

"Islamically, I am no longer on my period": A Study of Menstrual Tracking in Muslim Women in the US

Zaidat Ibrahim
zaibrahi@iu.edu

Indiana University, Bloomington
Bloomington, IN, USA

Novia Nurain
nmurain@iu.edu

Indiana University, Bloomington
Bloomington, IN, USA

Pallavi Panchpor
ppanchp@iu.edu

Indiana University, Bloomington
Bloomington, IN, USA

James Clawson
clawsonj@iu.edu

Indiana University, Bloomington
Bloomington, IN, USA

ABSTRACT

The widespread adoption of menstrual tracking applications has garnered much attention with recent research focusing on inclusive design. However, existing literature has yet to explore the impact of religious practices on menstrual tracking behavior. We investigate the menstrual tracking practices of Muslim women of faith in the United States, a population whose personal reproductive health behaviors are deeply influenced by their faith, values, and religious laws. We conducted a three-phase study consisting of preliminary surveys (N=133), semi-structured interviews (N=20), and a post-Roe v. Wade survey (N=77). We highlight motivations for tracking and uncover this overlooked population's challenges as they engage with menstrual tracking technologies. We reveal an intimate connection between menstrual tracking and religious practices. We uncover challenges from engaging with existing menstrual tracking applications and contribute design recommendations for accommodating faith in the design of health tracking technologies. We amplify a call to action for the HCI community to reduce the "othering" of under-represented populations and to better support the inclusive design of technologies that center religious identities and values for individuals of faith.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

Menstruation; Women's Health; Personal Informatics; Muslim Women

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1 INTRODUCTION

Approximately 50 million individuals worldwide use mobile applications to track their monthly menstrual cycle [93]. Menstrual tracking affords individuals the ability to plan and prepare for their upcoming cycles, enables individuals to map their contraception and fertility, provides insight into mood management, helps individuals better understand their bodies, and can be used as a learning resource for sexual health and wellness [87]. Menstruating individuals use several methods to track their periods, such as mobile apps, calendars, birth control pills, etc. [18]. Many popular menstrual tracking apps are available on the Apple AppStore and Google Play Store, including Period Tracker, Flo, Clue, Eve, etc. [23, 87]. These apps include symptom logging, period logging, notes, reminders about periods, pattern visualizations, community forums, health-related articles, and contact with health experts [87]. While applications and technologies for tracking the menstrual cycle continue to increase, they are not without their challenges. Some of these challenges include prediction accuracy, allowing sensitive data to be sold or leaked [19], relying on non-validated approaches to tracking menstrual pain (or Dysmenorrhea) over established pain management [83] and under-serving new menstruating individuals [19, 83]. Existing menstrual apps have been shown to embed certain assumptions based on societal norms, thus presenting users with an idealized normativity of the reproductive body (gendered and heterosexual contexts) [14, 60]. One such assumption is categorizing an average menstrual cycle length of 28 days [14, 14, 18, 66], eliminating those with irregular periods.

While many research studies explore the challenges of existing menstrual tracking technologies and menstrual tracking practices of women in the global south, situated within particular cultural contexts [50, 84–87], our work focuses on exploring the perception of menstrual tracking technologies (particularly apps) within a population whose engagement in faith practices is entangled with their menstrual cycle. We build on the work of prior research [18, 22, 40, 60] exposing the unintended inequities brought about by menstrual tracking technologies and suggesting solutions for charting the way forward. To our knowledge, HCI research on menstruation in the Muslim population has almost exclusively focused on the global south [50] and on the cultural stigma associated with menstruation [84, 86]. Considering the in-depth menstruation work done in

HCI, we decided to engage with Feminist HCI's quality of advocacy [9, 10] to study a population who has been long overlooked (e.g., Muslim women) within the literature of HCI and CSCW research, especially in the Western world.

Prior research has emphasized the need for researchers and designers to consider how religious aspects impact an individual's daily life [50] when designing new technologies. HCI researchers have long raised the need to investigate further ways of designing to support faith-based populations [92, 94–96] with a relatively recent interest in exploring Islamic HCI and designing for the Muslim world [50, 57, 61, 62]. The Muslim population accounts for 23% of the world (1.6 billion people) and is a population whose faith practices adhere to specified underlying principles and values [50]. For Muslim women, their motivations for tracking their menstrual cycle go beyond the goal of physically being prepared for their next cycle, as their menstrual cycle is tied to their abilities to perform certain religious practices or rites. For example, a Muslim woman who is menstruating is unable to observe the five daily prayers (*salat*) or observe either the obligatory (*Ramadan*) or voluntary (*sunnah*) fast, touch the holy book (*Quran*), and, in some cases, visit mosques/prayers spaces (*masjid*). Some of these obligations, such as fasting, must be made up later. Hence, this becomes an additional motivation for tracking the menstrual cycle within this population. This paper positions itself at the intersection of research on women's health, HCI, and religion. Our work seeks to fill the under-explored gap of menstrual tracking in Muslim women in the US. In this paper, we make the following contributions to HCI Research:

- We expand on previous menstrual tracking work to include the *experiences* of Muslim women and explore how they engage with menstrual tracking applications, exposing the intimate link between menstruation and religious practices. We uncover *challenges and shortcomings* that arise as Muslim women engage with period tracking apps and identify gaps between the design of existing tracking apps and the tracking needs of faith-based Muslim women.
- We present *design implications* and provide recommendations to inform the design of future period tracking applications that are inclusive of the needs and values of Muslim women.
- We advocate for a *call to action*, that eliminates "othering" (e.g., religion) and embraces an alternative design approach that centers the religious identity in designing intimate technologies to promote equity for Muslim women and improve menstrual health.

2 RELATED WORK

2.1 Menstruation and HCI

Menstrual tracking frequently plays a role in helping people prepare for their periods and in maintaining their health. In the HCI research community, the discourse on menstruation aims to comprehensively address the diverse aspects of menstruation and its intersection with technology and culture. Research has explored self-tracking in menstruation, providing insights into why and how people track their periods, the problems associated with menstrual

tracking [18], and users' experiences with menstrual tracking applications [15, 18]. Researchers have explored menstruation and stigma, revealing the culturally rooted stigmatization of menstruation [85, 86], menstrual literacy particularly in the global south [19], encouraging menstrual health literacy through technology-based support [84], promoting technologies to support individuals with irregular periods in learning more about their menstrual health (exemplified by innovations like "Crimson Wave") [21, 82], supporting embodiment in menstruating adolescents [34, 76, 78, 79], moving beyond social stigma to redesign sustainable, biodegradable menstrual artifacts [75], and providing a call for political advocacy that encourages open conversations on menstruation and menstrual technologies [15].

Researchers [14, 43, 44, 59, 77] have also challenged the existing design of tracking and quantifying technologies, recommending speculative designs for period trackers, as seen in projects like PeriodShare [59, 77], and reimagining menstrual and fertility tracking with a feminist approach, as demonstrated by projects like tactful feminist sensing [14]). The portrayals of people who track their menstrual cycles with apps are often depicted as users with "flat with monolithic experiences,"—which assumes that the goal of period tracking is centered chiefly around period management and fertility [56], and mostly inscribe particular visions of menstruation and the menstruating bodies [22]. Fox et al. [22] highlight that existing apps work with certain assumptions about menstruation; these assumptions include the notion of a "normal cycle," tracking motivations driven by fertility, and users who identify as women, heterosexual, and monogamous. Lupton [43] argues that menstrual and ovulation tracking technologies reshape our understanding of and engagement with our bodies. These technologies transform the body, its health, and its functions into quantifiable data, reducing them to mere calculations, predictions, and comparisons [43]. This algorithmic reduction of our bodily experiences flattens and dulls our perceptions of sexuality and reproduction, confining them to rigid and normalized categories. Lupton [43] further argues that certain facets of selfhood and embodiment are chosen for monitoring, leaving other aspects of selfhood inevitably overlooked or not considered. Self-tracking technologies often result from a narrow demographic of designers—typically white, well-paid, heterosexual males residing in the global north. As such, it is unsurprising that the existing limitations with menstrual tracking apps include the gendered design of menstrual tracking apps [18, 39]. The implicit assumptions and norms shaping the design and features of self-tracking and self-tracking applications are influenced by the decisions, preferences, and values of this narrow demographic of designers.

