler, including feelings of discomfort, fatigue, and body warming.

> If you're pregnant during very hot weather, it changes behavior a lot. You can't do anything anymore. Going to the neighbour's [female neighbour] is a real problem. You just want to stay in the shade. Because it's all to do with the heat, which makes your body tired. You feel like your body isn't healthy. It's like someone with a fever. Your body heats up as if you were sick. Your body is hot. Can't you see it? Touch my body. It's like that. (IDI 008 Del, Pregnant woman)

Extreme heat at night was linked to insomnia and sleep disturbances:

> During the day, you move from shadow to shadow to sit until evening. At night you can't sleep either. It's only turning in the courtyard there. If you start to go to bed, the heat will make you get up. You'll spin in the house and out till dawn. It's all due to the harmful effects of heat [the discomfort of heat that prevents sleep]. People are in their houses and you're going around in circles outside. If you come in at night, you're not going to sleep. Sometimes you'll pull all-nighter. [staying awake through the night] It's only in the early hours of the morning that the air becomes favorable. Hai, there's no sleep there. (FDG012Del, Woman of reproductive age)

Respondents and some spouses maintain that the heat makes women tired, as they cannot sleep well.

> Hot weather affects the pregnant woman to the extent that in her condition, she already feels tired. So, she needs time to rest properly. But when you're in the heat, it's difficult. She can't rest. The heat makes her tired. She can't sleep. As your body is hot right now, it plays on the baby [foetus] too. And that makes it [foetus] turn inside too and you can't sleep. During the day, you go from shadow to shadow to sit up until the evening. At night you can't sleep either. It's only turning in the courtyard there. (FG004Wem, spouse)

Part of the discomfort for pregnant women who interfered with sleep came from excessive perspiration in bed.

> When you're pregnant, it's hot everywhere, your whole body is hot and you're sweating, so it's not easy. The heat makes you tired and you can't go to bed. If you only go to bed, and the perspiration wets your body, you have to get up to get some more water. (IDI017Wem, Pregnant woman)

Women also reported discomfort from the fetus's reactions to heat stress, which is sometimes manifested internally by a change in fetal movements that causes concern for the mother. During periods of heat, women have noted either an increase in fetal movements, or an increase in calmness as a way for the fetus to express what it is feeling. Increased movement is often unpleasant for

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the mother, but this is because the fetus is also suffering from the heat.

> It hurts him [the foetus] so much that he only turns around. He, too, only kicks. Some babies kick so hard that you think your lower abdomen is going to burst (laughs), but right now it's heating up too. (FG005Wem, Mother-in-law)

Postpartum women were described by participants as being affected by extreme heat; they experienced fatigue and could not rest, especially since the newborn also suffers from heat stress, crying and being unable to sleep.

> If you give birth in the heat, the child there just cries. You and the child just suffer. I say that women who have just given birth there, the heat continues to make them suffer. …You've given birth, but you can't rest. The heat is still hurting you and your child. You can't rest, you're tired. The baby doesn't sleep, and the mother is also very hot. (KII-024Wem, Community leader)

It also emerged from the interviews that heat was perceived to influence women's blood pressure. One postpartum woman described her experience of the delivery period. She believed that the heat had contributed to her high blood pressure and do make the delivery easy.

> For example, when it's hot like this and a woman is pregnant and she suffers from [high] blood pressure, because some women have [high] blood pressure, with extreme heat like this on her it becomes another illness that's added. So, all this is difficult. I came here to give birth. With the heat, I was suffering like that, and my blood pressure had gone up. I tried in vain to give birth and was transferred to the hospital. In any case, there are air conditioners there. When I got there, my blood pressure had risen and they said I couldn't give birth by myself, that I needed a caesarean section. (FG002Wem, woman reproductive age).

In short, heat stress during pregnancy was felt by women in the form of physical discomfort, insomnia, heavy sweating and the sensation of the body overheating, all of which negatively affected their well-being.

Dehydration

Participants mentioned dehydration and thirst as a consequence of extreme heat. Some also believed that sweating in the heat increases dehydration.

> Heat tires pregnant women a lot, because dehydration…, you just sweat, as sweat just runs, no matter how much water you consume, you drink and it's like you don't drink, ha! The sweat runs and you're dehydrated, your mouth is dry. (DG005Del, Mother-in-law)

This perception was supported by a health professional.

