Original Paper

A Flexible Meal-Building Web Application for Food Is Medicine Programs: Development and Usability Study

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Abstract

Background: Food Is Medicine (FIM) interventions are increasingly integrated into health care and community settings. Although FIM interventions show promise for improving diet and clinical outcomes, results have been mixed, and positive effects may attenuate over time. Digital nutrition and cooking mobile apps and web applications have emerged as part of FIM interventions and may help FIM participants apply nutrition education to develop meal-preparation skills. The GRACE (get a base, round with real produce and proteins, add aromatics, cook gently, and enhance with flavor to align with dietary guidance) Framework provides the foundation for integrating ways to create and adapt meals. The GRACE Kitchen progressive web application (PWA) prototype was designed to operationalize this framework.

Objective: This study describes the development of the GRACE Framework, its translation into the GRACE Kitchen PWA prototype, and examines preliminary user feedback on the prototype.

Methods: An iterative developmental design based on 2 separate pilots (Food Is Medicine Healing Together [FIM-HT] and Food Is Medicine for Black Breast Cancer Survivors [FIM-BCS]) was organized into 3 developmental stages. In stage 1, qualitative interviews (n=17) with participants with hypertension from a 12-week pilot FIM intervention (FIM-HT) were analyzed to identify facilitators and barriers to sustaining Dietary Approaches to Stop Hypertension (DASH)–aligned eating, including produce delivery and nutrition education. Themes elicited from the FIM-HT interviews informed the development of the GRACE Framework. In stage 2, the GRACE Framework was translated into the GRACE Kitchen prototype. In stage 3, breast cancer survivors (n=12) participated in an 8-week FIM pilot (FIM-BCS) and simultaneously underwent preliminary testing of GRACE Kitchen. User experiences were assessed using a modified Mobile App Usability Questionnaire and focus group data.

Results: Across the 3 developmental stages, feedback from 29 participants contributed to the development of the GRACE Framework and the GRACE Kitchen prototype. During stage 1, initial conceptual ideas for the GRACE Framework were based on 3 themes identified in the FIM-HT interview data: Changes in Eating Behaviors, Challenges to Cooking, and the Maintenance of Healthy Cooking and Eating Behaviors. Participants emphasized finding new ways to incorporate vegetables, spices, and herbs; swapping in healthier ingredients; adapting recipes to their preferences; and navigating the challenges of meal preparation and cooking. In stage 2, this feedback informed the development of the GRACE Kitchen PWA. During PWA testing (stage 3), FIM-BCS participants (n=12) reported ease of use (2.70/4), satisfaction (2.67/4), and usefulness (2.71/4). The FIM-BCS participants also provided qualitative feedback indicating strong acceptability of GRACE Kitchen's guidance on making meals easier to prepare. However, they found the interface challenging to use and preferred a more mobile-friendly, easier-to-navigate approach.

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Conclusions: Preliminary feedback suggests that GRACE Kitchen was perceived as moderately useful and highly acceptable, while also revealing important usability limitations. Although participants reported that the GRACE Framework was supportive, further evaluation is needed to determine whether GRACE Kitchen can help sustain dietary practices.

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KEYWORDS

Food Is Medicine; health literacy; mobile apps; DASH diet; cooking; feasibility studies; mixed methods; culinary medicine

Introduction

A suboptimal diet is associated with diet-related conditions such as cardiovascular disease, type 2 diabetes, obesity, and diet-related cancer diagnoses [1-3]. Although diet quality has improved over the last 2 decades, with a lower proportion of individuals reporting poor diet quality (37.4% in 2020 vs 48.8% in 1999), only 1.58% of American adults achieved ideal diet quality [4]. Furthermore, based on a model of 10 dietary factors and US cardiometabolic deaths in 2012, suboptimal diets were associated with 45.4% of cardiometabolic deaths [3]. In 2018, over 50% of US adults had at least one chronic condition, and 27% had multiple conditions [5-7]. Additionally, these disease burdens disproportionately affect marginalized racial, ethnic, and low-income populations [8-13], particularly those who are food insecure and whose diet quality has not changed over the last 2 decades [4].

Food Is Medicine (FIM) interventions span a spectrum of programs and services, such as clinic-provided food assistance and produce prescription vouchers for farmers' markets, that address the critical link between a healthy diet and diet-related chronic diseases [14-19]. These interventions have been proposed as approaches to improving diet quality, addressing chronic disease, and reducing food insecurity. Recent evidence has shown that adult participation in FIM programs is associated with increased fruit and vegetable intake (+0.85 cups/day), reduced food insecurity (odds ratio 0.63), and improved cardiometabolic outcomes, including reductions in hemoglobin A_{1c} (−0.29%), blood pressure (−8.38/−4.94 mm Hg), and BMI (−0.36 kg/m²) [20,21]. FIM interventions that followed specific dietary patterns, such as the Dietary Approaches to Stop Hypertension (DASH) diet, were effective in improving cardiometabolic outcomes, including body weight, in healthy populations [22]. Although DASH was originally developed to lower blood pressure, its benefits extend beyond individuals with hypertension, with substantial evidence supporting its favorable effects on cardiometabolic risk factors in broader populations [23]. However, FIM programming varies, and although it may address food access by providing food assistance, this alone may not translate into FIM-related dietary behaviors, such as healthy meal preparation and the development of culinary skills. Although adding nutrition and culinary education to FIM programming has been associated with improved outcomes, these components are not consistently included. Furthermore, it remains unclear how nutrition knowledge translates into adaptable meal preparation and culinary skills, as well as sustained dietary behavior change [24].

Nutrition education can be positioned to address access, affordability, time, knowledge, capacity, and cooking skills, which are key factors that can shape the success of FIM programs [14-17,22,24,25]. Integrating nutrition education into FIM interventions is also considered a critical component of achieving successful clinical outcomes [26,27]. However, a scoping review of over 100 FIM studies found substantial variation in the integration of nutrition and culinary education into FIM programming, ranging from printed materials and video tutorials to nutrition and cooking workshops and digital health apps [28]. Furthermore, the frequency and delivery of educational sessions varied, ranging from 1-3 sessions during the intervention to on-demand delivery. Although registered dietitians most commonly delivered nutrition education, the vast majority of studies did not specify who delivered it [28]. Additionally, very few studies have evaluated educational components; therefore, the impact of education and the effectiveness of different educational approaches remain unclear [28]. FIM interventions that feature medically tailored groceries or produce prescription programs, in which meal preparation skills are particularly useful, were more likely to include printed materials, video tutorials, and mobile apps [28]. Given this variability and the limited evaluation of educational components, there is a need for a better understanding of the intersection of culinary medicine, behavioral strategies, and nutrition education [29]. Gaps also remain in translating these approaches into practical meal preparation skills and strategies for dietary behavior change beyond the intervention period, with some studies reporting a return to baseline cardiometabolic measures after support ends [30-32].

These findings highlight the need for complementary support in FIM studies that is accessible not only during the intervention but also afterward. Although digital apps have become increasingly available in FIM programming, current apps often prioritize food access, tracking, or information delivery without adequately supporting culinary skill-building [22,28]. As a result, many digital apps lack clear guidance on translating knowledge into sustained practices, such as meal planning, food preparation, and adaptive decision-making in real-world contexts. Engagement and effectiveness also remain variable across populations. Therefore, there is a need for a digital companion to FIM programming to address this gap. The GRACE (*g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance) Framework was developed to assist participants in applying nutrition education and culinary skills to prepare meals they want to eat, and that can become part of their daily lives.

