



# Exploring the Design Space of Technological Interventions for Menopause: A Systematic Review

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**Abstract.** Menopause is a phase in a woman's lifecycle, which is considered to have occurred when a woman does not have a menstrual period for 12 consecutive months. Despite being perceived just as a biological phenomenon, a woman experiences several psychosocial symptoms along the way as she transitions into menopause, which begin well before the cessation of menstruation and sometimes continue to exist even after the onset of menopause, making it a 2-to-7-year journey. Ongoing research on women's health in the Human Computer Interaction (HCI) research community has led to an increasing number of works focusing on the intervention of technology in women's health, including a rising interest in designing technological interventions for menopause. With approximately 6000 women reaching menopause daily in the US, there is a need to understand the design space of technological interventions for menopause by surveying prior studies, to eventually contribute towards designing technologies for menopausal women. This paper presents a systematic review of prior studies on technological interventions for menopause. The aim of the review is to (1) Understand how prior studies have approached the design of technological interventions for menopause (2) Identify the technological features and goals of the interventions proposed by prior studies (3) Identify the symptoms (physiological/psychosocial) being addressed by the proposed interventions. A systematic review of 12 papers collected from the ACM Digital Library highlights the characteristics of prior studies on technological interventions for menopause, such as type of study, study design and interventions that are discussed in the study. Based on the findings, we discuss aspects that were comprehensively studied, potential design implications for interventions for menopause along with limitations of the current study and opportunities for future research on technological interventions for menopause.

**Keywords:** Menopause · Women's health · Human Computer Interaction

## 1 Introduction

Menopause is a phase in a woman's lifecycle, which is considered to have occurred when a woman does not have a menstrual period for 12 consecutive months [15]. Research has shown that about 6000 people reach menopause daily in the US [2], usually between the

ages of 45 to 55. Common symptoms associated with menopause include hot flashes, night sweats, reduced sex drive and headaches [7] with early research addressing the most common symptom of hot flush using hormone replacement therapy [15]. Despite being perceived just as a biological phenomenon, a woman experiences several psychosocial symptoms along the way as she transitions into menopause. Menopausal symptoms begin well before the cessation of menstruation and sometimes continue to exist even after the onset of menopause, making it a 2-to-7-year journey before reaching menopause [2]. This has led to the division of menopause into stages, with most of the symptoms occurring during the menopausal transition stage which is the phase between the onset of menstrual irregularities and menopause [15]. Research aiming to understand technology's support for menopausal women have claimed the need for technologies to facilitate social support [12] and to enable communication among women and Health Care Practitioners (HCPs), along with sharing information regarding menopause and self-care strategies [2]. As a result, menopause has been a growing area of interest for technological interventions [11].

Technological interventions have been influencing women's experiences with their bodies and health. With women's health research gaining traction in the HCI research community, an increasing number of works focus on designing and evaluating technological interventions for several women's health issues. Much of the works focus on menstrual health [8, 9] and maternal health [3, 16, 20, 25] followed by menopause [14, 19] and vaginal health [1]. Menstrual trackers are the most widely designed and evaluated menstrual health intervention, with works examining menstrual tracking applications to understand women's menstrual cycle tracking practices [8] and designing better menstrual tracking systems [9]. Interventions for maternal health include designing for breastfeeding [3], designing mobile health applications to support women during pregnancy [16, 25] and designing for emotional well-being of pregnant women [20]. Despite being fairly recent, works on technological interventions for menopause include proposing mobile health (mHealth) applications for menopause such as a menopausal period tracking system [14] and a persuasive coaching application for self-care during menopause [19]. Other forms of technological interventions proposed for menopause include wearables such as smart cooldown bra [23] and smart spaces using ubiquitous computing [4] among others.