> They have dry throats and sweat, so we have to replenish the fluid they've lost, so we give them plenty to drink before and after delivery. (KII019Wem, Male)

It is important for women to be well hydrated during childbirth and for breast feeding. Yet some respondents mentioned not being able to hydrate properly because of the belief that pregnant women, parturient and postpartum women should avoid cold water and only drink warm water even in hot weather.

> I used to suck ice and then drink fresh water, but from eight months onwards I was told to stop as it's not good for the pregnancy, it can make the child bigger, and it could make me ill. Also, it [drinking fresh water] delays childbirth and when the child is large, you can have an operation [caesarean section]. (IDI013Wem, Pregnant woman)

Another woman added:

> …there's an old woman [mother-in-law] who came to assist me, so during the heat there, I like to drink fresh water, so she told me not to drink. [She said] that it makes the child [the foetus] bigger and also it prevents the child [the foetus] from coming quickly [delays childbirth]. (IDI-022Wem, Postpartum woman)

Women were also advised to '*…drink hot water morning, noon, and night* [regularly]', something that they found to be '*not easy in the heat*'. (IDI014Wem, Postpartum woman)

These quotes suggest that these women, who are already uncomfortable in the heat, may find it hard to keep properly hydrated if they are encouraged to drink only hot liquids.

Skin problems: boils and itching

Participants noted that certain skin infections generally occur at the time of extreme heat, and that pregnant and postpartum women suffer a lot in the heat because of the rash that appear on their bodies. These were 'hot spots' reported to appear on the arms, shoulders and under the breasts. As one respondent put it:

> If you give birth in very hot weather, it's really hard work! Because you can't wash yourself, the child cries too, and if you lift your breasts, you'll find that they're just hot spots down there, and it's yangass [a lot] like that. (FG006Wem, Woman of reproductive age)

These 'bourbouilles' (spots) were said to be uncomfortable as they caused itching. One pregnant woman explained,

> Your body stays full of bourbouilles [rash, spots], it itches, you just pour water on yourself, and it doesn't end. It's all due to the heat. In the armpits, even the front [genital area] is very itchy too. (IDI009Wem, Pregnant woman)

> Your body itches all the time, you shower and it's like you've done nothing, your skin comes off, because you're scratching your body. Often it can attack your sex [genitals] and it itches badly. If you get pregnant during the heat, you're going to scratch a lot. You scratch. The itching makes you tired. It scratches your body and when it's very hot it hurts your body. (FG006Del, Woman of reproductive age)

Others shared their experiences as postpartum women in hot weather, witnessing the effects of heat on their babies' skin.

> During the month of April, I suffered a lot. The swellings, pustules on my body and on the baby's too, it wasn't easy. When I was holding the baby, I don't know if it was because of the heat, but my body was also forming spots. I don't

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know if it's related to the heat of the baby's body, I don't know what it is. Even on my body, little spots were forming, just like on the baby. So, everything was hot. (IDI031Wem, Postpartum woman)

The child suffers from the heat as well as the mother. His [baby's] whole body gets covered with spots like this and you [the mother] can't hold him. Your whole body is covered in rash, and you can't sit down. Right then, you can't put a baby on his back! You can't put the baby on your back. You just hold him with your hands to comfort him. Yes. You put him on your shoulder. Otherwise, you can't carry him on your back. You must hold him like this with your hand to turn him. If you lie him down too, it's just crying. He doesn't know what to do. It's just suffering. Even to breastfeed him/her, it is difficult. (IDI 029Del, Postpartum woman)

Furthermore, health workers were described as not knowledgeable about heat-related problems and often fail to respond to women's needs. One respondent explained that her heat-related skin problem was perceived as chickenpox by the health professional:

When I was pregnant there, at first it wasn't hot, it wasn't extremely hot. But when I was halfway through, at 8 months, it was extremely hot and my whole body was full of spots and my face had big spots. But I went for consultations at the dispensary, and they said it's "tiissé" [chickenpox], but only one person said it's because of the heat, but that if the heat only goes away, it'll go away. Your whole body is covered in spots like that until the heat ends. It itches, you just pour water on your body, and it doesn't end. It's all due to the heat. (FG002Wem, woman of reproductive age)

In short, skin problems were reported to be a source of discomfort for both the pregnant woman and the postpartum mother. Skin problems appeared to also have a negative impact on a woman's ability to care for her baby—for example, making it difficult to hold the baby in her arms—and even on her desire to breastfeed regularly. The experience of respondents in our study was that health professionals sometimes have no answers to the questions asked by women facing the consequences of extreme heat.