Addressing these limitations requires participatory design [30], where researchers integrate users as collaborators and guide critical discussions using speculative design [6, 73] throughout the design process. Sultana et al. [80] offered a framework for designing within patriarchal contexts that involve empowering women from within, leveraging their existing tactics, and extending the design focus beyond individual users to encompass those in their surrounding social circles, such as religious leaders (*imams*).

Furthermore, a growing argument exists for digital menstrual trackers to serve as "capability-building tools" that foster equitable and period-positive futures. This stands in contrast to traditional tracking tools, which primarily focus on concealing menstruation, thereby challenging the established norms [87]. Privacy of menstrual tracking data is also being discussed in the literature [4, 47, 68]; research shows that app developers often do not consider the sensitive nature of period and sexual data and treat period data as "just another piece of data" [47]. While the privacy of menstrual tracking data has long been a cause for significant concern, it became exponentially crucial in the US when the Supreme Court overturned *Roe v. Wade*, removing federal protection of an individual's right to have an abortion. This overturn affects women's reproductive and human rights and could significantly impact and harm marginalized individuals and groups [47].

Advancements in technology for menstruation include the design of sensors to monitor menstrual blood loss [49], utilizing digital fabrication techniques to address some barriers to period technologies (e.g., cost and access to sanitary products) [45], creating region simulators such as the menstruation machine [55], speculative design proposals for reconsidering privacy and surveillance practices of menstrual tracking technologies [23], employing critical design practices to investigate how menstrual tracking data are presented [31], redesigning menstrual infrastructures in public spaces [24], and culturally responsive design for menstrual tracking [40].

We acknowledge that the HCI community has been expanding its knowledge of menstrual tracking and data-sharing practices; however, more work is still needed to ensure equity and justice in advocating for under-studied individuals who have been unconsciously left behind. To contextualize our work and contributions, we noticed that existing HCI studies on menstruation do not focus on specific values (e.g., faith, religion, and spirituality) that play critical roles in lived experience and people's intimate and sexual lives. In Epstein, et al.'s work [18], upon revealing the motivations for menstrual tracking, they proposed a call to action to expand research toward understanding the tracking habits of women from underrepresented cultural and ethnic groups. We position our work within these gaps by investigating the practices of a heterogeneous and cultural population bounded by a shared religion. In our work, we contribute to the ongoing research conversations [18, 22, 56] on culturally inclusive design and responsive approaches for menstrual health and technology [18, 22, 56]. We support the call to action for exploring how menstrual tracking technologies can be designed differently to foreground the varied needs and interests of menstruating individuals, especially within the context of the Muslim population.

2.2 Menstruation, the Body, and Islamic Faith

Researchers have called for the inclusion of faith, religion, spiritual practices, and values in the design of technology and HCI discourse, arguing that the lack of inclusion of these values has resulted in the secularized nature of HCI [51]. In her work with people facing critical life illnesses, Estelle et al. [71] argue that for a genuinely

human-centered approach, we must account for the spiritual values and that an individual's spiritual values form a core part of their human identity [71]. Furthermore, studies by Oguamanam et al. [52] highlight that participants in their research resorted to religious and spiritual-based strategies—*"activities such as seeking assistance from a higher power, praying, or attending church"*—for coping with stressors in their pregnancy journey. By recognizing the impact of human values on identity, behavior, and health, HCI researchers have the unique opportunity to truly address the most profound challenges and serve the needs and values of users [71]. Some examples of research that offer the inclusion of faith and religious importance in HCI include— the study of the intersection of Islamic values and sustainable living, which could help inform the design of sustainability practices [63], religion and intimate health [50], multidimensional approach to wellbeing in faith communities [53], and the study of online worship workshops to help inform the design of technology-mediated religious experiences [91]. Given our research, we discuss menstruation and Islam to explain the relevance of considering the impact of Islamic values on menstrual health.

2.2.1 Menstruation and Islam. The Islamic faith is guided by a set of beliefs and ritual practices or obligations, e.g., five daily prayers (*'Salat'*) and fasting (*'Sawm'*). While these ritual practices are core aspects of Islam and of being a Muslim, there are times when specific individuals are exempted from adhering to these obligations. Menstruating women are not permitted to observe obligatory fasting during the lunar month of Ramadan. This exemption also extends to voluntary fasting, observing the daily prayers, and participating in *'Tawaf'*—a vital component of the Hajj which refers to walking around the Holy Mosque (*'Ka'abah'*) seven times in a counter-clockwise direction. Menstruating women are also required to abstain from sex during their periods. While the obligatory fasting days that were missed due to menstruation have to be made up later, the days of prayers missed do not have to be made up. Simultaneously, the Islamic faith exhibits diverse implementations and practices across various regions worldwide; nevertheless, the fundamental principles that most Muslims uphold remain unchanged [50]. Research on religion and intimacy in three Muslim-majority countries by Mustafa et al. also highlights a central value regarding how Muslims consider their body as an *Amaanah* (an entrusted loan) that demands to be taken care of [50]. These values and beliefs—the essence of being a Muslim woman and the value of modesty and ensuring trust—are central to Muslim women's identities and how they interact with their health and wellness [50].

A significant component of being able to engage in prayers is purification or cleanliness, which is an integral value of Islam. Ablution (*'Wudhu'*) (pronounced woo-doo) is a ritual washing or purification process to ensure cleanliness before prayer or touching the holy book [35]. It involves washing body parts - the face, hands, mouth, and feet. A fuller version of this purification process that involves washing the entire body is called *'Ghusl'*. *'Ghusl'* (pronounced gu-sul), which loosely translates into "Ritual bath" or "Major ablu-tion" [20] and is a form of Islamic purification that takes place under certain conditions - after sexual intercourse or discharge of semen, after menstruation, or after post-natal bleeding [20]. For practicing



Figure 1: Study Design and Timeline

Muslims, Ghush is required before recommencing praying, fasting, or pilgrimage upon completing the menstrual cycle. Therefore, it is essential to know when a period phase is considered complete to perform the ritual act of Ghush. Each of these purification processes (Wudhu and Ghush) uses water to cleanse specific parts of the body (Wudhu) or the entire body (Ghush).

Moreover, religious law *'Fiqh'* (pronounced fee-k) guides menstruation in Islam. The Fiqh of menstruation defines the duration of the menstrual phase. Different Muslim schools of thought (similar to varying sects of Christianity) adhere to different Fiqh. In the largest sect of Islam, there are four schools of thought. For example, for people who adhere to the *'Shafi'i'* interpretation [32], the Fiqh states that menstruation does not exceed 15 days. Suppose a woman menstruates for more than 15 days. In that case, the legal ruling is that the menstruation days exceeding the 15th day are regarded as non-menstrual vaginal bleeding [33]. Once a woman is considered to no longer be menstruating according to her religious legal jurisprudence, she is no longer exempted from the obligations of praying and fasting and can resume her daily rituals. These laws, principles, and guidelines influence Muslim women's behavior regarding menstrual, intimate health, and religious participation. It is, therefore, essential to consider religious identity as a Muslim when designing menstrual health technologies.