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The GRACE Framework was established as a skill-based approach, informed by pilot FIM interventions, to guide individuals in building meals using flexible, adaptable components rather than prescriptive recipes that can be maintained after FIM interventions. The GRACE Framework includes the following steps: *g*et a base (eg, grains), round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance, such as the DASH diet. To extend this approach into practice, we developed GRACE Kitchen, a web-based prototype application that implements the GRACE Framework to support flexible meal construction based on available foods and individual preferences. The primary purpose of GRACE Kitchen is to support meal construction and the practical application of nutrition and culinary knowledge gained through FIM interventions, with the goal of improving culinary skills, meal planning, cooking self-efficacy, and food utilization. The aim of this study was to describe the formative development of the GRACE Framework and the initial prototyping of the GRACE Kitchen application within FIM interventions that used the DASH diet to support home cooking and adaptable meal construction.

Methods

Study Design

This study used an iterative developmental design based on 2 separate pilot studies (Food Is Medicine Healing Together [FIM-HT] and Food Is Medicine for Black Breast Cancer Survivors [FIM-BCS]) and was organized into 3 developmental stages [33]. The first stage included qualitative interviews (n=17) with participants in FIM-HT, a 12-week, single-arm pilot study. Findings from the interviews and the principal investigator's (PI; SL) implementation experience informed the second stage: the development of the GRACE Framework and a progressive web-based prototype application (GRACE Kitchen). Finally, the third stage involved evaluating the initial app components in the FIM-BCS study (n=12), an 8-week, single-arm pilot intervention. The development and iterative design of the GRACE Framework and GRACE Kitchen prototype were reported using the GUIDED (Guidance for the Reporting of Intervention Development; see Multimedia Appendix 1) checklist [34].

Stage 1: Qualitative Study Informing Initial Design of the GRACE Framework and Web-Based Application

Setting and Intervention Context

The initial development of the GRACE Framework and web application was informed by qualitative interviews with participants in the FIM-HT pilot study (n=17). FIM-HT was a 12-week pilot study involving 24 Black women with hypertension. The intervention provided biweekly DASH-aligned food, in-person cooking classes, virtual nutrition and hypertension education, and hypertension self-management support via SMS text messaging. The aim of the study was to assess the feasibility and acceptability of the FIM-HT pilot. Participants in this stage were recruited through a local Chicago clinic via provider referrals and electronic health records. The eligibility criteria were self-identification as Black/African descent women with hypertension (≥130/80 mm Hg or a diagnosis of hypertension), a BMI ≥30 kg/m^2, and an age of 18 years or older. Exclusion criteria were inability to speak or read English, cognitive impairment, inability to cook at home, current cancer treatment, liver or renal disease, or pregnancy. The target sample size was 20 participants to test feasibility and acceptability, allowing for approximately 20% attrition from an initial enrollment target of 24 participants, consistent with other pilot studies [35]. No separate qualitative sample size target was established for the interview component because interview participants were drawn from those who completed the FIM-HT pilot study.

Procedures

After the 12-week FIM-HT pilot concluded, we conducted individual interviews with 17 women with hypertension. Of the 20 women who completed the pilot, 17 participated in the interviews. The interviews were conducted online using HIPAA (Health Insurance Portability and Accountability Act)–compliant audio-recording software (Zoom; Zoom Video Communications, Inc). The individual interviews took place from November 2023 to February 2024, and each lasted 30-60 minutes. The purpose of the interviews was to explore participants' experiences with the FIM-HT pilot study, their perspectives on its components, and best practices for engaging them during and after the pilot. The relevant interview questions and probes that informed this study were as follows:

- Can you share your thoughts on the cooking classes and grocery delivery?
- How was your experience with the DASH eating plan specifically? Did it help you better understand and manage your hypertension? Were there aspects of the plan that you found particularly beneficial or challenging?
- Could you describe your current eating habits? Has the project, particularly the DASH eating plan, influenced these habits? Can you provide an example?

Participants' feedback, particularly regarding what they learned in the cooking classes about creating healthy meals and maintaining the DASH diet, was used by the PI (SL) to conceptualize and develop the GRACE Framework.

Stage 2: Development of the GRACE Framework and Progressive Web Application (GRACE Kitchen)

GRACE Framework and Kitchen Overview

The GRACE Framework was developed as a pragmatic approach to building DASH-aligned meals using produce and pantry items provided as part of an FIM intervention. However, the broader purpose of this framework is to help individuals create recipes and meals using ingredients they have on hand and according to their personal tastes while maintaining healthy eating habits, regardless of the dietary pattern or intervention they are following. Insights from the FIM-HT interviews suggested that ingredient substitutions and modifications to cooking methods (ie, switching from frying to sautéing), along with an emphasis on seasoning, meal preparation, and awareness of healthier cooking practices, were needed to support behavior

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changes aligned with DASH eating patterns. These insights informed the development of GRACE Kitchen. GRACE Kitchen was designed to support FIM program participants who receive fresh produce in creating easy-to-prepare recipes while preserving their individual cooking styles. Additionally, GRACE Kitchen helps reinforce the culinary and nutrition skills learned through nutrition education. The framework was also intended to promote greater independence and flexibility in meal preparation over time.

There are 5 meal-building steps in GRACE, and they are rooted in the DASH eating pattern. As defined earlier, GRACE stands for get a base, round out with real produce and protein, add aromatics, cook gently, and enhance with flavor. Get a base refers to selecting a base ingredient, such as whole grains, rice, broth, or greens, and building the meal around it. Next, round out the meal with real produce and proteins aligned with DASH, such as kale, spinach, chickpeas, and lean chicken. Aromatics refer to vegetables such as peppers, onions, and garlic, which help flavor the base, produce, and proteins. Cook gently refers to using cooking methods such as roasting, sautéing, steaming, and baking. Lastly, enhance with flavor is the finishing step, which helps balance the flavors of the meal. Herbs, spices, and acids (eg, lemon and lime juice) are central to this step and can be incorporated directly or through sauces and vinaigrettes.

Although GRACE is presented sequentially, its steps are flexible and can overlap. For example, when using GRACE to prepare a grain bowl, one can make a rice bowl (get a base) seasoned with onions and garlic (add aromatics), then add broccoli and chicken (round out with real produce and protein) sautéed with green peppers (add aromatics and cook gently), and finally add a squeeze of lemon, thyme, and oregano (enhance with flavor). As the FIM-HT pilot, which was based on the DASH diet, informed the development of the GRACE Framework, the framework emphasizes the use of spices and herbs to enhance flavor. This approach was developed to give participants a choice in how they prepare their meals while building skills and developing flavors that prioritize sodium reduction.

The GRACE Framework was designed to be flexible, allowing individuals to cook as little or as much as they like. GRACE is particularly well suited to rice or grain bowls and stir-fries, but it can also be used to prepare soups, salads, sheet-pan meals, and meals using slow cookers or pressure cookers. This flexibility extends beyond meal types to weekly meal preparation. Individuals can prepare 1 or 2 GRACE meals per week and then reheat, remix, or assemble them throughout the week without having to cook from scratch each time. Reheating a meal on the stovetop or in the microwave is a convenient option when cooking is not possible. Remixing a meal involves adding 1 or 2 vegetables, proteins, or grains, or enhancing it with sauces already on hand. Assembling a meal involves combining the prepared components with 1 or 2 additional pantry or produce items to create a new dish, such as a salad, wrap, or cold meal.