Physical ability to perform basic daily activities

All the women we interviewed are engaged in domestic activities including childcare and household chores (washing dishes and laundry, fetching water, cooking, sweeping the yard, fetching firewood) on a daily basis that require them to be physically active. The women explained that in the heat during pregnancy, they avoid work that requires considerable physical effort, especially in the sunshine, because they feel physically unable to do so. This considerably reduces their productivity in all domestic activities.

When I was pregnant, when it was hot, I couldn't work like when it wasn't hot. If you start working, you get tired at the slightest effort, so you must give up and go and rest. If you say you're going to work, you get tired very quickly, so you must let go and take a rest. It's the heat that causes all these problems. (FG006Wem, Woman of reproductive age).

Women based in the rural health district of Kaya spoke about the difficulty of fetching firewood.

If your co-wife doesn't help you with half your work, such as fetching water and cooking, it gets complicated. Because when you're pregnant and you're eight months' pregnant in April, it's not easy. It's extremely hot right now, so if you don't have someone to help you with the cooking, it's complicated. It's so hot right now that getting wood for cooking isn't easy. (IDI001Del, Pregnant woman)

If I got up and couldn't work, I'd call my co-wives' children so they [the girls] could help me. Often, I could not stand up because the foetus was moving all the way to the heart, and that hurt. So, I'd ask them to come and help me work. To wash, to clean the yard and the house, to wash the clothes, and sometimes I'd tell them to cook for me. Otherwise, I couldn't work. (IDI003Del, Pregnant woman)

In short, women described how hot weather affects their ability to carry out daily household tasks. Some of them regularly called on the help of family and friends, including co-wives and neighbours, but those without help would be obliged to carry out these tasks themselves, exposing themselves to the risk of serious health problems.

Psychological consequences

Participants reported an increase in irritability, sadness, anger, stress and anxiety for pregnant and postpartum women in the heat, all of whicht affects overall maternal well-being.

Sadness

Pregnant and postpartum women reported that heat affects their mood, making them sad: '*Often I'm a bit sad, I'm not happy. My face is tight, and I don't feel like chatting with anyone*'. (IDI009Wem, pregnant woman.).

Another respondent explained:

The heat can change the mood of a person who used to like to laugh and chat. But as she's very hot and pregnant, she doesn't want to chat anymore because there's something that's hurting her, she's not in the best of shape, so that means she doesn't want to chat. (IDI012Wem, Postpartum woman)

A postpartum woman shared her experience of how the effects of heat on her child in turn affect her emotions as a mother.

Can't you see on his neck? Do you see [bourbouilles /rash on the infant's neck]? It's the heat that does it. If the sun comes out, it causes an itching rash, and he starts to cry. When the sun comes out, it feels like ants are biting him. But it's the heat that's making him have an itch. So, heat makes me, and my children suffer. The babies here are like that, if it's very hot, they start crying, because it's so hot, and that saddens me. (IDI015Del, Postpartum woman)

Anxiety

Anxiety from heat was more often mentioned in relation to the postpartum period. The baby who cries because of

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the heat is often seen by other people in the household or community as the one who cries for no reason. This is a source of worry and anxiety for the mother. According to one mother, '*A child who doesn't speak! It's complicated. When the baby cries, I can't figure out what he has and what he wants, and that worries me*' (IDI018Wem, Postpartum woman).

Postpartum women also felt that babies who could not suckle well at the breast were a source of anxiety for mothers, especially when they had to stay inside the house, where the heat is more intense. In the research site, cultural practices for postpartum care of women in some communities recommend that the mother and newborn remain inside the home for a period ranging from 7 to 40 days. Often women saw staying indoors in hot weather as difficult, both for herself and for the baby.

> You can't sleep outside with the child, you have to stay inside the house, because the child mustn't go outside. So, it's an obligation for you to stay inside. Sometimes the child cries incessantly, it's very hot, you can't sleep, the child cries and you can't take him outside either. You often wonder if he's coming down with something because he cries so much. (IDI003Del, Postpartum woman)

Sometimes the mother can no longer feed herself properly because of the anxiety caused by the baby's crying. Also, the fact that the child cannot feed properly affect his/her growth and make him/her look sick, affecting the mother and making her anxious.