3 METHODS

We conducted a three-phase study: Phase I - a preliminary survey (total N=164, sampled dataset N=133), Phase II - semi-structured interviews (total N=22, sampled dataset N=20), and Phase III - a post-Roe v. Wade survey (total N=121, sampled dataset 77) (Figure 1). The study was approved by the Indiana University, Bloomington Institutional Review Board (IRB). The preliminary survey was launched in March 2022, with interviews conducted from March 2022 to early June 2022, and the post-Roe v. Wade survey was launched in May 2023.

3.1 Phase I: Preliminary Survey

The preliminary survey (Phase I) allowed the research team to collect demographic information from a broad sample of Muslim women living in the U.S. It was used as a recruitment instrument for the interview portion of the study. Participants were recruited through multiple channels. The first author e-mailed Muslim student organizations in the U.S., contacted Muslim influencers on Instagram, and reached out to Muslim women's Slack communities

to share recruitment flyers. As a result, recruitment flyers were posted on Instagram stories, Facebook groups, mailing lists, and Slack channels. A summary of preliminary survey respondents is presented in Table 1. Participants who completed the preliminary survey and provided contact information were contacted and invited to participate in semi-structured interviews (Phase II). The survey contained open-ended questions asking about respondents' tracking motives, practices, and tools. In addition, we asked to identify whether or not they were practicing Muslims, their menstruation cycles, and irregularities. Twenty-six participants stated they were willing to be contacted for follow-up interviews and provided their contact information. We reached out to all 26 individuals, however only 22 responded to our e-mail.

3.2 Phase II: Semi-Structured Interviews

We interviewed a total of 22 participants, two of whom (P6 and P9) were interviewed to pilot our interview protocol (their data were not included in our findings). Interview participant demographics (N=20) are summarized in Table 2. Given the sensitive nature of the subject under investigation, we ensured that two of the female authors of this paper conducted the interviews to facilitate participant engagement throughout the study. The interviews allowed us to gain deeper insights into the experiences of Muslim women in America who use menstrual tracking apps. During the interview, we started with a brief introduction to the study and then asked questions about the participants' period-tracking habits, their experiences with period-tracking applications, their attitudes toward their periods, and their feelings about period-tracking. We also asked them to describe if/how their religious practices were impacted by their periods and reflect on how menstruation and religion impacted their daily lives. The semi-structured interviews lasted between 20 and 40 minutes (mean=27.2 minutes, standard deviation= 9.2) and were conducted and recorded using Zoom to minimize participants' costs (e.g., travel costs). During Phase II of our study, the US Supreme Court overturned the constitutional right to abortion access. This development sparked widespread discussions about the potential implications for menstrual tracking apps and surveillance [46, 64, 69, 72] and a broader conversation on faith and abortion [2]. Consequently, our research team sought to investigate how this decision might impact our study population, particularly in light of the possibility that abortions may still be permissible under certain religious laws. As such, we launched Phase III (the post-Roe V. Wade survey).

3.3 Phase III: Post-Roe V. Wade Survey

We launched Phase III of our study in March 2023 (9 months after the Supreme Court's decision) to investigate what impact this decision may have on the participants' menstrual tracking behaviors and opinions. We contacted previous participants who had provided e-mail address information in Phase I. To reach out to new participants, we again shared our recruitment materials with Muslim Facebook groups, Muslim women's Slack channel, and the first author's WhatsApp contacts and groups. The survey asked the following questions: "Has your decision to use technologies to track your menstrual cycle changed post-Roe v. Wade?", "Please explain your response to the previous question (Has your decision to use a period tracking app changed post-Roe v. Wade?)" and "What are your concerns post-Roe v. Wade?". We report 77 responses to this survey.

3.4 Data Analysis

3.4.1 Phase I: Preliminary Survey Data. We received 164 survey responses, with a 98.5% completion rate. We discarded incomplete surveys, from participants in countries outside the U.S., had no location data specified, had no age specified, and were from individuals younger than 18 years old. We removed 31 responses, leaving 133 survey responses in our dataset (see Table 1). Survey participants' (N=133) average age is 29.1 years; the minimum age is 18 years, the maximum is 49 years, and the standard deviation is 8.5 years. To ease the reporting of our findings, we assigned the Phase I survey participants labels S1 through S133.

3.4.2 Phase II: Semi-Structured Menstrual Interview. From the twenty participants, we collected 544 minutes of audio-recorded interviews. All interviews were transcribed using otter.ai, an online text transcription tool. The first and second authors coded twenty interviews following Braun and Clarke's thematic analysis approach [12]. We began by familiarizing ourselves with the data and generated an initial set of codes. When we reached alignment in our coding, we independently coded the complete set of interviews. The authors met frequently to discuss the codes and resolve conflicting codes. After generating codes, the research team reviewed them and utilized affinity diagramming [67] to categorize the codes into themes. We discovered themes such as "Tracking Methods", "Motivations For Period Tracking in Muslim Women", which support the findings of other menstruation work in non-Muslim individuals. We also find unique themes on "the relationship between Menstrual Tracking and religious practices", and "Implications for Designing for Muslim Menstrual Tracking". These later two themes are the core findings of our work and contribute to expanding the existing research on menstruation. We discuss the full scope of these themes in our findings section. The mean age of our Phase II semi-structured interview is 29.4 years; the minimum age is 21 years, the maximum age is 49 years, and the standard deviation is 8.6 years. See Table 2 for interview participant demographics.

3.4.3 Phases III: Post-Roe V. Wade Survey Data. We treated Phase III survey data (total N=121, sampled dataset 77) as completely distinct from survey respondents in Phase I. We discarded 44 incomplete responses, including participants who neither reported their age nor their location. We assigned each respondent in Phase

III an I.D. labels R1 through R77. The mean age of our Phase III survey participants is 28.4 years; the minimum age is 18 years, the maximum age is 45 years, and the standard deviation is 6.2 years.

3.5 Positionality, Self-Disclosure and Challenges

Our team is composed of researchers based in the U.S. from diverse cultural and religious backgrounds; three of whom are female and one of whom is male. The first author identifies as African Muslim; the first author was born and raised outside the U.S. and has lived in the U.S. for over a decade. The second identifies as Hindu and Asian American, and the third author was born and raised in a developing Southeast Asian country, identifies as Muslim, and has lived in the USA for about four years. The final author identifies as a non-practicing protestant white American. All authors conduct HCI research on vulnerable populations but within different domains; three authors work in women's health and one author works with older adults. Reflecting on Barad's work on feminist research [7, 8], we adopt a feminist grounding to understand how researchers' perspectives, experiences, and emotions impact the data collection and analysis. Two female authors conducted the interviews as it allowed the participants to feel comfortable expressing themselves. One of the researchers conducting the interviews belonged to the Muslim community and brought in her own experiences and viewpoints to adeptly capture the nuanced and comprehensive understanding of participants' lived experiences and tensions around religion and technology. The diversity of our backgrounds, faiths, genders, and life experiences helped us as a research team to critically analyze our data and generate inclusive findings and discussion. Participants across three phases of our study self-identified as female. Therefore, in our findings, we use the term "women" in referring to the participants. We acknowledge that we did not use more inclusive terms in our recruitment methods, which may have influenced the gender categories who chose to participate in our study. In a future follow-up study, our research team intends to be more inclusive in our recruitment language.