The GRACE Kitchen progressive web application (PWA) translates the GRACE Framework into a digital format. Its features are designed to help users identify available produce and pantry items and guide them in building meals using the GRACE steps. The application also supports weekly meal planning by demonstrating how to use reheating, remixing, and assembly techniques to prepare meals based on available time and convenience.

Development of GRACE Kitchen

The GRACE Kitchen PWA was developed based on participants' needs and preferences, including factors that could influence the maintenance of dietary behaviors and continued use of the skills learned during the FIM-HT pilot study. For example, following completion of the initial FIM-HT pilot, monthly cooking classes were offered during the summer in response to findings from the qualitative interviews. Additionally, analysis of the FIM-HT qualitative data revealed participants' interest in continued digital engagement, including newsletters and additional Zoom-based classes. Therefore, a digital application was identified as one strategy for maintaining participants' connection with the intervention content and reinforcing the meal-building skills learned during the program. Although feedback from Black women informed the development of the PWA, GRACE Kitchen was not designed exclusively for this population. Rather, the application was developed in response to needs identified through the pilot work, with an emphasis on supporting adaptable meal construction and adherence to healthy eating patterns, such as DASH. The PI (SL) developed an initial prototype, and 2 computer science students (SS and SK) developed the application based on this prototype and feedback from FIM-HT participants. SS and SK continued to refine GRACE Kitchen to better integrate the GRACE Framework. The GRACE Kitchen PWA uses HTML, CSS, and JavaScript for the front end and Flask (version 3; Pallets Projects) and Python (version 3; Python Software Foundation) for the backend. We initially created a culturally tailored recipe database from a CSV file using a responses.json file. We also developed a scoring system for the curated recipes to indicate food accessibility, DASH scores, and nutrient density scores. Additional features included shopping lists, sample frameworks tailored to participants' preferred meal types, and a guide to weekly meal planning.

Stage 3: Preliminary Testing of GRACE Kitchen in the FIM-BCS Pilot Study

Setting and Intervention Context

After development, the GRACE Kitchen PWA underwent preliminary testing from January to March 2026. Its usability was assessed through 2 online focus groups and surveys administered during the FIM-BCS pilot study. Participants were recruited through a local community–based organization for breast cancer survivors in Chicago using flyers and referrals following presentations by the research team at the organization's regular meetings. Eligibility criteria included being at least 6 months after completing active cancer treatment; self-identifying as Black or of African descent; being female and aged 18 years or older; and self-reporting a diagnosis of hypertension, a BMI ≥25 kg/m^2, or both. Exclusion criteria included inability to speak or read English, cognitive impairment, current cancer treatment, inability to cook at home, liver or renal disease, or pregnancy. The FIM-BCS study was

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designed as a single-arm pilot study to test components and procedures of an abbreviated FIM study. The target enrollment was 12 participants, allowing for 20% attrition and a final sample of 10 participants. The final sample size was based on prior breast cancer pilot studies [36,37]. No separate sample size target was established for the focus groups because participants were drawn from the FIM-BCS study sample.

The purpose of FIM-BCS was to assess the feasibility and acceptability of an FIM program for Black breast cancer survivors with cardiometabolic risk factors. The FIM-BCS pilot study used an 8-week, single-arm design that included in-person cooking classes, virtual nutrition education, self-management support via SMS text messaging, recipe delivery through the GRACE app, and biweekly food delivery in Chicago. The intervention consisted of 4 weeks of active intervention followed by 4 weeks of maintenance. During the active intervention, participants received 2 cooking classes based on the GRACE Framework and 2 virtual nutrition education sessions.

The GRACE Kitchen PWA was introduced during the intervention maintenance phase to support FIM-BCS participants in applying the meal-building framework introduced during the cooking classes. Food was delivered to participants every other week during both the active intervention (cooking classes) and the maintenance phase.

Procedures

The GRACE Kitchen PWA was deployed to all 12 FIM-BCS participants during the 8-week study. Participants had approximately 4 weeks to use the app and provide feedback (weeks 4-8 of the intervention). At week 8, we conducted 2 focus groups with 10 participants: 6 in focus group 1 and 4 in focus group 2. A basic demographic survey, which included questions about social networking access and use, and a modified Mobile App Usability Questionnaire (MAUQ) were administered via REDCap (Vanderbilt University) [38] at the end of the intervention. The MAUQ is a validated 18-item questionnaire that measures the usability of health apps. It assesses usefulness, ease of use, and satisfaction. Ease of use assesses whether users can understand the app's functionality and whether information is presented clearly. The interface and satisfaction domain assesses users' ability to interact with the app's design and their overall satisfaction with the app. Usefulness measures the app's effectiveness in fulfilling its intended purpose. The MAUQ uses a 7-point Likert scale [38]. For this study, the MAUQ was modified to use a 5-point Likert scale and coded numerically from 0 to 4 (0=completely disagree, 1=disagree, 2=neither agree nor disagree, 3=agree, and 4=completely agree) to reduce response complexity and facilitate participant understanding, consistent with prior adaptations of the MAUQ for specific populations [39] (Multimedia Appendix 2). The GRACE Kitchen app was refined based on focus group data from the FIM-BCS pilot study and MAUQ scores. The focus groups explored participants' views on cooking, learning preferences, and preferred ways of engaging with recipes. They also explored app usability and navigation as well as ways to improve GRACE Kitchen using the following questions:

- How was GRACE Kitchen useful?
- How did you use the recipes?
- How can GRACE Kitchen be improved?

Data Analysis

FIM-HT interview transcripts were transcribed verbatim, coded, and analyzed thematically [40]. The PI (SL) and 2 undergraduate students facilitated the individual interviews. During the initial analysis of the FIM-HT data, the PI developed a structured codebook incorporating both inductive and deductive codes. The deductive codes were developed based on the FIM-HT interview guide, which was informed by Social Cognitive Theory, whereas inductive codes were identified through transcript review [41,42]. The codebook included definitions for each code, its intended scope and boundaries, and guidance on when the code should be applied. AA, SL, and an undergraduate student applied the codebook to the dataset. They also applied relevant codes from the FIM-HT qualitative codebook that informed the development of the GRACE Framework. Transcripts were double-coded, and the analysts met regularly with the PI to compare coding, discuss discrepancies or gaps, and identify additional or missing codes. Related codes were then grouped into broader categories and reviewed by the analytic team to develop the final themes. These procedures, including the use of a structured codebook, double coding, regular analytic meetings, and consensus-based resolution of discrepancies, were used to support the consistency and credibility of the qualitative analysis.

The FIM-BCS focus groups were also transcribed verbatim and independently coded by SL and AA using a deductive thematic analysis approach. Coding focused on participant responses related to the usefulness and navigation of GRACE Kitchen. SL and AA compared the coded transcripts and met to resolve discrepancies in coding and theme development. Related codes were grouped into broader categories and reviewed across transcripts to identify recurring patterns, which were then organized into final themes. The questions specifically used to inform theme development were "What did you find useful about the GRACE Recipe Generator App?" and "How could the GRACE Recipe Generator app be improved?" Independent coding, coder comparison, consensus discussions, and team review were used to support the consistency and credibility of the analysis. All coding was conducted using ATLAS.ti (version 25; ATLAS.ti Scientific Software Development GmbH).