> The child cries so much that you yourself [the mother] can't eat. You must fan him to calm him down. You can't sit down. You take him to go back and forth, you're just going in circles… In any case, the heat is very tiring for the baby, and it's tiring for the mother too. The child cries and you, the mother, don't have time to sit down either. What's more, he can't even suckle. As soon as he latches on, he stops because the heat makes him tired. He can't suckle properly, so he doesn't get into shape. He can't suckle properly! Mom's not happy either, she's worried. It's not going well. (FG001Wem, Mother-in-law)

Irritability during pregnancy

Most participants mentioned irritability caused by extreme heat, which often made women less than courteous in their language.

> Often when I'm hot like this, you come, you talk to me, I throw up on you [I am rude to you] at the same time. I talk to you badly because I'm hot, it's the pain of heat. (IDI009Wem, Pregnant woman)

> If you're pregnant like that in very hot weather, if the slightest thing happens, with the heat you get angry very quickly. With heat like that, with pregnancy making you tired too, you get angry very quickly. Something that's not worth it, you take it as a problem until it tires you out again. (FG006Wem, Woman of reproductive age)

According to a healthcare professional in the urban facility,

> Women are getting more and more irritable, and that's due to the heat, especially if it's a pregnant woman, she gets angry quickly and at any moment. (KII019Wem, Healthcare professional)

This view was also expressed by older women:

> If you're pregnant, even when it's the kids in the yard making noise, it's as if the heat is rising… Even extreme heat can cause someone to get irritable very quickly. As the woman can't stand the heat, the slightest thing makes her angry and it becomes a fight. She even chases the children out of the house, asking them to be quiet, because the noise of the children's fun and games is unbearable. And it's all because of the heat, and it's irritating. (FG002 Wem, Mother-in-law)

Social impact

Our findings revealed that extreme heat has a social impact on pregnant and postpartum women, through affecting their interpersonal relations with others, resulting in isolation during pregnancy, disharmony with family and friends, and difficulty caring for the newborn.

Disharmony with others

The psychological consequences of extreme heat on women affect their social relationships, particularly the quality of their rapport and interactions with those around them. Women reported frequent arguments with others family members (spouse, mother-in-law, children and co-wife).

> Pregnant women, when it is hot like that, [they] don't want anyone talking to them. If someone talks to her… it looks like you've done something to her like that. That makes her angry. She gets angry fast. One little word and it's a fight. She doesn't get along with anyone. It's all linked to the heat and the pregnancy. (IDI031Wem, Pregnant woman)

Relationships in the home often become strained, affecting couples' intimacy. A mothers-in-law explained her experience.

> She doesn't want anyone to speak to her… She doesn't even want anyone to talk to her, no, because the heat makes her very tired and tires the one inside too [the fetus]. All this means that she doesn't even talk to herself anymore, and she doesn't want anyone to talk to her, you know. (FG005Wem, Mother-in-law)

> With pregnant women, there are only upsets. It's her husband and her who have become adversaries (laughs). It's hot like that and she doesn't even want to be spoken to or touched. And to tell the truth, she's right too. With the heat she can't sleep, she can't lie down, she can't eat the way she wants to, ah! So, you just must be careful with her. And then you only comfort her in the meantime. Even with us mothers-in-law, it often turns into arguments. (FG-022Del, Mother-in-law).

As far as sexual intimacy is concerned, urban women from Wemtenga explained:

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If it's very hot, the husband must look for himself! [no more intimacy, satisfy himself sexually] (group laughter). Because you yourself can't breathe normally [in the heat]; and at this level [implying the sexual act], you can faint (group laughter). As for me anyway, during the heat when I was pregnant with this child, my husband even avoided talking to me (group laughter). If he spoke to me, I'd get angry at the slightest gesture and we'd argue, because I spoke badly to him. He'd often say: Ha! I know what you've got, I should pray to God that you'll give birth in good health only. I'm going to leave and when your anger passes, I'll come back (group laughter). (FG006Wem, Woman of reproductive age)

As for me, during the heat if my husband even opens his mouth to say ho! I'm only looking for something, even if it's with a piece of wood I want to hit him (group laughter). I see that he's the one who put me in this situation, and you still come and talk to me, the heat makes me tired and my whole body hot, and you still come and talk to me [about sex/intimacy]. If I obtain wood to beat you, you'll know yourself that I'm hot (group laughter). (FG006, woman reproductive age 2).