4 RESULTS

In this section, we report the findings from Phase I (N=133) preliminary survey data (S1, S2, S3...), Phase II (N=20) interview data (P1, P2, P3...), and Phase III (N=77) post-Roe v. Wade survey (R1, R2, R3...R77). Tables 1 and 3 represent summary data from our preliminary and post-Roe v. Wade surveys. Our Phase I survey and Phase II interviews uncovered several reasons why Muslim women in the United States are motivated to track their menstrual cycles. Our participants tracked their monthly menstrual cycles to increase their understanding of how their periods affect their mood, fertility, and menstrual health. They were motivated to keep records for the practical purposes of improving their communication with healthcare providers and ensuring they were prepared with sanitary products for their period. For the most part, and unsurprisingly, our findings on tracking motivations and methods align with previous work investigating menstrual tracking in western populations [18], indicative of the commonalities in tracking methods and motivations that transcend cultural or faith beliefs. However, a unique finding from our participants that differentiates them from findings from

Table 1: Summary of Phase I Preliminary Survey N=133

| | Did not Disclose (N=1) | Non-practising Muslim(N=4) | Practising(N=128) | Total (N=133) |
|-----------------------------------|------------------------|----------------------------|-------------------|---------------|
| Observe Fast | | | | |
| Yes | 1 (0.8%) | 2 (1.6%) | 124 (97.6%) | 127 (100.0%) |
| No | | 1 (50.0%) | 1 (50.0%) | 2 (100.0%) |
| Sometimes | | 1 (25%) | 3 (75.0%) | 4 (100.0%) |
| Race | | | | |
| Asian | | 2 (3.0%) | 64 (97.0%) | 66 (100.0%) |
| Black or African American | 1 (2.95%) | 1 (2.95%) | 32 (94.1%) | 34 (100.0%) |
| Multi-racial | | 1 (3.1%) | 31 (96.9%) | 32 (100.0%) |
| Did not disclose | | | 1 (100.0%) | 1 (100.0%) |
| Length of cycle | | | | |
| 24 days | | 1 (4.8%) | 20 (95.2%) | 21 (100.0%) |
| 38 days | | | 7 (100.0%) | 7 (100.0%) |
| 24-38 days | 1 (1.0%) | 3 (3.0%) | 95 (96.0%) | 99 (100.0%) |
| Did not respond | | | 6 (100.0%) | 6 (100.0%) |
| Period Length | | | | |
| less than 4.5 days | | 1 (8.3%) | 11 (91.7%) | 12 (100.0%) |
| 4.5-8days | 1 (.90%) | 3 (2.8%) | 104 (96.3%) | 108 (100.0%) |
| 8-15 days | | | 9 (100.0%) | 9 (100.0%) |
| Greater than 15 days | | | 3 (100.0%) | 3 (100.0%) |
| Did not disclose | | | 1 (100.0%) | 1 (100.0%) |
| Currently on Birth Control | | | | |
| No | 1 (0.8%) | 2 (1.7%) | 118 (97.5%) | 121 (100.0%) |
| Yes | | 2 (16.7%) | 10 (83.3%) | 12 (100.0%) |
| How they track period | | | | |
| App | 1 (1.2%) | 3 (3.6%) | 80 (95.2%) | 84 (100.0%) |
| Calendar | | | 10 (100.0%) | 10 (100.0%) |
| Memory/ "I simply Remember" | | 1 (5.3%) | 18 (94.7%) | 19 (100.0%) |
| Paper System | | | 7 (100.0%) | 7 (100.0%) |
| Multiple methods | | | 13 (100.0%) | 13 (100.0%) |
| Did not disclose | | | 2 (100.0%) | 2 (100.0%) |
| Devices Personally Owned | | | | |
| Smartphone | 1 (0.8%) | 4 (3.0%) | 128 (96.2%) | 133 (100.0%) |

Table 2: Phase II: Interview Participant (N=20) Demographics & Tracking Methods.

| Interview ID ID ^a | Age | Profession | Ethnicity | Tracking Method Method | Used Apps Apps |
|---------------------------------|-----|-------------------------|-------------------|---------------------------|-----------------------|
| P1 | 29 | Insurance adjuster | Black/A.A | App | P-Tracker & Flo |
| P2 | 21 | Student | Asian | App | Clue |
| P3 | 21 | Student | Asian | App | Apple Health |
| P4 | 25 | Student | Black/A.A | App | Flo |
| P5 | 26 | Therapist | Asian | App | Flo |
| P7 | 31 | Teacher | Other | App | Flo |
| P8 | 37 | Family Business | Black/A.A | App | Ovia |
| P10 | 24 | Student | Two or More Races | App | Flo |
| P11 | 25 | Student | Asian | App & Journal | Flo |
| P12 | 22 | Student | Black/A.A | App | Flo |
| P13 | 35 | Homemaker | Asian | Journal & App | Apple Health |
| P14 | 22 | Student | Black/A.A | Calendar | N/A |
| P15 | 49 | Childhood Educator | Asian | App | Fitbit & Apple Health |
| P16 | 26 | PhD Student | Asian | App | Flo |
| P17 | 44 | Student | Asian | Calendar | Flo |
| P18 | 21 | Student | Asian | App | Flo |
| P19 | 22 | Student | Asian | Calendar | N/A |
| P20 | 39 | Doctor | Asian | App | Period Tracker |
| P21 | 28 | Pharmacy Manager | Asian | App | Flo |
| P22 | 42 | Global Logistic Manager | Asian | App | Fitbit |

^a P6 and P9 are omitted as they were the pilot participants in the study

previous studies is the intimate link between menstrual tracking and adhering to religious practices (sections 4.1). We present the challenges in tracking with apps (sections 4.2). In our findings, we

draw from Luptons' work to highlight connections to previous literature on technology and the body [42–44].

4.1 Relationship Between Menstrual Tracking and Adhering to Religious Practices and Guidelines

For participants, an added motivation for menstrual tracking is to help support their adherence to religious practices and guidelines that exempt them from practicing certain religious rituals, e.g., fasting and prayer (subsection 4.1.1), consider implications for times when the duration of the period is unusually long (subsection 4.1.2) and plan social activities that do not clash with timings for religious rituals (subsection 4.1.3). Our finding highlighted a central discourse in Lupton's self-tracking cultures [42], where she highlighted that *'self-tracking has no meaning in itself, but is endowed with meaning by the wider discourses on technology, selfhood, the body and social relations that circulate within the cultural context in which the practice is carried out'* as a result, self-tracking for participants in our study takes on additional layers of meaning influences significantly by their religious context and guidelines.

4.1.1 Adherence to Islamic Guidelines or Practices. Our participants mentioned that one motivation for tracking is to help prepare for adhering to the religious guidelines of times when they would be unable to participate in certain forms of religious worship—prayers and fasting—and knowing when they would need to perform the purification process or ghusl. In addition, in Islam, engaging in sexual intercourse during one's period is prohibited, and Muslim women and their partners strive to adhere to plan on adhering to this prohibition.

Observation of Fasting and Prayers. Participants talked about having a close link between period tracking and religious observance. For instance, S23 mentioned while experiencing menstruation she followed guidelines that involve abstaining from specific religious practices, such as the mandatory five daily prayers, voluntary prayers, and any obligatory or optional religious fasting. Once her menstruation period concluded, S23 performed the cleansing ritual (ghusl), after which she resumed these religious practices:

"I track for religious reasons, to know when to fast and pray and to know when to take the ritual bath to purify myself after my period." -S23

Interview participant P18 expressed she mentally prepared for exemptions from praying and fasting, explicitly highlighting the prayers on celebratory religious holidays or *Eids*. P18 revealed that even during the celebratory religious holidays, menstruating individuals are still not allowed to participate in the special congregation prayers on that day, based on the assertion that the conditions for participation in these special prayers are the same as those for regular daily prayers. Therefore, menstrual tracking and predictions helped her mentally prepare for the feelings of exclusion that may occur from their exemption from participating in these prayers.