With a growing interest in designing technological interventions for menopause, there exists a need to systematically review related literature in the HCI research community, aimed towards understanding the landscape of technological interventions designed or proposed for menopause and identifying opportunities for designing better technological interventions for menopausal women. While prior works within the HCI research community include systematic literature reviews of technological interventions for children with special needs [5] and health technologies for families [17], there is a dearth of works that systematically review literature on technological interventions for menopause. Informed by the body of literature that showcases the value of a systematic review, we propose a review of prior studies that combine menopause and technological interventions, in order to explore the design space of technological interventions for menopause. In this paper, we present findings from the review of 12 papers (the process of identifying this collection of 12 papers is detailed below) focused on technological interventions for

menopause, systematically collected from the ACM Digital Library. The contribution of this systematic review is to characterize prior studies on technological interventions for menopause by identifying the technologies used, their features, goals of interventions (particularly the type of menopausal symptom being addressed) as well as methodologies adopted during the design process. The broader aim is to showcase how menopause is framed by prior studies proposing or designing technological interventions, contributing towards the mitigation of medicalization of menopause [4, 6].

## 2 Methods

The systematic review of technological interventions for menopause was a four-step process, beginning with a comprehensive search for related literature in the ACM Digital Library database followed by screening of the collected data to finalize the corpus for analysis. The following criteria were key to choosing a paper during the screening process (1) The paper must target menopausal women (2) The paper must include a design or proposal of technological intervention for menopause (3) If no technological intervention was designed or proposed, the paper must include implications or guidelines for designing technological interventions for menopause. The data collection process involved reviewing the finalized papers and collecting information particularly related to the study methodology, context and technological intervention being designed or proposed. The final step involved analyzing the data aimed towards answering the research questions (RQ). The following research questions guided this systematic review, during the collection and assessment of characteristics of prior studies on technological interventions for menopause:

- RQ1: What are the types of technological interventions designed or proposed for menopausal women?
- RQ2: What symptoms (physiological/psychosocial) have been explored in the design of technological interventions for menopausal women?
- RQ3: How have prior studies approached the design of technological interventions for menopause?

### 2.1 Database Search

As technological interventions for menopause designed or proposed within the HCI research community was the focus of this review, ACM Digital Library was chosen as the relevant database. With interventions for menopause falling within the broader area of interventions for women's health, a quick search was performed to assess the amount of data available within the database. The search targeting women's health and technological interventions within the ACM Digital Library - Full Text Collection resulted in a smaller corpus (78 publications falling between the years 2011 and 2022). For a comprehensive review, the search was expanded to ACM Guide to Computing Literature which resulted in a slightly larger corpus (91 publications falling between the years 2007 and 2022). As a result, the larger ACM Guide to Computing Literature database was used to search for literature related to technological interventions for menopause.

The primary search consisted of an iteratively developed boolean search string, containing a total of 18 terms combined with AND/OR operators, distributed across the key

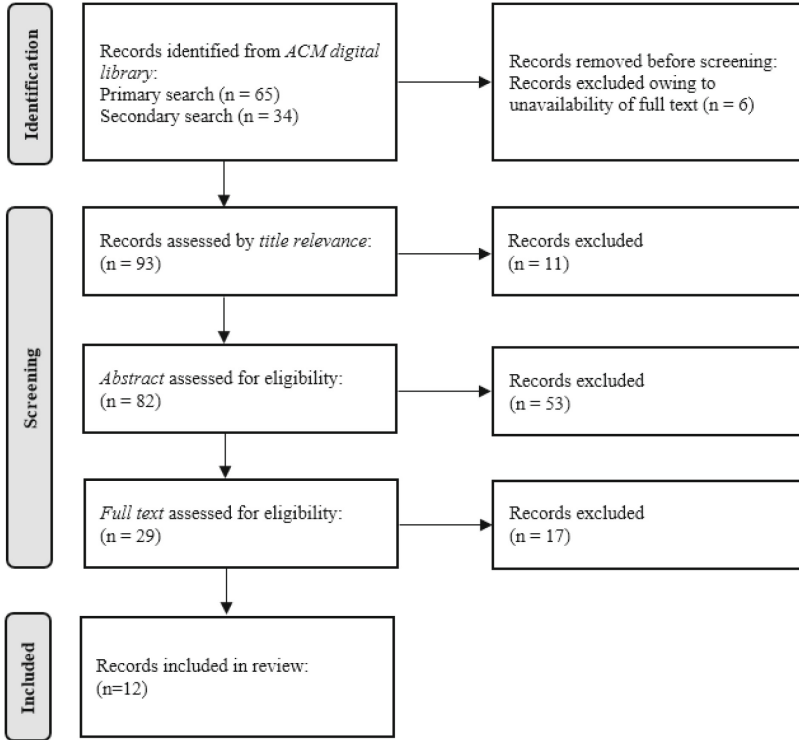
categories of menopause and technological interventions. For instance, terms related to menopause included “menopausal women”, “midlife women” and “perimenopause” to name a few. Whereas terms related to technological interventions included “digital health”, “health technologies” and “FemTech”. Since the corpus related to the broader category of women’s health was small to begin with, no constraints were imposed related to the publication years or publication venue. The resulting corpus consisted of 65 publications, falling between the years 2005 and 2022. Since prior review of literature related to women’s health interventions revealed the frequent use of mobile health (mHealth) as an intervention technology, a secondary search was done, specifically looking for mHealth technological interventions for menopause. The search string included the previous terms related to menopause and instead of terms related to technological interventions, specific terms related to mHealth such as “mobile health”, “mobile app” and “mobile health application” were used in the boolean search string. To avoid repetition, the search excluded publications related to menopause and technological interventions. The resulting corpus from the secondary search included 34 publications (after removing duplicates). At the end of the database search, a total of 99 publications were moved to the next step of title, abstract and full text screening.