For the MAUQ survey, descriptive statistics, including means and SDs, were calculated in R (R Foundation). Responses were collected using a 5-point ordinal Likert scale and coded numerically from 0 to 4: 0=completely disagree, 1=disagree, 2=neither agree nor disagree, 3=agree, and 4=completely agree. Higher scores indicated more favorable perceptions of app usability. We assessed 3 subscales: Ease of Use, Interface and Satisfaction, and Usefulness. Ease of Use was calculated by averaging responses to questions 1-5; Interface and Satisfaction were calculated by averaging responses to questions 6-12; and Usefulness was calculated by averaging responses to questions 13-18. Internal consistency reliability was assessed by calculating Cronbach α for each MAUQ subscale.

There were no missing qualitative data from the completed interviews or focus groups, and all available transcripts were included in the analyses. All participants in the FIM-BCS

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intervention completed the modified MAUQ; therefore, there were no missing questionnaire data requiring imputation or other handling.

Ethical Considerations

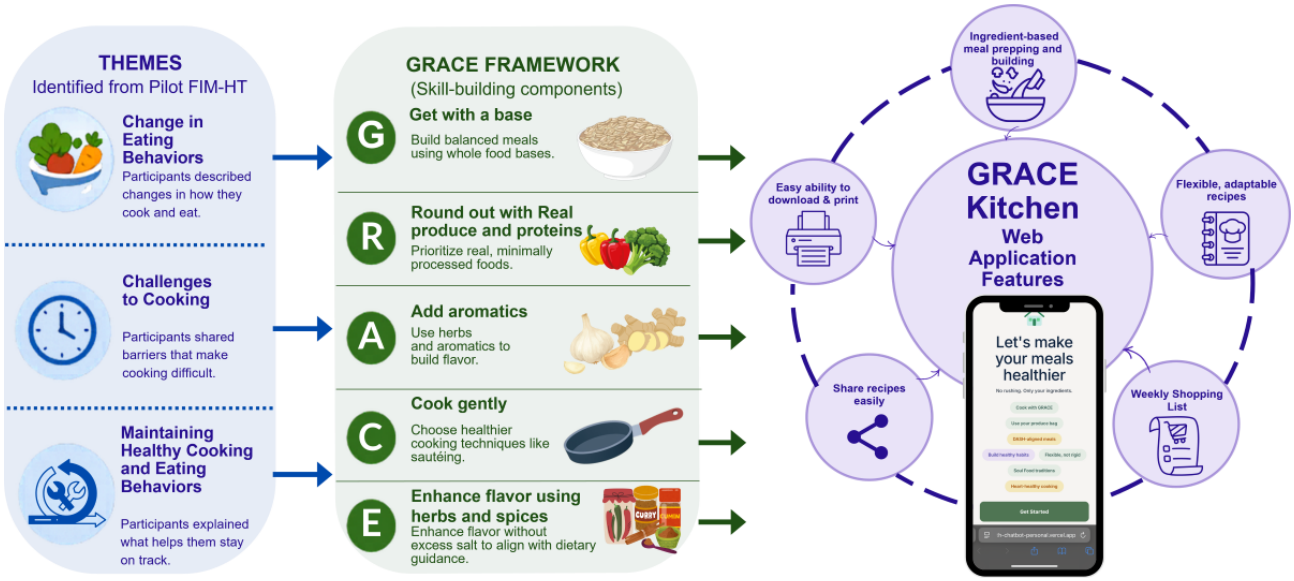
Institutional Review Board approval was obtained from the University of Illinois Chicago for FIM-HT (approval number 2022-0947) and FIM-BCS (approval number 2022-0966). All participants provided informed consent before participating in the studies. Study data were deidentified and stored securely, with access limited to authorized study personnel. Participants received cash compensation for participating in the interventions. Compensation varied between studies based on study burden and time commitments. Participants in FIM-HT received up to US $435 over 24 weeks for participating in multiple study components, including blood sample collection, an individual interview, biweekly in-person cooking classes, biweekly Zoom nutrition and HTN classes, SMS text message responses, and travel to clinic visits and classes. Participants in FIM-BCS received up to US $150 over 8 weeks for participating in 2 cooking classes, 2 Zoom nutrition classes, and 2 focus groups (1 at the beginning and 1 at the end of the study). Cash compensation may have influenced participants' willingness to enroll in the studies.

Results

Overview of the Developmental Stages

The results are presented across 3 developmental stages: (1) development of the GRACE Framework informed by interviews with FIM-HT participants; (2) technical development of the GRACE Kitchen PWA; and (3) preliminary testing of the GRACE Kitchen prototype using focus group and survey data. Figure 1 summarizes the progression from participant insights to the development of the GRACE Framework and, subsequently, the GRACE Kitchen PWA and its features.

Figure 1. From participant insights to development of the GRACE Framework and GRACE Kitchen web application features. FIM-HT: Food Is Medicine Healing Together; GRACE: *g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance.



Stage 1: Development of the GRACE Framework via the FIM-HT Focus Group

Participant Characteristics

We conducted 17 interviews between November 2023 and February 2024. All participants were women, with a mean age of 50.4 years.

Qualitative Feedback Informing the GRACE Framework

Participants described factors they perceived as important for maintaining dietary changes learned during the FIM-HT pilot intervention. They also discussed how they adapted and developed recipes to suit their tastes, preferences, and food availability. Building on these findings, the PI (SL) developed the GRACE Framework by translating the themes into concrete meal-building attributes represented by the G-R-A-C-E components, with the goal of supporting the maintenance of healthy dietary behaviors (Table 1).

The main themes identified were (1) changes in eating behaviors, (2) challenges to cooking, and (3) maintenance of healthy cooking and eating behaviors. Factors and themes associated with changes in eating behaviors informed the development of the GRACE Framework and the identification of key features for the digital application.

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Table 1. FIM-HT[a] themes, illustrative quotations, and implications for GRACE[b] development from participant feedback (n=17).