A healthcare professional shared his views on the impact of heat on a pregnant woman's relationship with her partner.

When it comes to housework, she's already pregnant, and having sex isn't easy! And when it's hot, she doesn't want to go near her husband. And that affects the couple's relationship a lot, because some husbands can't stay without having sex, but if it's hot and the wife doesn't want anyone to get close to her, it's difficult. When the weather's pleasant, intercourse becomes a pleasure, but when it's hot, women don't like intercourse, and the pregnant woman on top of that, it's not easy. She does her best to satisfy her husband so that he doesn't go elsewhere, but when it's still hot it's difficult. It affects the couple, and the husband isn't happy, when he asks, and he doesn't obtain and that's a problem. So, it comes into play. It's just little fights and arguments. (KII033Wem, healthcare professional).

Our participants noted that heat causes pregnant women to be isolated, thereby negatively affecting the formation and maintenance of social relationships. As the heat makes them want to be alone in an airy environment in order to cool down, this makes it harder to live in symbiosis with the rest of the community (spouse, co-wives, neighbours and even her children).

When it's very hot for a pregnant woman in any case (…) very often they have no relationship with the neighbours, she goes off to find a corner to stay alone so as not to be disturbed by other people. Because it's so hot there, she doesn't even want anyone to come near her. So, she becomes distant with people. (KII026Del, Healthcare professional).

Ah… as it's very hot it plays on the relationship with people. It affects a pregnant woman because she often doesn't like to sit and talk to people anymore. If she's sitting down and it's very hot in the meantime, she'll get up to take care of herself. As a result, her relationships and conversations with others can't go well. When it's hot, I don't go near people anymore (laughs), if a child comes near, it's just a fight (laughs), it's, 'you must get away from me, because I'm very hot!' (IDI016Del, Pregnant woman)

Difficulties in caring for the baby

The discomfort experienced by postpartum women in extremely hot weather often leads to women physically distancing their body from the body of their newborn. They feel physically uncomfortable when the baby is placed on the mother's skin when she's already hot and sweating. In fact, holding the baby and engaging in skin-to-skin care were said to increase sweating and heat-related discomfort, making the mother reluctant to do this.

A spouse in a focus group spoke out about the impact of warmth in relation to skin-to-skin contact between baby and mother.

During the heat, the contact of the baby and his mother, their contact is much less, she doesn't even want to take the baby. Because she can't, there's the heat and the weather is very hot, she herself is hot, she can't take the baby, it's only making him lie down. (FG003Wem, Spouse)

Along the same lines, a healthcare professional also shared his experience as a practitioner who has regularly assisted postpartum women in very hot periods. Regarding skin-to skin care, another healthcare professional claimed:

It's very hot, and even the mothers don't want to be too close to the children. They want to be comfortable so they can get some fresh air. And even those of us who work in the health centers (midwives or birth attendants), when we put the baby skin-to-skin with the mother, as soon as we move, you'll come back to find that she's detached the child and put him to bed. So, they don't take it well. (KII-035Wem, Health professional)

Community members also explained how difficult it is for women who have just given birth to care for their infants in the heat. There was some suggestion that this could impact negatively on mother-baby bonding.

First of all, a baby needs to feel better, to have a pleasant environment, and the environment is disturbed by the heat, and when the baby is tired because it's hot and everyone's upset, he needs love to make it work. If there's no affection in the end, it's hard! For a baby to feel secure, he needs his mother to hold him. And a mother who feels uncomfortable because of this same warmth is often even afraid to touch the baby and to feed him. The heat also makes her tense. (KII23Del, Community leader)

Sometimes, we sense that the mother is not happy or enthusiastic about picking up and holding the child. We get the impression that she's not happy and does it reluctantly, because she has no choice. She may pick up the child who is uncomfortable and starts crying, and if he starts crying, the mother too… well… it's pitiful. Because of the heat, the child can lose weight because his mother avoids him, and it's not easy to hold him. All this contributes to tiring the child, because it's a time when the child wants himself and his mother to be accomplices. But if the mother steps

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aside and says, 'it's hot, there's heat', it's as if she doesn't like the beautiful creature she's just created. (KII028Wem, Community leader)

Economic impact

In the study sites, most women are involved in farming, petty trading, and income-generating activities. Most of these activities are carried out outdoors, with variable access to shade. In hot weather, women avoid work that requires physical effort, especially in the sun, which considerably reduces their productivity in all activities. This pattern was confirmed to be true for pregnant women as well, as they must often reduce or even abandon their activities in the heat. This considerably reduces their productivity and income.