## 2.2 Screening Process

The first step in the screening process was to review the total set of 99 publications for availability of full text. This was conducted since a comprehensive search within the ACM Guide to Computing Literature database resulted in extended abstracts being included. Having excluded 6 publications, owing to the unavailability of full text, 93 publications were moved to the title screening step. Publication titles were reviewed for relevance to menopause and technological interventions. Since the corpus was comparatively small, only the completely irrelevant titles, that were neither related to technological interventions nor narrowly related to menopause, were excluded during the screening process. This step led to 82 publications screened for their abstracts which involved reading abstracts of the chosen publications. The publications whose abstracts were directly related to menopause or designing technological interventions for menopause were moved to the full text screening step. While abstracts completely unrelated to menopause resulted in the publications being excluded, several abstracts addressed women’s health issues more broadly, thereby showing potential to be related to menopause. This resulted in publications related to broader women’s health issues also being moved to the next step, resulting in a total of 29 publications being included in the full text screening process. A comprehensive review of the full text of the chosen publications resulted in the final corpus containing 12 publications, ranging between the years 2015 and 2021. Figure 1 shows the process followed during the systematic review that led to the final corpus.

## 2.3 Data Collection

To curate the corpus for data analysis, each publication was reviewed, and key pieces of information related to the study were extracted. This included details regarding the type of study, study design, empirical data being used by the study (along with participant



**Fig. 1.** PRISMA flow diagram showing the number of publications at each stage of the systematic review

demographics) and details regarding the technological interventions being designed or proposed. Publications that did not include design of technological interventions, empirical data or those that included just implications for designing technological interventions for menopause, were flagged for exception despite their key information being recorded. Table 1 shows the corpus of papers on technological interventions for menopause, sorted in ascending order by year, that this literature review is based on.

### 2.4 Data Analysis

Data analysis involved analyzing the key pieces of information curated during the data collection process and associating them with the research questions, in search of responses. Since the corpus was relatively small, the analysis focused on the characterization of studies discussed in each paper rather than trying to analyze the corpus quantitatively or qualitatively. The purpose of analysis was to understand the landscape of ongoing research on technological interventions for menopause and generate preliminary implications based on the results and guidelines disclosed by the studies being reviewed. With the broader goal aimed towards understanding how the prior studies and