FIM-HT themes and illustrative quotes	Participant insights and relevance to GRACE development
Theme 1: Change in Eating Behaviors	
"My experience was good. With the vegetables and stuff, I really try to emphasize vegetables in every meal that I eat now."	R—real produce and protein
"...eating less salt is very important. And like I said, the class helped us find other ways not to use seasoning, but to use certain vegetables and certain peppers and certain things to season your food rather than using a lot of salt. So that was helpful."	R—real produce and protein and A—aromatics
"Well, I'll tell you what I did swap. I used to fry a piece of fish. Now I bake a piece of fish with some rice and some vegetables. Now, before I would have fried fish, maybe fried french fries. You see what I'm saying? But everything baked. So now either I'll have a baked piece of fish and I may have a baked potato and vegetable. So everything is baked now. I'm not doing all that frying anymore. That's out of the question."	C—cook gently
"I use those [spices] every day in my life. The coriander and the thyme, the rosemary. I use rosemary when I can find rosemary. Then I go on a rosemary binge and I just cook everything with rosemary before it goes bad. I didn't use too much of the cornstarch, but now I know to add it for my sauces to thicken it up. Honey is an everyday thing. If I don't incorporate it in my tea, I find a way to put it in my food, but not a lot of it."	E—enhance with herbs and spices
"I remember how I used to go up to her the following week, as we were doing the recipe, how she add to it, how she subtract to it. She made it her own, that's the word. How she made the recipe her own."	Recipe adaptation informed meal construction approach
"The different seasonings that you guys gave us in class, I definitely use those more. It just expanded my base of different seasonings to use. But the biggest was stopping was using vegetable oil and use olive oil. And then, getting used to that."	E—enhance with herbs and spices
Theme 2: Challenges to Cooking	
"The most challenging was actually incorporating the cooking into my life, because I don't like to cook, so I have to, you know, go above like, what I would like to do, and so that's been the most challenging, really."	Inconvenience of cooking
"I just think that meal prepping and being able to just go to the refrigerator and get something that's already done, I would start to eat more instead of having to cook something from scratch and then keep everything else in line too."	Need for meal planning
Theme 3: Maintaining Healthy Cooking and Eating Behaviors	
"...inside my house. The healthiness just doesn't start with me. I have a legal guardianship of my three grandchildren. I have two five-year-olds and one three-year-old. And I'm starting them out eating healthy so they won't end up making the mistakes that I made when it comes to food."	Family motivation for shifts to healthier eating
"Zoom could be nice. To check up on them, see that they're eating the right stuff. Do a little Zoom meeting with them...checkup upon them, see if they're doing the right thing, they're doing the right portion. Question them to see what their intake of food is. Seemed like you had us taking pictures and stuff, tell them to send you a picture of what they ate."	Interest in continual engagement and sharing photos
"I make a grocery list. And if I can't afford to get there at this time, then I put it on my next grocery list. So I made a grocery list...I keep a grocery list at all times on my table. So I don't go in the grocery store without even counting money, how much I'm spending. But it helps me to keep the grocery slip of the healthy things I need to eat."	Shopping list is helpful for healthy cooking
"They'll call and say, 'I want that salmon recipe', then, 'What I got to put in it?' Or, 'I like that vegetarian salad, what can I put in it?' So I've been sharing these recipes with them, so that means they got to buy the right stuff."	Sharing recipes
"I keep two folders, the folders with all my recipes and I keep my folder for my grocery list. And that keeps me balanced and keep it simple for me."	Interest in having shopping lists and recipes
"I hope that I can hear from you all on Zoom again or send you a picture or two. You can text me and say send what I eat and that's helpful. That's all. Just keeping in contact."	Wanting to stay connected after the intervention

[a]FIM-HT: Food Is Medicine Healing Together.

[b]GRACE: *g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance.

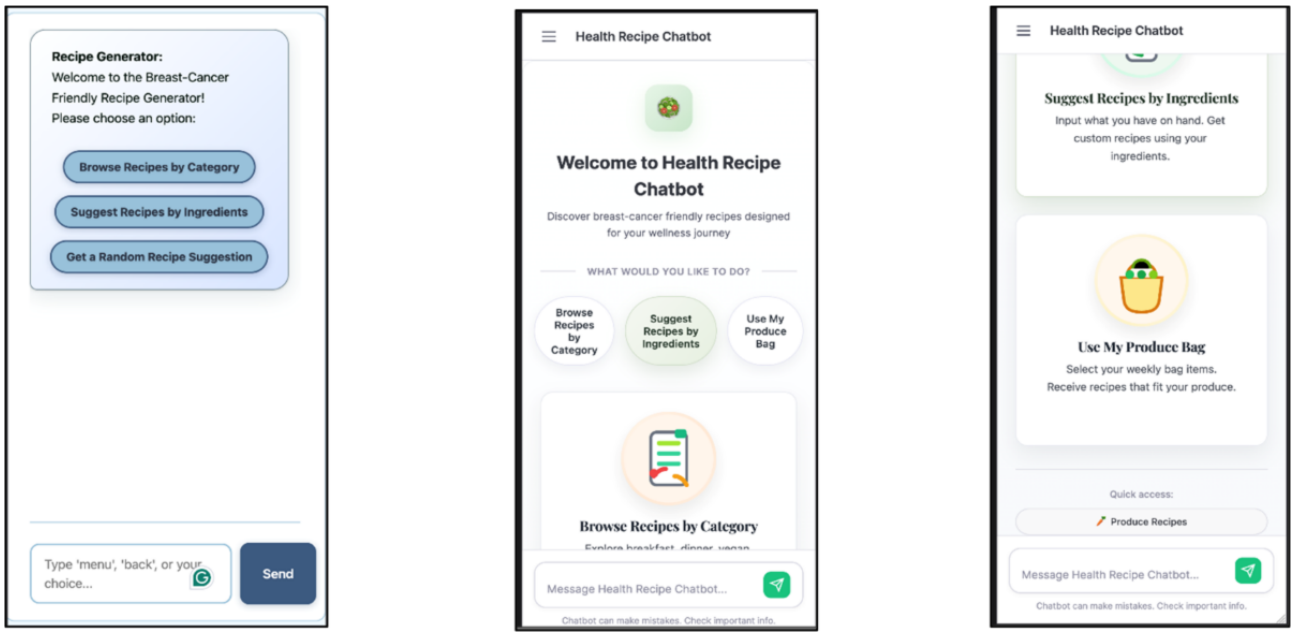
Stage 2: Technical Development of GRACE Kitchen

The themes presented in Figure 1, together with the PI's interpretation of the requirements for GRACE Kitchen, informed the initial design of the application. In collaboration with the computer science students, the PI developed the mobile app to display recipes suggested by FIM-HT participants, along with other attributes of recipes they developed during the cooking

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classes (eg, ease of preparation and cultural relevance). First, key features were designed to facilitate recommendations for produce that could be incorporated into recipes, as well as additional ingredients that participants had on hand and could use to modify the recipes. Second, features were added to help users follow recipes on a week-by-week basis, aligned with the FIM-HT program's produce bag distribution schedule, as the GRACE Framework was introduced and incorporated into the flexible recipes provided. Third, a weekly shopping list feature was added to support the preparation of recommended recipes. Screenshots of the initial iteration are shown in Figure 2.

Figure 2. Participants' insights informed the development of the GRACE (*g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance) framework and the GRACE Kitchen Web App.



Stage 3: Focus Groups and Survey Data From GRACE Kitchen Prototype Preliminary Testing

Participant Characteristics

Twelve participants completed the FIM-BCS pilot. The participants were women aged 44-66 years, with a mean age of 56.7 years and a mean annual income of US $84,970. At baseline, participants (n=12) reported their use of digital health apps: 10 (83%) reported tracking progress toward health-related goals on their tablet or smartphone, 7 (58%) used social networking sites such as Facebook (Meta Platforms, Inc) to share health information with others, 12 (100%) visited social networking sites, 10 (83%) watched health-related videos on YouTube (Alphabet Inc), and 10 (83%) participated in an online forum or support group for people with a similar health issue. Two focus groups were conducted after completion of the FIM-BCS pilot. As many as 10 of the 12 participants attended 1 of the 2 focus groups.

Usability Results

All 12 participants in the 8-week FIM-BCS pilot completed the modified MAUQ at the end of the study. Table 2 presents descriptive statistics for participants' responses by subscale. All 3 subscales demonstrated good to excellent internal consistency: Ease of Use (α=.826, 5 items), Interface and Satisfaction (α=.942, 7 items), and Usefulness (α=.872, 6 items). Item-total correlations across the 3 subscales ranged from 0.51 to 0.99. Three items showed comparatively lower correlations (r=0.51-0.57). The item in the Ease of Use subscale was "Whenever I made a mistake using the app, I could recover easily and quickly." The item in the Interface and Satisfaction subscale was "The app adequately acknowledged and provided information to let me know the progress of my action." The item in the Usefulness subscale was "I could use the app even when the internet connection was poor or not available." However, removing these items would have improved reliability only marginally (by <0.02); therefore, all items were retained.

Table 2. Summary statistics of the modified MAUQa survey (n=12).