I had stopped working two months before giving birth, because when I stopped to work, it was because I felt sick because of the heat. (IDI032Wem, Postpartum woman)

When I was pregnant in the heat, work can't be the same as when it wasn't hot. If I start working, the slightest effort makes me tired, so I must leave it and go and rest. If I say I'm going to work, I get tired very quickly, so I must leave it. It's the heat that causes all these problems. (FG002Wem, Woman of reproductive age)

If you had a job to do to earn an income, you can't do it anymore, because the heat makes you suffer …the jobs I used to do before pregnancy like drawing water from the wells for market gardening, harvesting vegetables. With the state of pregnancy and especially the sun and the heat, when I go there, I just give up as soon as I've started. IDI002Del, Pregnant woman)

DISCUSSION

Our results demonstrate that extreme heat affects the well-being and functioning of pregnant and postpartum women for all the domains considered: physical, psychological, social and economic.

On a physical level, women mentioned thirst and dehydration, skin problems such as itching and 'bourbouilles' or heat rash, profuse sweating and a feeling of high body temperature, fatigue and insufficient sleep. Some of the physical consequences may seem relatively harmless in a country where maternal and neonatal mortality are high. But lack of hydration can affect health, as well as the duration of labour[36–38] and breast feeding is very important for child survival.[14] Also, dehydration is harmful and may cause kidney damage if its excessive.[39] Pregnant women in our study reported difficulty sleeping at high temperatures. Poor-quality sleep has been found to be associated with an increased risk of depression in pregnant women.[40 41] However, our data suggest that some symptoms of thermal stress (such as nausea, headaches and fainting) are either not experienced by women in this setting or, more likely, not interpreted as being related to heat, as they were not specifically mentioned.[42] Some of these symptoms are associated with other pregnancy-related complications such as pre-eclampsia and eclampsia or, in the case of nausea, are even interpreted by women as sign of a new pregnancy.[43 44] This may explain why women do not perceive them as signs associated with exposure to high temperatures. In addition, health personnel does not seem to have many answers to offer, illustrating potential gaps in their knowledge of the issue. More broadly, the initial training of health professionals rarely includes the subject of heat, especially in Africa.[45 46] On this basis, we have designed an intervention to integrate heat messages into routine maternal and child health activities in Burkina Faso.[47]

A key finding in our study was that local beliefs about hydration and harm during pregnancy mean that women are advised to not drink cold water as this is considered potentially harmful, leading to prolonged labour and large babies. In Kenya's coastal and north-eastern region, it is believed that drinking water during pregnancy suppresses the activity of babies in the womb, leading to stillbirth. Also, nursing mothers are discouraged from drinking cold water in some communities, as some local beliefs suggest that it freezes breast milk.[48]

The participants' comments were particularly rich in relation to the psychological and social consequences of heat on their daily lives. Heat was found to affect women's mental well-being, manifesting in symptoms of heat stress such as irritability (quick to anger) and anxiety. Our results also show that the effect of heat on physical and mental well-being interferes with breast feeding and infant care, personal relationships and economic activity. Several studies have shown that heatwaves can pose a significant risk to people's psychological health and well-being,[49 50] and that ambient temperature can be associated with emotional well-being.[51] One study showed that cumulative, acute exposure to extremely high temperatures induced maternal emotional and psychological stress.[52] This association was found to differ according to women's exposure to short or long sunshine duration, the existence of pregnancy complications and socioeconomic level.[52] Women's increased irritability also affected relationships with spouses by increasing the incidence of conflict. According to the urban participants, in our study, sexual relations during pregnancy are often experienced as deeply uncomfortable for women in hot weather. A study carried out in Ouagadougou found that male partners-initiated intercourse the most, while women in most cases agreed to sex to satisfy or retain their partner.[53] Since women's consent for sexual relations is often assumed and not commonly sought in this setting, pregnant women who do not wish to have sex with their partners may claim discomfort from the heat in order to be 'left in peace', as our participants put it. Under normal 'temperature' and circumstances consent for intercourse is not always sought by the husband. In this way, the hot weather may paradoxically protect pregnant women in these situations.