**Table 1.** The corpus of papers on technological interventions for menopause.

Paper	Author(s)	Year	Technological Intervention
Designing MHealth Intervention for Women in Menopausal Period	Lee et. al [14]	2015	Mobile health (mHealth) for menopausal women's wellness
Understanding Women's Needs in Menopause for Development of MHealth	Lee et. al [13]	2015	Mobile health (mHealth) for menopausal women's wellness
Participatory User Requirements Elicitation for Personal Menopause App	Trujillo & Buzzi [21]	2016	Mobile application for personalized coaching system for menopausal women
Persuasive Design of a Mobile Coaching App to Encourage a Healthy Lifestyle during Menopause	Senette et al. [19]	2018	Mobile application for personalized coaching system for menopausal women
Towards a Fuzzy Rule-Based Systems Approach for Adaptive Interventions in Menopause Self-Care	Trujillo & Buzzi [22]	2018	Mobile application for personalized self-care
Parting the Red Sea: Sociotechnical Systems and Lived Experiences of Menopause	Lazar et al. [12]	2019	No technological intervention design is being proposed
Inaction as a Design Decision: Reflections on Not Designing Self-Tracking Tools for Menopause	Homewood [10]	2019	No technological intervention design is being proposed
(Re-)Framing Menopause Experiences for HCI and Design	Bardzell et al., [4]	2019	Tracking and relieving stress balls, Smart vibrator, Smart mirror, Smart spaces using ubiquitous computing
HCI and Menopause: Designing With and Around the Aging Body	Tutia et al. [23]	2019	Wearable smart cool down bra, Mobile application for [23] self-tracking, Interactive story map, Adaptive gathering tool
Resisting the Medicalisation of Menopause: Reclaiming the Body through Design	Ciolfi Felice et al. [6]	2021	Smart textile wearable
Utopian Futures for Sexuality, Aging, and Design	Schulte et al. [18]	2021	Wearable smart lingerie

*(continued)*

**Table 1.** (continued)

Paper	Author(s)	Year	Technological Intervention
Designing Interactive Technological Interventions for Menopausal Women	Warke [24]	2021	Web based menopausal digital diary, Wearable interactive jewelry

the designed or proposed technological interventions have framed menopause. Following section presents the findings from the analysis of the collected corpus, sectioned based on key information used for assessing each study.

### 3 Findings

This section reports findings from the systematic review of 12 papers focused on technological interventions for menopause. The sections are categorized based on the pieces of information that played a key role in characterizing each study against the research questions.

#### 3.1 Type of Study

Following others [17], type of study in each paper was classified as formative, evaluative or design proposal. Studies were considered formative if they discussed research conducted to elicit design implications or guidelines for designing technological interventions for menopause. Evaluative studies were those that evaluate and report the impact of new or existing technological interventions for menopause. Papers were considered to contain a design proposal study if they propose a novel design of a technological intervention for menopause. Most of the papers reported a combination of studies, such as formative and design proposals or design proposals and evaluative.

Among the 12 papers, only 4 papers discussed an exclusive type of study, with 3 of them being formative suggesting guidelines for designing interventions for menopause based on understanding menopausal women's experiences [12, 14, 18] while 1 of them containing design proposals [24] for technological interventions for menopause. A total of 4 papers discussed studies that were both formative and design proposal, among which 1 paper contained formative guidelines followed by designs proposed by the researchers [13], 1 paper contained formative guidelines but design proposed by participants of research [6], 1 paper discussed formative guidelines followed by design provocations rather than proposals [23] and 1 paper contained speculative design proposals followed by guidelines for designing interventions to enhance menopausal women's experiences [4]. Among the 12 papers, 2 of them included a design proposal and an evaluative study containing a straightforward design proposal of an mHealth intervention followed by evaluation of the same [19, 22]. There were 2 papers that were within an exception category of formative and evaluative studies, with 1 containing formative guidelines and use case for interventions for menopause which were evaluated by participants [21] and the other taking a reflective approach in evaluating existing interventions for menopause

and proposing inaction as a guideline for designing menopausal interventions [10]. Note that some of the design proposals looked beyond using computational technology, as they included design of textiles, services, and speculative scenarios among others.

### 3.2 Study Design

This section reports details regarding the study discussed in the 12 papers being reviewed. Participant size and demographic characteristics are reported wherever available, with participant involvement denoting the contribution that participants have towards the design of technological interventions for menopause. Context of study and research methodologies are included to curate the approaches that prior works have taken in designing technological interventions for menopause.