"...Our period is significant because we can't pray, we can't fast... especially during Ramadan; in the month of fasting, it was essential for me to know when I would get my period and if I would get it, say, twice during Ramadan, like at the beginning or the end. So it was just essential for planning. Also, when we have the Eid prayer at the end of Ramadan, it was helpful to know if I could pray or if I wouldn't so that I could mentally

prepare myself so I wouldn't be upset. Spoiler: I was upset. But, it's beneficial to know when I should expect not to be able to pray" -P18.

Other participants tracked their periods to know how many days of fasting they needed to make up for due to missing the obligatory fast in the holy month of fasting (*Ramadan*). Unlike the obligatory five daily prayers, missed days of fasting due to periods would need to be made up outside of Ramadan. Therefore, these individuals needed to track the number of days of fasting that they missed while menstruating. For instance, P15 talked about how she planned for Ramadan:

".. it's just good to know when Ramadan is coming and you're going to fast, which days of the month, you're going to be missing..." -P15

In summary, participants were motivated to keep records to help prepare for adhering to Islamic guidelines and exemptions on prayers and fasting.

Prohibition of Sexual Intercourse. Participants also reported tracking to prepare for prohibition from sexual intercourse during menstruation. For instance, P8, a married woman who monitored her menstrual cycle and communicated this information to her husband to ensure their compliance with religious restrictions on sexual intercourse. She conveyed her thoughts as follows:

"... you know, abstaining from sexual intercourse during my period is based on religion, although it's not something I didn't think I would want to do, it just seems messy..." -P8.

Exemptions From Religious Pilgrimage. Participants also reported tracking to help plan for certain religious rites such as Islamic Pilgrimages (*Hajj* and *Umrah*). As with the five daily prayers, menstruating individuals are exempted from performing certain rites if they find themselves menstruating during the pilgrimage. Participants were motivated to track to help plan pilgrimage travels and activities. For instance, P15 emphasized that, because of these exemptions, organizing her pilgrimage plan was of utmost importance, and she even contemplated using medications to halt her menstrual cycle to ensure she did not menstruate during the pilgrimage

"It just helps to know when it is coming...When you go on the pilgrimage, you cannot participate if you are menstruating. So I wanted to make sure that if I was going and we were planning that I would know whether I needed to take any medication to stop my cycle..." -P15

4.1.2 Implications For Periods Longer Than "Normal" Duration. From our participants, we teased another intimate connection between tracking one's period and religious practices, which is the implication for what is considered to be the "normal" length of period. The implication is that participants whose period exceeded the "normal" length must perform ghusl and recommence their forms of worship even if she continue bleeding. The guidelines for menstruation duration and how the bleeding is defined vary based on Fiqh interpretations (mentioned in Section 2.2). In these instances, the Fiqh of menstruation—the interpretations and diversity in implementing and practicing Islamic beliefs—becomes more apparent. We present two examples from the survey response, S66, and the interview response, P10. S66, quoted below, highlighted

that the Fiqh she adhered to did not consider any period longer than ten days a "normal" period. Therefore, she recommenced the obligations of prayer and fasting even if her period extended beyond ten days.

"I follow the Fiqh opinion that the minimum duration for a period is three days and its maximum duration 10, as well as that there must be at least 15 days of purity between the end of one menstrual cycle and the start of the next. I keep track for the sake of maintaining ritual purity." -S66.

P10 mentioned further this implication for longer than average period length in the quote below:

"...I follow the belief/opinion that your period can only last ten days. And if it lasts longer, it's irregular, not defined as a period longer than ten days. Second, one needs 14 full days of purity or non-bleeding between two periods. And anything outside these defined time slots is not considered a period...For Muslim women, this is relevant because when you're on your period, you can't engage in certain aspects of worship, such as praying and fasting...for example, if during the month of Ramadan, I have a period where I'm physically bleeding for 11 days, I would still fast the final, the 11th day, because Islamically I'm no longer on my period. I try to make sure that I can worship or engage in these acts when I can. And because I have very long periods, that was my reason for starting to track." -P10

These quotes describe participants' attempts to balance menstruation's medical and religious aspects, especially when menstruating days are longer. While we didn't specifically ask participants with irregular periods about the complexity that comes with determining what is or is not "normal," this finding revealed that menstruating individuals with longer than "normal" periods have increased challenges when balancing their adherence to religious guidelines within a complex and emotionally fraught condition.

4.1.3 Planning Social Activities. In our study, participants illustrated that exemptions from mandatory prayers created chances to organize social activities that would otherwise clash with the prescribed schedules of the five daily prayers. Consequently, these participants took advantage of their menstrual days, and thus the days of exemption, to engage in pursuits that may disrupt prayer timing or affect the acceptability of their prayers. P18, a 21-year-old college student who tracked her period using the Flo app, prioritized her daily prayer schedule and found that sometimes social activities with her friends, especially her non-Muslim friends, conflicted with the stipulated times of one or more of the five daily prayers. Therefore, she planned social activities with her friends around her period since she did not have to worry about prayer times clashing with her social activities. In her case, period days were opportunities to engage in activities with her non-Muslim friends.

"...Many of my friends will complain about when they're on their period, especially non-Muslim friends. But I see it sometimes as an opportunity if somebody wants to go out to do something. I say, 'Okay, perfect. Let's go

out. I'm on my period. So I don't need to worry about prayer.'... that's one of the reasons why I want to know when my period was coming, just because sometimes people wanted to plan things or there were assignments we had to do where we'd have to go out. So, I would prefer to do those on my periods. I don't need to worry about praying in a public place that is not as accessible..." -P18.

Similarly, P15 utilized the exclusions from religious activities as a time to plan other social activities that they would not otherwise be able to participate in. According to P15, quoted below, wearing nail polish invalidated the ablution, a purification process required before prayer. Therefore, during her period days, she could freely apply nail polish without concern for its impact on her prayers.

... It's good to know... if you want to plan like a pedicure and a manicure, because, as a Muslim, I have chosen, or you know, to my understanding is that I cannot pray when I have nail polish on, so I try to plan accordingly" -P15

4.2 Tensions Around Religious Values & Period Tracking Applications

As Lupton [43] highlights, self-tracking technologies face limitations acknowledging the influence of various aspects of individuals' lives, such as their belonging to minority ethnic groups and religious communities [43]. Research remains scarce on how different subgroups engage with these technologies [97]. Here, we detail the religion-related challenges our participants faced using period-tracking apps for menstrual cycle tracking.

4.2.1 Community Forums Clash With Value for Modesty. Several period tracking applications have community boards or educational interface elements that allow users to discuss and learn more about topics relating to their sexual and reproductive health. While this is a relevant feature on a period tracking app, it sometimes clashes with the Islamic values for modesty (or 'Haya'), which frowns upon open conversations about sex, sexual partners, dating, or intimacy, even more so with strangers. These values became apparent in how our participants engaged in period conversations within virtual settings, such as community features within menstrual tracking apps or social media groups. The initial enthusiasm for the forums waned amongst participants due to their unmoderated nature and unfiltered content, ultimately causing them to lose interest and stop engaging. The tensions between wanting to seek knowledge but through the lens of Islamic guidelines became a significant challenge, resulting in non-engagement with these features on menstrual tracking applications. P8 emphasized how she received a negative comment on her discussions within a Facebook group that encouraged engaging in sex during one's period. As a result, she found it uncomfortable to engage in community conversations on social media or within the community portions of tracking apps.