Subscales	Mean (SD)	Range
Ease of Use	2.700 (0.641)	1.600-3.800
Interface and Satisfaction	2.667 (0.556)	1.286-3.000
Usefulness	2.706 (0.491)	1.500-3.167

[a]MAUQ: Mobile App Usability Questionnaire.

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Qualitative Feedback on GRACE Kitchen Prototype

We conducted 2 focus groups to obtain feedback on the usability of GRACE Kitchen. The first focus group included 6 participants, and the second included 4. Participants were asked how useful they found the GRACE Kitchen app and how it could be improved. These discussions yielded 2 overarching themes: (1) Accessibility and Navigation Concerns and (2) Perceived Usefulness and Flexibility (Table 3). Although many focus group participants considered the app an "excellent" idea, most reported difficulty navigating it. Participants described the GRACE Framework and recipes as useful for becoming more familiar with different fruits and vegetables, generating meal ideas, and adapting meals to improve flavor. However, most participants reported limited direct use of the app-based recipes. Common usability concerns included difficulty locating recipes and print functions, the number of steps required to access recipes or other desired content, and challenges using the app on mobile devices. Participants enjoyed the recipes available on GRACE Kitchen but noted that they did not always have all the required ingredients. They valued the app's ingredient information and recipe suggestions but also indicated that it could be improved by including information on where to purchase affordable produce.

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Table 3. Focus group feedback on GRACE[a] Kitchen usability and perceived usefulness (n=2; 10 participants).[b]

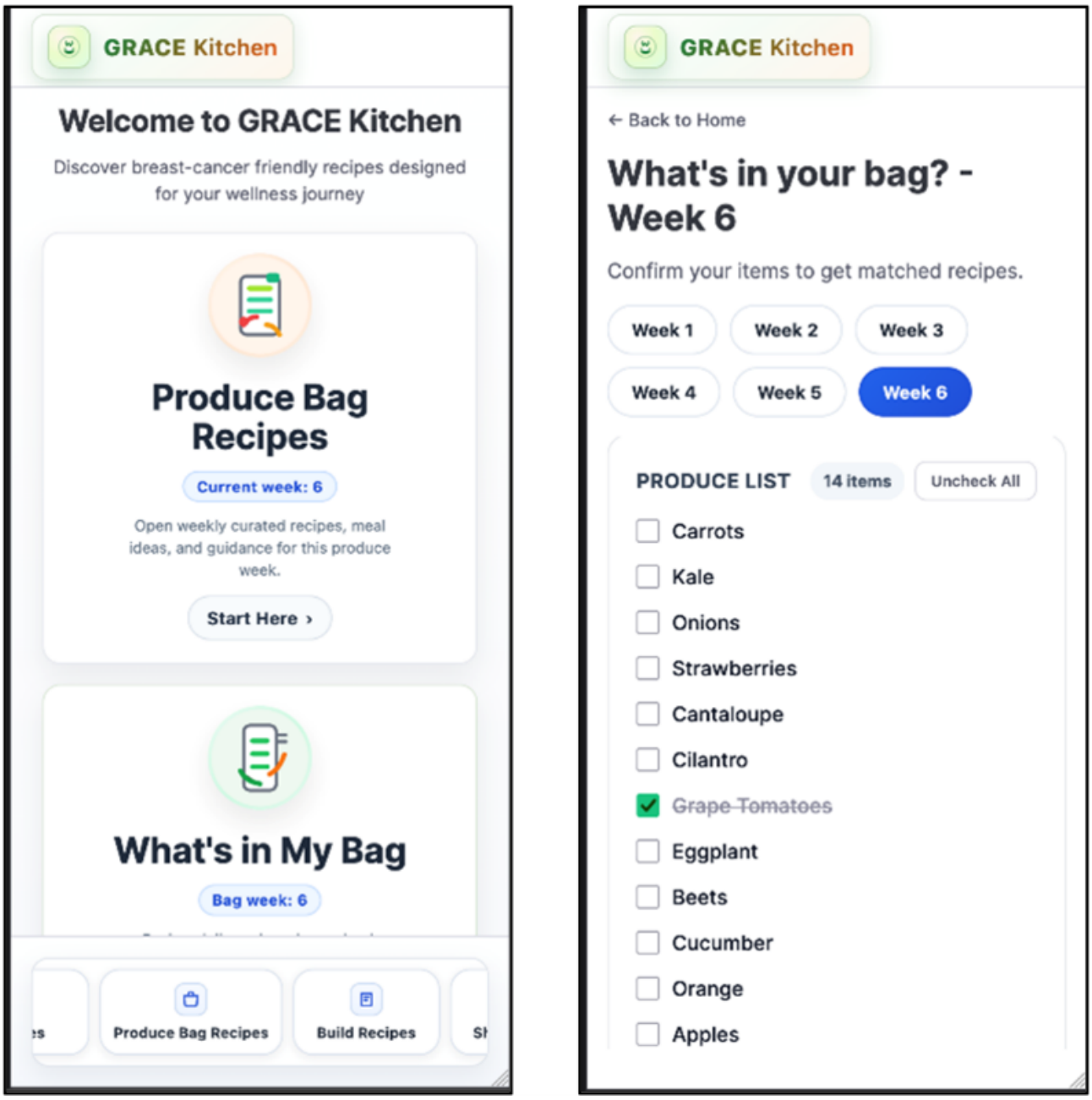
Themes and subthemes/findings	Illustrative quote	Recommendation for updating GRACE Kitchen
Accessibility and Navigation		
Mobile Usability	"The usability of [the web app] made me frustrated...It might be different looking at a computer screen versus looking at my phone."	Optimize the prototype for mobile devices using responsive layouts, larger controls, and simplified navigation.
Unclear Navigation Controls	"I had to figure out, like, it was some little buttons at the bottom. That I didn't even know that was there, that I was supposed to be clicking to, I guess, like, get to the next thing."	Increase visibility of navigation controls and use clearly labeled buttons, prompts, and progress cues.
Too Many Steps to Access Content	"It felt like it was just a lot of steps to get to the point."	Reduce the number of clicks or screens required to reach recipes and other frequently used content.
Navigation Delayed Understanding of App Purpose	"I got to the point where I at least could see recipes, and I'm like, oh, okay, now I'm getting the concept of the app."	Provide direct access to core functions and brief introductory guidance that communicates the purpose of GRACE Kitchen early in the user experience.
Difficulty Printing and Accessing Recipes	"Everything we received in the bag, and then it'll tell you, like, the different recipes. Then I kind of looked at the recipes and said, okay, which one? I didn't make any of them yet. Like [participant name removed] said, I tried to print it, but then I went back and I looked again. Then you have breakfast, lunch, snack...okay, let me see what type of breakfast I did, what type of lunch ideas, so I did that as well."	Simplify recipe navigation and provide clearly visible print, save, and share functions.
Visibility of Cost Information	"I really enjoyed it, and it was something about the cost, but I noticed the cost wasn't on when I clicked the bag. It was on a different tab."	Place estimated cost and other frequently sought information prominently within the recipe or meal-building interface.
Mobile Display of Nutrition Information	"I guess it was supposed to have been, like, nutritional breakdown of what, like, the amount of carbohydrates, or the amount of this, or the amount of that, but I didn't see any generated numbers. I saw where it was listed....But I didn't see what generated numbers were based upon the recipe. So again, that could be something just because I was using a phone versus a desktop."	Ensure nutrition information displays consistently across mobile and desktop devices and clearly links nutrient values to the selected recipe.
Access to Affordable Ingredients	"I went in, and it did tell us an estimate cost of, like, a family of four, and blah blah blah, so it did have a cost. I said maybe they could add, like, maybe where we can buy it [referring to produce and ingredients], or, you know suggestions of where you can get the produce."	Consider adding information on where users can obtain affordable produce and recipe ingredients, including relevant local food resources where feasible.
Perceived Usefulness and Flexibility		
Recipes as Meal Inspiration	"Everything we received in the bag, and then it'll tell you, like, the different recipes...Then you have breakfast, lunch, snack...okay, let me see what type of breakfast I did, what type of lunch ideas, so I did that as well."	Maintain recipe browsing as a source of meal ideas while increasing flexibility to adapt recipes to available ingredients.
Food Exploration, Substitutions, and Flexible Recipe Use	"So, instead of having the green cabbage, I started using more purple cabbage. Instead of using yellow onions, I started using more purple onions. I even tried purple sweet potato, and that's a bomb, by the way. It's better than the orange one to me. I even tried the purple sweet potatoes."	Continue to emphasize food exploration, ingredient substitutions, and flexible recipe options so users can adapt meals to available ingredients and personal preferences.