#### Participant Size and Demographic Characteristics

Among the 12 papers reviewed, only 8 of them reported some form of empirical data that involved participants. Within the 8 studies containing data related to participants, 2 pairs of papers and a group of 3 papers, were related. To elaborate, papers [13, 14] were both related and works of the same authors, with [14] involving a total of 13 participants including middle aged women between 45 and 60 and their family members, located at South Korea, to curate guidelines for designing technological interventions for menopause based on participant requirements and [13] proposing prototype of an mHealth intervention for menopausal women, designed based on guidelines gathered during the study discussed in [14]. Similarly, papers [4, 12] were related, with [12] reporting findings from analysis of empirical data scraped from an online forum, while [4] used the same to propose speculative interventions for menopause. The papers [4, 12], despite not having direct participant involvement, contained analysis of 300 discussion threads and 2065 corresponding comments, from covering approximately 72% of a Subreddit menopause forum corpus. The papers [19, 21, 22] were all related to the same study (divided into four phases) based off of Tuscan region in Italy, with [21] eliciting initial requirements for a mobile application for menopause gathered from 26 women experiencing pre-menopause or menopause (the first two phases), [19] designing a prototype based on the requirements gathered and evaluating the same with 14 women (the third phase) and [22] developing the technical model for the mobile application for menopause, involving a total of 34 participants (missing demographic information) during the evaluation of model variables (fourth phase). Among the other 5 papers, only 3 papers reported on some form of participant data. The paper [23] reported on a study involving 17 cisgender women, recruited from social media groups related to menopause, towards understanding participant requirements in designing technological interventions for menopause. The paper [6] insisted on the value of participants being active actors during the design process, by involving a total of 12 women between the ages 44 and 58 from one or more of the countries including Argentina, Sweden, Finland, and France, across two phases, eventually leading to participants proposing designs of interventions for menopause. The opinion paper [18] summarized a workshop exploring the role of technology to support aging women with their intimate life, that involved active conversations among participants and researchers, coming from a Western European perspective, but the paper did not disclose the exact participant size. Further, papers

[10, 24] had no form of participant data with [10] taking an autoethnographic, reflective approach towards designing for menopause whereas [24] contained design proposals without concrete empirical data.

### **Research Methodology**

Research methodology adopted by each study was included in the review, to understand how prior studies have approached the design of technological interventions for menopause. From the review, it was evident that most of the studies took the efforts to actively engage with participants' experiences including eliciting their requirements and ideas during the design and evaluation of interventions. For instance, papers [18, 23] discussed studies that adopted a participatory design approach to encourage participants to actively communicate their experiences and ideas using a speculative narrative. Another form of participatory design method discussed, related to participants designing interventions with materials provided during the study [6]. Some other common methods adopted by several studies were focus group interviews [14, 21, 23] and semi-structured interviews [6, 14, 23], both aimed towards gathering firsthand qualitative data from participants' experiences. The papers [4, 12] adopted a theoretical approach towards analyzing secondary data collected from scraping, along with [4] using a speculative design methodology to propose design interventions for menopause. Papers that were exceptions involved unique methodologies including [19] that described an evaluative study using thinking aloud protocol and [10] where the researcher reflected based on the evaluation of existing interventions for menopause, to eventually decide not to design technological interventions for menopause.

### **Participant Involvement and Context of Study**

All studies that involved participatory design as a research methodology [6, 18] showcased ample involvement, with participants actively contributing towards the formulation of design implications or towards the design of technological interventions for menopause. Participant involvement was also observed in studies involving focus group interviews [14, 21, 23] as well as semi-structured interviews [6, 14, 23], as firsthand experiential information from participants contributed towards the design of interventions for menopause. Evaluative studies [19, 21, 22] also showcased participant involvement with participants actively involved in evaluating use cases [21], evaluating prototypes [19] where participants expressed their concerns related to data privacy and evaluating model variables [22]. Exception papers related to participant involvement included paper [12] that had secondary data collected from an online forum and papers [10, 24] that had no form of participant data.