"[...]I try to filter anything that I say, do, or think...through the lens of Islam—so I participate in community conversations where there's a variety of religions or beliefs. It sometimes becomes weird [...] On Facebook, there was a post about having sex during your period. And I said, 'Well, that's something we don't believe in doing.' And

the comments I got were: 'Oh, that's outdated,' 'You can't prove that that's harmful,' and blah, blah. And even though I went, I found studies online that demonstrated that it is harmful to women. Others debated it; some debates are just not worth it. So I stay away" -P8.

P8 highlighted the importance of filtering the information received in menstrual communities/groups on Facebook through the Islamic lens, as religious values are deeply tied to the lived experience of menstruation and sexual, intimate health. However, these filters are currently non-existent in menstrual tracking technology and, therefore, not aligned with the faith-based lives and values for modesty in Muslim women. P11, a 25-year-old Asian practicing Muslim woman in America, used the Flo app for tracking. She found that the community aspect of the app is both Western and not geared toward her, given her cultural background and religious beliefs. As a result, she did not consider the community a safe space to learn and discuss her menstrual health.

"I feel like the community chat or the community aspect is not geared toward me... We (referring to Muslim women) don't take part in the Western dating aspect as a Muslim woman. And most of, a lot of the questions are kind of about their intimate partners. And if someone sexually active describes their problems, I think those are some things that I don't find very geared toward me. And a lot of people ask questions about that. I mean, at least from my app, I could see that. So... I'm not active at all in the community aspect. As a single woman who is not sexually active, there are not a lot of safe places in the Flo app..." -P11.

Similarly, P7, who also used Flo for tracking her periods, considered that the conversations within the community section of the app felt very open and almost like a violation of the faith-based value of modesty and, to a larger extent, a violation of privacy. Although she was not opposed to discussing these topics, she felt it would be more important to discuss them within guidelines.

"Okay, well, I used to go the questions part of the app. And some of the questions and concerns are very provocative. It's, of course, not for Muslim women... And some things that the ladies discussed, I wouldn't feel that they're appropriate to be discussed on such a platform. Of course, for the modesty that we have as Muslim women. But for them, it's normal. So sometimes, answers [to questions] would be very open, which I wouldn't say I like because it feels like it is a violation of privacy. I don't believe that whatever they're discussing is sealed by the developers of this app, and I feel like everything is out in the open. So this is one of the things that I don't like...the discussions on the app." -P7.

P5, a user of the Flo app who sometimes took a peek at the community center within the app, talked about how she felt that the app did not represent her identity. To her, representation was significant, and she found these to be lacking within the community features of the menstrual tracking app. She expressed:

"...Something that jumps out at me is that in the community engagement center. And I've noticed that there

are a lot of Barbaras and Karens and not many Hibah...But it doesn't seem like this is an app for Muslim women. I would feel differently and more supported if I felt like this is an app for Muslim women... It's still women; women still go through similar issues. you don't have to be Muslim to experience a specific kind of issue. But seeing that kind of representation (Muslims) makes you feel comfortable. And it makes me feel more open to opening up about certain things...Sometimes I find myself not saying what I want actually to say, or over-explaining certain things" -P5.

4.2.2 The Multiple Calendar Challenge. Participants talked using two calendar systems: the Islamic Hijri calendar (based on the lunar system) and the Gregorian calendar. The former is used primarily for identifying religiously significant days and months, e.g., celebratory holidays, fasting, and pilgrimage months. P18 utilized an analog tracking system to track her period during Ramadan. While P18 tried using period-tracking apps, she was not satisfied with the experience because they couldn't accommodate her specific religious needs. She particularly stressed the importance of a feature that notifies her of the precise start and end times of her period. This was crucial because if her period begins before sunset during fasting, she must compensate for the entire day's fast. Conversely, if her period ended by mid-day, she could not continue fasting for that day and must make up for it later. These considerations are highly relevant to the daily lives of Muslim women, necessitating seamless integration of dates, durations, and calendars in tracking apps.

"[...] for instance, during Ramadan, we need to keep track of the days we can't fast because we can't pray or fast when we're on our periods. So I have a dry-erase board where I write the dates I couldn't fast and then track them that way... I had my period for five days [...] from this day to this day, and I'll have to make those up." - P18

On the other hand, P4 uses a period tracking app to track her periods and Muslim Pro¹ – a fasting tracker application based on the lunar calendar to track missed fasting days resulting from menstruation – to ensure that she correctly takes note of the number of days of fast that she had missed. Then, she matches these dates with her Gregorian calendar as well.

"[...] I also use the Muslim Pro app. And it says: 'Did you fast today?' So I track it like that. Just so I make sure, I have the number of days correct." -P4

Survey respondent S79 swapped between the Hijri and Gregorian calendars to keep track of the days of fasting that she had missed.

".It helps me track the days to pay back my fasts or make the nearest prayer before I get my period...I write it on the calendar or sometimes swap between the Hijri and Gregorian calendar to try to make a guess" -S79.

These experiences of working with both calendars can be burdensome tasks to keep track of amidst other life responsibilities.

¹Muslimpro- <https://www.muslimpro.com/>

4.2.3 Gaps in Knowledge and Guidance for Navigating Menstruation. Participants in our study highlighted the knowledge gap in trying to balance connections to their faith during menstruation. Mainly the participants were concerned that they needed more Islamic knowledge in navigating the disconnect that comes from the inability to engage in some forms of worship while on their period. We present an instance in the quote below. P3, a 21-year-old, emphasized that period conversations are still taboo within her Muslim community and are frequently not talked about. As a young woman, she found that some areas of her knowledge were still missing—for example, what should she do with the "time off" from prayers? How should she know when and how to purify herself or perform a ghusl? These conversations would be helpful to features within community groups/online forums embedded in tracking apps; there are gaps in education around faith and periods for individuals who identify as Muslim women.

"..When we do have our period, we can't pray. And it's just a week of 'what do I do with my time?'[...] And then, like, when? Do you do Ghusl or purify your body?"—P3

4.3 Roe v. Wade and Implications for Menstrual Tracking Technology

Of the 77 responses we received 87% (N=67) of the survey respondents said they tracked their menstrual cycle. Of those who currently tracked their menstrual cycle, 81% (N=54) reported that their decision to use technologies to track their menstrual cycle had not changed post-Roe v. Wade (see Table 3). Though for the majority of the participants, their tracking behaviors had not changed, many participants shared that the court's ruling did not affect them due to their commitment to the religious value of sexual abstinence before marriage. Additionally, participants shared a variety of concerns that surfaced in light of the court ruling, such as disclosing marital status, data privacy, bodily autonomy, and surveillance, that may impact their perceptions of the ruling. For instance, R8 expressed concerns that the overturn was unjust to women's reproductive health:

"I feel terrible that a decision that should be in the hands of women and women alone is in the hands of government officials. Unfair doesn't feel like a heavy enough word. Roe v. Wade being overturned is an injustice."—R8

Another participant R59, a 39-year-old mother with a daughter, expressed concerns, mostly looking into the future. She mentioned that she continued using a period tracker but worried that women's rights were being removed.