[a]GRACE: *g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance.

[b]All iterations of the GRACE Kitchen app, revised in response to feedback from FIM-BCS participants, are shown in Figures 3 and 4.

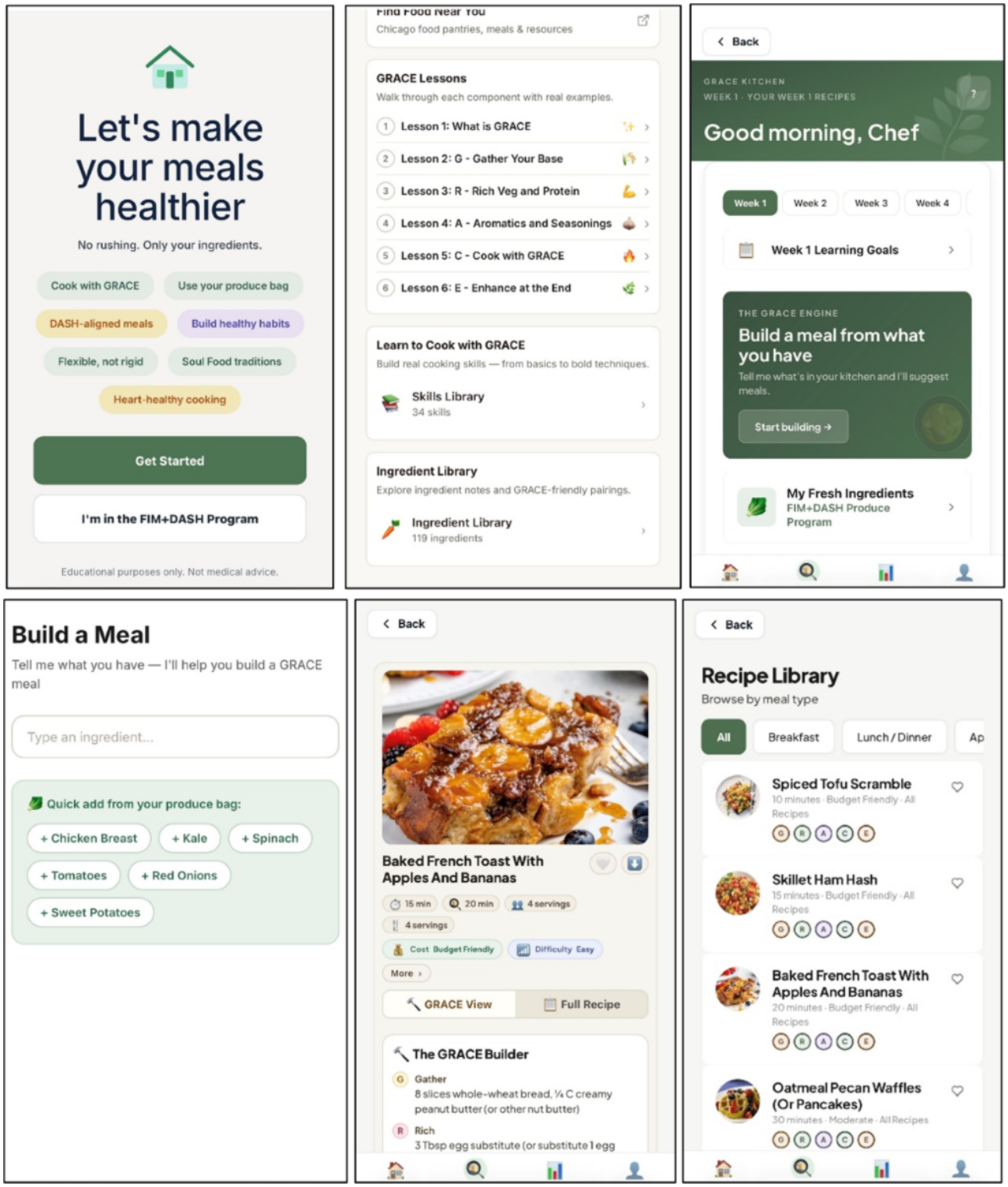
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Figure 3. GRACE (*g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance) Kitchen app prototype screenshots from the revised iteration in February 2026. Right: home screen (version 2) incorporating weekly produce bag. Left: What's in your bag home screen.



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Figure 4. GRACE (*g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance) Kitchen app prototype screenshots from the April 2026 revision. GRACE Kitchen app prototype screenshots from the April 2026 revision. Top Left: Home screen and navigation for usability based on feedback (version 3). Top Middle: Improved integration of GRACE concepts. Top Right: Home screen for weekly recipes. Bottom Left: Recipe Builder home screen. Bottom Middle: Example recipe. Bottom Right: Recipe Library home screen.



Discussion

Principal Findings

This study describes the development and preliminary evaluation of the GRACE Framework and its translation into the GRACE Kitchen web-based application. Findings from the initial FIM-HT interviews highlighted 3 key areas relevant to participants' experiences during the intervention: changes in eating behaviors, challenges to cooking, and maintenance of healthy cooking and eating behaviors. Participants expressed interest in continued engagement to support their health journeys after the FIM-HT intervention. They also discussed aspects of the cooking classes that they enjoyed, including learning about herbs and spices, incorporating more vegetables into their diets,

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and adapting cooking methods and techniques. The GRACE Framework was developed in response to insights from FIM-HT to (1) help participants make decisions about preparing healthful meals; (2) apply nutrition and culinary knowledge to adapt meals based on available foods and personal preferences; and (3) strengthen participants' ability to build meals independently. This work also laid the groundwork for translating the GRACE Framework into the GRACE Kitchen app. The app was subsequently evaluated with Black breast cancer survivors in the FIM-BCS pilot study, providing preliminary insights into its usefulness, accessibility, and usability. Together, the findings from FIM-HT and FIM-BCS provided insights into participants' perceived needs for maintaining the skills and knowledge gained through FIM programming.