With respect to the context, studies involving participatory design, focus group interviews as well as evaluations were conducted in a design lab setting or researchers' institution with only one study [6] reporting that the semi-structured interviews were conducted including at the participants' homes or workplaces. The context of the study was included in the review to assess how much of menopausal women's contextual information was included during the design of technological interventions for menopause.

An overall observation from the review of participant data and study design showed that efforts were being made to understand menopausal women's experiences, by

deploying participatory design research methods, either through firsthand participation or through secondary data, during the design of technological interventions for menopause. The studies reviewed so far, however, suffered from the fact that interventions for menopause were predominantly west centered, revealing opportunities to design technological interventions for menopausal women in the global south.

### 3.3 Technological Intervention

This section reports details regarding the technological interventions designed or proposed by the 12 papers being reviewed. Details regarding the technological interventions including the type of technology and features are reported wherever available. The subsection on goal of intervention is aimed towards assessing the symptoms being addressed by the designer or proposed intervention, with a broader goal of understanding how the interventions frame menopause.

#### Type of Technology and Features

Among the 12 papers reviewed, only 8 of them involved some form of technological intervention being designed or proposed. With papers [13, 14] being related, the intervention being proposed was an mHealth intervention focused on menopausal women's wellness, that allows menopausal women to record their menstrual cycle, provide personalized information from health professionals and social support. The papers [19, 21, 22] were also related to the same study, with the proposed intervention being a persuasive mobile application that acts as a mobile coaching system for menopausal women, automatically adapting to their personalized health needs. The paper [23] proposed design provocations including wearable technologies such as smart cool down bra and mobile application for self-tracking menopausal symptoms and sharing educational information. Despite being a research proposal with no empirical data, the paper [24] proposed a web based technological intervention, the menopause digital diary, to record menopausal women's daily personal stories. The paper also included a design proposal for an interactive jewelry that takes the form of a wearable, for tracking quantifiable menopausal symptoms. The paper [4] included proposal of smart vibrator, smart mirror and smart spaces designed using ubiquitous computing, to cater to menopausal women's needs. Papers also included design proposals for interventions for menopause that are beyond technology, details of which are discussed in the following sections.

#### Goal of Intervention

The review included the goal of technological interventions being designed or proposed, in order to assess how prior studies have framed menopause, particularly based on the symptoms such as physiological or psychosocial. As stated earlier, menopause has been often perceived as a biological phenomenon with research proposing hormone replacement therapy to address the most common menopausal symptom of hot flush [15]. The assessment of the goals of technological interventions was approached with the presumption that works continue to reduce menopause to a set of biological symptoms. However, our presumptions were proven wrong when most of the studies showcased the efforts taken in addressing menopausal women's overall well-being. This was particularly the case with the papers [19, 21, 22] that focused on designing a mobile coaching

application aimed towards self-care for menopausal women. The same was the case with the papers [13, 14] whose aim was to design mHealth intervention for menopausal wellness, though there was a lack of clarity on the definition of menopausal wellness. In the paper [4] the authors clearly stated their belief that menopause is beyond physiological symptoms and the same was evident in their design proposals that were aimed towards addressing menopausal women's overall well-being. Despite proposing a wearable for the specific symptom of hot flush, in the paper [23] the authors stated that the focus of their design interventions is to design with and around menopausal women's overall well-being. The same was the case in the papers [6, 18] where the proposed designs seemed to be related to overall well-being of aging women and enhancing their menopausal experiences. In the case of [24], the proposed interventions were aimed towards collecting menopausal women's experiential and quantifiable data, to serve as a repository for women to understand their own menopausal experiences and eventually enhance their quality of life.

An overall observation was that mHealth technology was the most opted form of technological intervention with proposed designs taking the form of mobile applications. Understanding the goals of interventions revealed that efforts are being taken to mitigate the medicalization of menopause, by designing for menopausal women's overall well-being rather than a specific physiological or psychosocial symptom. The challenge, however, was the lack of evaluation of the proposed designs to understand their effectiveness in providing delightful experiences for menopausal women. Further, most of the studies seemed to lack consideration of context and did not explicitly discuss how the proposed interventions can measure and enhance menopausal women's contextual experiences.