The results also show that women have difficulty caring for their newborns, particularly when it comes to practising skin-to-skin care in extreme heat. Newborns are

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vulnerable to both heat and cold. Their need to stay close to their mother's body, particularly when they are premature, is well recognised.[54 55] Kangaroo mother care, including skin-to-skin contact, protects against a wide range of adverse neonatal outcomes, facilitates careful monitoring of the baby and improves the likelihood of exclusive breast feeding.[56] However, as in our research, recent studies in Africa and beyond have shown that women often find it difficult to apply this care.[57 58] The hot climate was one of the obstacles to the continued practice of home kangaroo care by women in southern India.[59]

In most communities in Burkina Faso, particularly in the two data collection sites, cultural practices for postpartum care of women in some communities recommend that mother and newborn remain inside the home for a period ranging from 7 to 40 days, when it can be very hot indoors.[32] More specifically, although it is the babies who need to be kept inside rather than women per se, the women are obliged to stay indoors in order to feed their baby. This practice is still occurring today and was mentioned by women as a local practice that exacerbates the discomfort of heat for both mother and newborn.

Economically and professionally, women reported being less productive during periods of heat, which can lead to a drop-in household income. Some stop their income-generating activities and do not receive economic support in a country where physical labour is the norm and there little social protection. This is despite women being essential to the agricultural sector: in 2019, 68% of workers in the agriculture, livestock, hunting and support activities sector were women.[60] Pregnant women continue to perform physical labour even late in gestation, including walking long distances to fetch water and firewood. However, the results also show that some women sometimes receive help with domestic chores from those around them, notably co-wives and mothers-in-law.

Strengths and weaknesses of the study

Overall, we have collected data on a little-researched subject. Our research is probably the first or one of the first applications of the concept of maternal well-being in relation to climate change in the Burkina Faso context, and this study addresses an important gap in knowledge concerning the consequences of heat on the well-being of pregnant and postpartum women.This study reported views from FDGs, IDIs and KIIs from a broad range of people. This multifaceted approach strengthened the data quality and trustworthiness through the convergence of reports by these different groups and can be used to inform future work and potential areas for intervention in the Burkina Faso context. These findings are not intended to be generalisable in terms of statistical significance but provide insight into the challenges with extreme heat during pregnancy and postpartum in two districts as well as across Burkina Faso more generally. That is a strength because this study might affect practice or policy. It offers suggestions for healthcare professionals and policy-makers for addressing these issues. The weakness of the study is that the timing of the study meant that data collection itself did not occur during the hottest period of the year, although participants were asked to reflect on their experiences during extreme heat. In terms of method, future studies on this issue would benefit from the addition of ethnographic participant observation to capture the emic perspective, provide richer data on the impact of heat on women's daily activities and triangulate with interview data.

CONCLUSION

Pregnancy and the postpartum period are vulnerable times for women. Our research has shown that global warming, which leads to extreme temperatures, has a multifaceted impact on mothers and newborns. Extreme heat affects women's functionality and well-being, including their ability to care for themselves and their child, their capacity to work, and their ability to maintain good relations with their partner and family. Cultural practices and beliefs may exacerbate some of the negative consequences or make it harder for women to cope with the heat. There is some suggestion that women may not recognise heat symptoms as such, implying that there is a role for specific health messaging on this issue. In Burkina Faso, there is currently no national policy on heat and maternal and child health. Health workers often lack the knowledge to better inform women about heat-health risks. Implementing programmes and policies aimed at building the capacity of health workers to communicate with women about good practices for adapting to extreme temperatures would be an important first step towards improving local preparedness for warming.

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Data availability statement Data may be obtained from a third party and are not publicly available. Full transcripts cannot be shared publicly due to potentially identifying information. The content and words of respondents in interviews could

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potentially be used to identify individuals. Even anonymisation could pose risks to confidentiality. Data are available on request to the Comité d'éthique pour la recherche en santé in Burkina Faso (+226 72757187) or from from the Research Ethics Committee of the London School of Hygiene and Tropical Medicine .

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