"That women won't have the right to make their own decisions over their bodies. I have a daughter now, and even though I'm done having children, I worry about her and the following generations. I used a period app tracker before Roe v. Wade and will continue to do so"—R59

Survey participants also mentioned the tensions between abortion permissibility within the confines of the faith versus a complete abortion ban. For instance, R48 expressed a viewpoint that supports the concept of "pro-choice," which entails allowing the pregnant individual to decide on abortion while adhering to Islamic principles.

"Everyone should be able to decide what they do to their bodies. Islam has guidelines and even allows it (abortion) in certain circumstances. So I am pro-choice."—R48

Participants who avoided menstrual tracking applications were concerned about privacy and surveillance. These concerns resonated with the broader discourse on "dataveillance", a term Lupton [43] describes as a practice in which digital data is collected and often utilized by third parties without sufficient user transparency. Notably, developers frequently fail to adequately inform users about how their data may be collected, shared, and used, further exacerbating privacy anxieties [1]. It's crucial to emphasize that when it comes to personal choices like adopting an app, our participants expressed worries about their data privacy, bodily autonomy, potential infringement on reproductive rights, and concerns that such decisions might intersect with religious rights, particularly regarding the permissibility of abortion under specific circumstances. For instance, R18 described her concerns around reproductive rights and potential data breach:

"I am concerned about reproductive issues. I know that medications are frequently outlawed for people because they might cause miscarriage without regard to the patient's health, concerns, or needs. I feel bodily autonomy is significant [...] I am a bit scared to use apps now because companies can track and sell your data."—R18.

5 DISCUSSION

Our research uncovers two key themes: (1) the intertwining of menstruation and the religious practices of Muslim women, and (2) the obstacles faced by menstruating Muslim women when utilizing current period-tracking technologies. We discuss considerations of religious identity in HCI studies on menstrual tracking, advocate for intersectionality in HCI research to foster inclusivity of individuals' values in the design of technologies, especially those values rooted in religion and faith, and amplify the voices of under-explored populations. Additionally, we offer recommendations for designing inclusive menstrual tracking technologies.

5.1 Considering Religious Identity in the Design of Personal Health Tracking Technologies

Researchers [13, 16, 27, 28, 41] have emphasized the pivotal role that individuals' identity, including factors like age, gender, ethnicity, and religion, has in shaping their worldview. While previous HCI studies have explored ways in which various aspects of identity impact users' experience and the design of technologies [27, 88], religion remains relatively unexplored, particularly in contexts where religious practices intersect with health. In the context of self-tracking, Lupton [43], argues that identity is important to consider when conducting critical sociocultural analysis of different perspectives in self-monitoring. Lupton also advocates that designers and researchers should "situate design within social and political contexts" as a means of challenging social inequalities, fostering critical reflection, and creating design interventions that are different from those offered by the existing dominant representation. Importantly, re-imagining self-tracking beyond self-improvement

Table 3: Summary of Phase 3 Post-Roe V. Wade Survey (N=77)

| | Survey Respondents (N=77) | |
|------------------------------------------------------------------------------|---------------------------|-------|
| | No. | % |
| Do you track your menstrual cycle | | |
| No | 10 | 13.0% |
| Yes | 67 | 87.0% |
| Frequency of Period Tracking | | |
| Did not Disclose | 10 | 13.0% |
| Always | 63 | 81.8% |
| Other | 4 | 5.2% |
| Ethnicity | | |
| Asian or Pacific Islander, | 21 | 27.3% |
| Black and African American | 28 | 36.4% |
| Prefer not to respond | 1 | 1.3% |
| Prefer to self describe | 11 | 14.3% |
| White | 16 | 20.8% |
| Has your decision to use tracking technology changed Post-Roe V. Wade | | |
| Did not Disclose | 2 | 2.6% |
| No | 62 | 80.5% |
| Yes | 13 | 16.9% |
| Educational Background | | |
| Regular high school diploma | 3 | 3.9% |
| Some college credit, but less than 1 year of college | 5 | 6.5% |
| 1 or more years of college credit, no degree | 7 | 9.1% |
| Associates degree | 4 | 5.2% |
| Bachelor’s degree | 31 | 40.3% |
| Professional degree beyond bachelor’s degree | 4 | 5.2% |
| Master’s degree | 18 | 23.4% |
| Doctorate degree | 5 | 6.5% |

presents us with the opportunity to critique and reshape dominant narratives of selfhood and embodiment, thus enabling the emergence of new possibilities [43]. We endorse this call to action in rethinking our designs beyond dominant representations, by encouraging the community to consider the religious aspects of individual lives and explore how adherents of faith practices interact with technology for health.

Feminist HCI and Value Sensitive Design (VSD) offer a nuanced approach to addressing design challenges. Feminist HCI emphasizes pluralism over universalism in design, advocating for artifacts that embrace diverse perspectives [9]. In the context of menstrual tracking apps, a pluralist approach could facilitate customized community features for women with similar values, fostering shared learning without compromising privacy. VSD encourages consideration of designs constrained by existing technology [5, 11, 25, 38, 48]. VSD’s tripartite methodology prompts researchers to question whose values are prioritized in the design process. Ignoring these questions, particularly in health-related technologies, risks promoting "othering" and straying from equitable research. Our work aligns with the voices of researchers [29, 37], advocating for diversity in HCI studies. A content analysis by Himmelbach et al. [29] highlighted the underrepresentation of religion in HCI work. Essential to promoting justice and inclusivity is intersectional work [29, 36, 37, 74, 89, 90] that considers marginal identities and addresses the dimensions of identity and health.

Harrington et al. [81] proposes expanding HCI design beyond problem-solving to "designing for advancing" - amplifying goals and identities through creative collaboration. "Designing for advancing" empowers understudied groups to express their needs and ensure designs reflect their unique identities. We suggest applying this approach to religious identity, creating opportunities for Muslim women and other faith groups to share their stories, and highlighting the values that they hold important in order for us as researchers to design solutions that align with those specific values. As researchers, it is crucial to design solutions that align with these values to prevent "othering". For instance, the Jewish faith values modesty and utilizes the Hebrew calendar and the Hindu faith uses the lunar calendar to keep track of festivities, such as the Karva Chauth. To achieve inclusivity, researchers must identify common values within different faith groups (i.e., modesty, alternative calendar systems use, etc.) and navigate potential clashes. Design solutions need to incorporate these commonalities across different faith groups, and when values clash, multiple design options may be considered to cater to diverse user groups.

Participatory design, involving collaboration with Muslim women and faith-based groups, ensures that design approaches are inclusive and aligned with their needs. Designing with the goal of "advancing" contributes to a better balance between health and faith practices. As researchers, we must consider how to utilize methods (e.g., participatory and co-design approaches) that include the experiences of under-studied groups. We may need to produce a set of

design objects (similar to Period Packets [22] or Curious Cycles [15]) that invite Muslim women to explore ways in which technology could better support their menstrual health while upholding their preference for religious and faith values. A good example of inclusive design incorporating faith values into technology for women's health is the application Baby+ [65] which was created for pregnant women in Pakistan. The Baby+ app [65] was designed to include verses from the Quran and prayers for a healthy pregnancy. Several participants in that study expressed that the prayers feature was their favorite part of the experience, indicating the relevance of inclusively designing technologies that consider people's values. That paper is one of the few works we have found that has successfully contributed research to the nascent exploration of faith and personal health informatics. We hope our work can serve as a call to action for HCI researchers to collaborate on investigating, supporting, and designing for under-served religious and faith-based communities to improve health and wellness while respecting these communities' priorities, norms, and values. To this end, in the subsequent subsection, we present design recommendations that could advance the unique goals and values of Muslim women.