### 3.4 Beyond Technology

This section was a result of the systematic review as some of the papers included design proposals for interventions for menopause, that are beyond computational technology. To elaborate, the current review approached technological interventions as those that involve some form of computational technology including mHealth, smart wearables and telehealth, among others. However, the collected corpus not only contained technological interventions for menopause but also included other forms of design interventions such as design of textiles, services, and scenarios, all contributing towards a better menopausal experience. For instance, [4] discussed speculative interventions such as a menopause lifestyle brand that provides products and services aimed at the new freedom available menopausal women. In [6], the participatory design study resulted in the design of cocoon and spike mat, both being made from textile materials inspired by Soma design. The resulting narratives from a participatory workshop summarized in [18] included a sexual care package subscription and lingerie suitable for women using urinary incontinence pads, both aimed towards enhancing aging women's bodily experiences. Presence of other forms of design interventions for menopause in the corpus opened opportunities for design implications that look beyond technological interventions for menopause. Further, it also exposed a gap in the current review, highlighting opportunities for future work.

## 4 Discussion

The synthesis of findings from the review of 12 papers on technological interventions for menopause serves as a starting point for initiating conversations on the role of HCI in designing interventions for menopause and eventually contributing towards mitigating medicalization of menopause. In the following section, we reflect on how the assessment of the corpus addresses the proposed research questions, by characterizing the technological interventions being discussed. This section also sheds light on how such interventions construct menopause, exposing the existing limitations and discussing implications and opportunities for future research that contributes towards de-medicalization of menopause. The proposed implications are nascent owing to the size of the corpus, which in itself reveal an opportunity - of the need for HCI to intervene more actively in designing interventions for menopause.

### 4.1 Characterizing Technological Interventions

The responses to the research questions guided the process of characterizing technological interventions for menopause focusing particularly on the aspect of menopause that is being addressed by the intervention (such as a symptom) leading to understanding how the intervention operationalizes menopause. We approached the review with an a priori hypothesis that studies continue to reduce menopause to a set of biological symptoms. The hypothesis was falsified, when the assessment of studies showcased the efforts taken by interventions to address menopausal women's overall well-being rather than focusing on a specific physiological or psychosocial symptom. However, interrogating each of the technological interventions being designed revealed menopausal women's health data that is being captured and processed, showcasing their limitations. For instance, [13, 14] propose the design of an mHealth intervention that support menopausal women's overall wellness, by capturing data related to menopausal women's period cycle alongside personal demographic information. The proposed intervention is claimed to share personalized menopause related information by gauging the woman's menopausal phase. Additionally, the intervention is claimed to push messages with exercise suggestions, thereby constructing menopause as a biological condition. A similar approach is taken in [19, 21, 22] where the authors propose the design of a persuasive menopause mobile application that supports self-care. Analyzing the prototype, however, revealed that the application captures menopausal women's physiological symptoms such as hot flush, osteoporosis etc. alongside diet and steps walked, with the goal to persuade users into making behavioral changes, leading to the reduction of cardiovascular risks caused by menopause. By focusing on an effect of menopause that is clearly physiological, the aforementioned study continues to construct menopause as a biological condition. Several other studies, while speculatively proposing technological interventions, tended to focus on either a specific physiological symptom such as hot flush [23] or quantifying symptom related data using sensors and bio signals [24], thereby reducing menopause to a biological construct. Very few studies that proposed the design of services and non-technological interventions for menopause [4, 18] looked beyond the physiological symptoms of menopause.

In summary, a closer look at the interventions revealed that, while efforts are being taken to support menopausal women's holistic wellbeing, there remains a gap in translating those efforts into design of tangible technological interventions. Additionally, it was evident that non-technological interventions focused more on designing interventions for menopausal women's overall wellness.