5.2 Implications For Design

Our research reveals a desire among participants for religious accommodations within general-purpose apps, necessitating customization in existing menstrual tracking tools. While this approach offers the potential to support women of faith, it raises concerns about potentially alienating non-Muslim users who might disapprove of the changes. In designing new menstrual trackers or modifying existing technologies, we recommend the following design considerations. Our recommendations extend to other faiths, especially in areas with shared values like modesty and privacy. We encourage designers to engage in collaborative design practices with individuals from diverse faiths. Taking a collaborative approach enables designers to uncover subtle conflicts in values and work towards developing inclusive solutions.

5.2.1 Designing For the Faith-Inspired Value of Modesty. First, our research indicates that modesty is a key motivator for behavior in practicing Muslim women. To cater to these values, menstrual tracking apps should offer options for users to opt out of features conflicting with their beliefs. Allowing users to choose participation in community features and resources empowers them. Apps could include content filters based on user preferences, enabling individuals to avoid objectionable material while engaging in comfortable conversations. Designers might explore the creation of user-monitored communities within an app, fostering relationships among like-minded individuals who share similar values. This approach aligns with users' modesty values, potentially enhancing engagement and promoting discussions on health and well-being within a secure, faith-aligned environment. This design recommendation will support other faith groups and empower individuals with the opportunity to create their faith-centered communities. This area holds exciting opportunities for future HCI research, utilizing participatory and user-centric design [26, 30, 54] principles to investigate how design decisions in menstrual tracking technologies can resonate with the value of modesty. The emphasis would be on creating designs tailored for the Muslim population and other

religious groups with similar modesty-aligned values. Future research work could explore how values from different faiths inform design choices.

5.2.2 Educational Resources Geared toward Muslim Women. Designers could integrate Muslim-specific educational materials into future period tracking technologies. Addressing knowledge gaps at the intersection of faith and menstruation, these resources can offer guidance on managing the spiritual disconnect Muslim women often feel during their periods, along with articles from faith experts versed in menstrual cycles and reproductive health. Providing information on Islamic laws related to menstruation, purification rituals, and maintaining spiritual connection during menstruation could be challenging but valuable. For individuals with extended menstrual duration, navigating religious practices and guidelines that define menstruation differently than medical terms can be challenging (mentioned in Section 4.1.2). For example, many individuals need help identifying when to determine the end of a menstrual cycle based on patterns of bleeding and performing the ritual bath process. Educational resources provide crucial support in this context, helping them determine when they can resume participation in their faith practices and ultimately reducing the potential for stigma. To accomplish this task requires designers to design within the patriarchy [80]. To adopt this orientation, researchers need to collaborate with religious figures to create educational content for Muslim women [50]. In addition to modifying existing technologies to support menstruating Muslim individuals, critical and speculative design enables designers to imagine alternative futures of self-tracking technologies that foster inclusivity and destigmatization, aligning with calls to accommodate all menstruators [73]. In the US context, where abortion laws impact everyone irrespective of religious beliefs, there's an opportunity to develop educational resources addressing the religious considerations surrounding the permissibility of abortion.

5.2.3 Designing for Multiple Calendars. Coordinating multiple calendars for period tracking proved error-prone and frustrating in our study. Menstrual tracking apps can address this by integrating various calendars to capture cycle details. Our findings suggest an opportunity to design apps supporting Muslim women in tracking both menstrual and faith-related aspects efficiently. For instance, enabling tracking of religious obligations like fasting alongside menstrual information is crucial. Designers could incorporate features allowing users to log missed fasting days due to menstruation. Adopting multiple calendar features, similar to those available for iPhone users with lunar and Gregorian options, can broaden app accessibility not just for individuals practicing Islam, but also for those of various faiths and cultures who rely on alternative calendar systems. Beyond mobile apps, designers should explore alternative methods for period tracking, such as the Islamic Geometry-Based Moon-Period Calendar [58], a physical artifact offering a non-app-based approach.

5.2.4 Designing for Privacy. Despite the post-Roe v. Wade decision by many participants to continue using menstrual tracking applications, there is a notable uptick in concerns regarding data privacy, bodily autonomy, and surveillance. Redesigning menstrual tracking technologies to address these concerns is both a challenge and

an opportunity. Researchers advise transparency in data-sharing practices, emphasizing user awareness of collected data and its usage [3, 70]. They also propose regular privacy check-ups for better user understanding of data sharing, security, and privacy policies in period tracking apps [3]. To promote bodily autonomy in menstrual tracking, Tuli et al.'s [87] concept of "designing for self" is recommended, urging a shift away from smartphones and empowering users to shape and personalize their relationship with menstrual trackers [87]. Dong et al. [17] suggest protecting users' privacy by allowing app access without logging in or sharing health data, enabling users to keep their period data local and confidential. Design researchers could explore these opportunities and also look beyond mobile apps for designing various menstrual tracking artifacts.

6 LIMITATIONS

We attempted to reach a diverse group of Muslim women; however, we acknowledge that our recruitment methodology may have been biased toward practicing Muslim women, particularly those from the Muslim Student Organization bodies. Our recruitment flyers did not specify whether we wanted Muslims actively practicing their faith. However, the preliminary survey (Phase I) asked participants to self-identify their religion and to select whether they considered themselves practicing or not practicing. Around 96% of our preliminary survey participants self-identified as practicing Muslims. Our participants were US-based; therefore, careful consideration must be taken in applying our findings to Muslim women from other backgrounds, especially those who live in non-western environments (e.g., Muslim women in the Arab world or the Middle East). One limitation of our work is that our recruitment led to an overwhelmingly large proportion of practicing Muslim women. Therefore, our findings may not be generalized to individuals who identify as Muslim but do not actively practice their faith. Our preliminary survey did not provide the option to self-identify race/ethnicity. In all phases of the study, we did not ask participants to identify their religious sect within Islam. Also, while there are different ways in which faith practices in Islam are observed in different regions (i.e., Global North) and cultures of the world, the underlying principles and guidelines are the same. Future work could explore the intersection of faith-based values and Western-centric values to unpack innate relationships. Lupton's work could provide a guiding lens to explore such intricate intersectionality. Another limitation is that we did not specifically investigate our participants' perceptions of privacy in the menstrual apps, though we are interested in pursuing this investigation in future studies.

7 CONCLUSIONS

Menstrual tracking applications are widely used and offer users the opportunity to track periods, understand their bodies, engage with other women on topics relating to health and wellbeing, and learn about overall health and wellness. However, for Muslim women, menstruation is also tied to their spiritual practices, offering an added layer of motivation for menstrual cycle tracking that extends beyond health. To investigate how Muslim women in the United States track their periods and understand the impact that menstruation has on their religious practices, we conducted a preliminary survey (N=133), semi-structured interviews (N=20), and a post-Roe

v. Wade survey (N=77). We uncover the similarities of Muslim menstruators with other menstruators, supporting the findings from prior research, and detailing the intimate link between menstrual tracking and religious practices. We present recommendations for designing a faith-inclusive period-tracking app for Muslim women. We highlight the need to support their faith-inspired values, design for complex calendaring and long-term tracking of religious obligations, and provide educational resources to increase understanding of how menstrual health relates to their faith. We discuss how we, as researchers, can engage with religion and spirituality in our designs and advocate for moving past the "othering" of religious identities. Ultimately, our research highlights a need to design health technologies that are responsive to varying religious beliefs and values and we encourage designers to extend personal health tracking technologies to address the specific challenges and needs of individuals of faith.

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