## 4.2 Construction of Menopause

We approached the analysis with the presumption that menopause has been overmedicalized. However, several studies proved otherwise, with their discourses centered around designing technological interventions for menopausal women's holistic wellbeing. Comparing the discourse of the studies being reviewed alongside the technological interventions being proposed, including the data being collected and its functionalities, however, revealed a gap in the discourse being translated into the technological intervention being proposed. We observed that menopause continued to be operationalized as a biological construct, with interventions capturing quantifiable data and taking an information processing approach. While the overall analysis showed that studies are moving away from medicalization of menopause, towards holistic wellbeing, it was evident that the claims were nascent with the technological interventions continuing to quantify menopausal experiences. The studies that proposed non-technological interventions were more aligned towards supporting menopausal women's holistic wellbeing but fell short of being implemented and evaluated and remained speculative. Additionally, the review showed that studies on interventions for menopause were predominantly west centered, revealing opportunities to design technological interventions for menopausal women in the global south.

In summary, the assessment of the interventions discussed within the corpus showed that efforts are being taken to mitigate the medicalization of menopause, but the technological interventions being proposed lacked clarity on how the efforts were translated to support menopausal women's holistic wellbeing.

## 4.3 Towards De-medicalization of Menopause

The assessment of studies proposing technological interventions for menopause, revealed opportunities to look beyond physiological symptoms and quantifiable menopausal experiences. Further, the synthesis revealed design interventions for menopause beyond computational technology, through design proposals of textiles, services, and scenarios, all of which were aimed towards addressing menopausal women's holistic well-being. As an attempt to contribute towards de-medicalization of menopause, a potential design implication would be to propose system designs that combine emergent computational technologies along with non-technological interventions such as services [4], soma design inspired products [18], care packages [18] etc. aimed towards not only capturing quantifiable data but also providing enhanced experiences for menopausal women's overall well-being. This implication was inspired by the design proposal discussed in [4] where the authors propose the design of Menobuddy, a traditional doll combining computing capabilities to record and playback menopausal experiences in the form of stories.

In order to contribute towards the de-medicalization of menopause, we suggest that technological interventions be designed acknowledging the “entanglements of the physical and psychosocial” [6] experiences during menopause.

## 5 Limitations and Future Work

The aim of this paper was to characterize prior studies on technological interventions for menopause by identifying the symptoms (physiological/psychosocial) being addressed and showcasing how menopause is framed, eventually contributing towards the mitigation of medicalization of menopause. A systematic literature review was adopted as the methodology, to survey the landscape of studies on technological interventions for menopause within the HCI research community.

The database searched to create the literature corpus was the ACM Digital Library. Despite being recent, designing interventions for menopause have been an emerging area of interest in various fields. However, this review was focused only on interventions proposed by the HCI research community, with an underlying assumption that the ACM Digital Library is the optimal database for a comprehensive review. The resulting size of the corpus, however, revealed the need for looking beyond the ACM Digital Library, to include other databases such as Google Scholar, to expand the size of the corpus. The primary database search focused on technological interventions for menopause with the secondary search narrowing down to mHealth interventions. However, there could have been other forms of technological interventions for menopause, which were not captured by the current review. Furthermore, the review was intended to survey the landscape of technological interventions for menopause by characterizing studies related to the same, rather than assessing the quality of each study. As a follow on, review of the corpus also revealed other forms of design interventions for menopause, that are not necessarily technological, which are also not captured in the current review.

Menopausal conditions are often experienced alongside other related health conditions, owing to the woman’s age. This means that there could be technological interventions not necessarily designed for menopause but cater to menopausal women’s health needs. Since the current review focused exclusively technological interventions for menopause, a potential future work can be aimed towards expanding the corpus to include interventions that directly or indirectly cater to menopausal women’s health needs, to eventually propose technological interventions that cater not only to menopause but potentially to other health conditions that women experience alongside menopause, designing for those experiences as a whole.

## 6 Conclusion

This review reports a systematic synthesis of 12 papers in HCI literature focused on technological interventions for menopause, aimed towards exploring the design space for creating interventions for menopause. The findings revealed that designing technological interventions for menopause has been a rising area of interest, with studies being fairly recent (2015 to 2021) but most of them aiming to address menopausal women’s overall well-being rather than reducing menopause to a set of biological symptoms, by

involving women during the research and design process. The findings also revealed that interventions for menopause can expand beyond computational technology, to cater to menopausal women's health needs. Based on the findings, we unpack design implications for menopause and recommend areas where HCI might be able to intervene.

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