Comparison With Prior Work

FIM-BCS participants reported favorable ratings for satisfaction, perceived usefulness, and ease of use of the app, although interface and satisfaction received the lowest ratings of the 3 subscales. Participants raised concerns about the app interface, particularly recipe navigation and the availability of information about ingredient costs and accessibility. Similar to findings from the myDietCam pilot, participants identified opportunities to improve ease of use and interface design while recognizing the app's potential usefulness. The myDietCam study also highlighted the importance of reducing navigation burden and improving the accessibility and organization of app features, although usability scores were higher in that study [43]. These findings are consistent with previous mobile health (mHealth) usability studies showing that perceived usefulness and relevance to daily life are central drivers of acceptability, even when usability challenges persist [44,45]. Additionally, participants viewed GRACE Kitchen as a conceptually sound and helpful tool for meal preparation and appreciated having recipes available, but expressed a preference for a simpler interface and a mobile-first design. These findings align with prior mHealth studies demonstrating that users value simplicity, personalization, and relevance to daily life as key drivers of engagement and satisfaction [46]. For example, usability studies of mobile health apps across chronic disease populations consistently identify perceived usefulness and ease of use as primary determinants of acceptability, while navigation difficulties and accessibility issues can limit sustained use [47]. Our findings are also consistent with emerging research that positions skill-based approaches as central to translating nutrition knowledge into real-world cooking practices within FIM interventions [48-50]. Overall, preliminary feedback suggests that GRACE Kitchen has conceptual promise but also highlights important usability limitations.

Participants appreciated having recipes available to support a more flexible approach to cooking. They responded positively to the concept of flexible meal building, which was introduced during the cooking sessions and discussed in the focus groups. However, the digital web-based application will need to reflect this flexible approach while retaining features that participants may expect from a digital cooking companion, including recipes that provide examples of meals that can be built and adapted. Current digital nutrition applications primarily focus on nutrition education, dietary tracking, and algorithm-driven meal recommendations. Generative AI tools are also emerging as a means of producing recipes and structured meal plans [51-53].

Implications For Food Is Medicine Programs

For FIM programs, our findings highlight the importance of considering not only food access but also the practical barriers that influence participants' ability to prepare and use the foods they receive and to continue applying these skills beyond the food provision period. Participants in our study identified common barriers to home cooking, including cost, convenience, and limited confidence. Similar barriers have been reported across diverse populations, including Black women and individuals with cardiometabolic conditions, among whom established habits and structural constraints influence food choices and food preparation practices [54-56]. Addressing these barriers may also require attention to practical capabilities, such as meal planning, food preparation, and decision-making, to support sustained dietary behavior change [28,54,57]. Furthermore, there is a need to better understand the relationship between home cooking and improved diet quality, including increased fruit and vegetable intake and decreased consumption of ultra-processed foods [58,59].

There is also limited evidence in the FIM literature on the impact of nutrition education, particularly digital nutrition support [28]. Digital tools are needed that account for the contextual barriers that FIM participants and others seeking to sustain cooking habits may face, including limited access to fresh produce, time constraints, and convenience. The FIM literature has tended to focus on food provision and the intersection of food with clinical care, including food prescriptions, medically tailored groceries, and medically tailored meals [28].

Little is known about food waste, food utilization, and the role of nutrition education in addressing these issues [60]. This underscores the need to understand how food moves from the produce bag to the plate and what skills and facilitators are needed to support this process. However, these constructs are not consistently operationalized in FIM or digital health interventions [22,32,51,61]. Although existing FIM interventions have demonstrated improvements in food access and dietary intake, less attention has been given to food utilization and the practical skills required to prepare perishable foods and incorporate them into daily meals [32]. Prior research suggests that challenges in food utilization contribute to food waste and may limit the effectiveness of food provision programs [62].

The FIM-HT and FIM-BCS interventions were informed by social cognitive theory [41,42] and the Socioecological Model [63], which guided the broader intervention approach. Behavioral science frameworks have also been proposed as a means of strengthening FIM intervention design and evaluation by clarifying behavioral targets and potential mechanisms of change [64]. Although GRACE was not prospectively developed as a theory-driven digital behavior change intervention, its findings can be interpreted through the Capability, Opportunity, Motivation-Behavior (COM-B) model to examine how capability, opportunity, and motivation may influence participants' ability to translate available foods into meals they are willing and able to prepare (see Multimedia Appendix 3).

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In the context of the GRACE tools, capability, opportunity, and motivation, the core components of COM-B [65], provide a framework for considering how cooking knowledge and meal-building skills, access to foods and resources, and individual preferences and routines may influence participants' ability to translate available foods into meals they are willing and able to prepare. The GRACE Framework and GRACE Kitchen features can be interpreted as aligning with the capability domain through their emphasis on the knowledge and skills needed to construct balanced, nutrient-dense meals. Opportunity is reflected in the combination of GRACE cooking guidance with access to available foods and pantry items. Motivation is reflected in the emphasis on individual preferences, taste, cultural context, cooking routines, time, and personal cooking styles. The flexibility of the GRACE Framework and GRACE Kitchen, including reduced dependence on specific recipe ingredients and strategies for reheating, remixing, and assembling meals throughout the week, can also be interpreted as aligning with motivation by supporting planning and adaptation to daily life.

Similar applications of COM-B to dietary behaviors have identified influences related to knowledge and skills, environmental and social opportunities, and motivation [66,67]. COM-B has also been applied retrospectively to evaluate digital health interventions [68,69]. For example, Musgrave et al [68] used COM-B retrospectively to evaluate a mobile app designed to support breastfeeding and identify potential mechanisms of behavior change and opportunities for future refinement. Taken together, these findings suggest that GRACE may be relevant across multiple COM-B domains. However, COM-B was not used prospectively to develop the framework or guide data collection. This interpretation also suggests that FIM programs may benefit from considering not only food provision but also the capabilities, opportunities, and motivational factors that influence whether provided foods are prepared and incorporated into meals.

Limitations and Future Directions

This formative approach to the development of GRACE Kitchen should be interpreted in light of its limitations. As a formative evaluation of a prototype application, the findings are limited to short-term perceptions of usability and acceptability and do not provide evidence of effectiveness or sustained engagement. The application was developed using insights from 2 separate interventions, both of which had small sample sizes and included populations with different backgrounds. The FIM-HT study included Black women with hypertension, whereas the FIM-BCS study included Black women who were breast cancer survivors with cardiometabolic risk factors (hypertension, obesity, or both). Although both interventions used FIM approaches and DASH-aligned dietary principles, differences between the populations may limit the transferability of the findings. Furthermore, development of the GRACE Kitchen app was not the primary goal of either study. FIM-HT was not designed to identify or obtain formative input for a digital application; rather, insights from the participant interviews subsequently informed the development of GRACE Kitchen. In the FIM-BCS study, app use was optional. Therefore, the findings should be interpreted as preliminary insights into the app's perceived usefulness, accessibility, and usability rather than evidence of its effectiveness. Behavioral outcomes were not assessed, and the GRACE Framework was not developed using formal behavior-change metrics. However, the framework and app conceptually align with the COM-B model, providing a basis for future evaluation. This study also did not examine cooking self-efficacy, culinary skills, food utilization, diet quality, or sustained dietary practices in relation to GRACE Kitchen use, nor did it assess associations between app use and these outcomes. Subsequent studies should evaluate the impact of GRACE Kitchen on diet quality, cooking self-efficacy, and food utilization using larger, more diverse samples. They should also assess long-term engagement and scalability. Comparative studies examining GRACE Kitchen alongside existing recipe-based or algorithm-driven tools may help clarify its added value in supporting food literacy and sustained behavior change. Future studies should prospectively evaluate these relationships using validated measures, app engagement data, and longitudinal follow-up.

We plan to revise the prototype based on user feedback and identify opportunities for additional feasibility studies of a fully developed GRACE Kitchen mobile app. Subsequently, we plan to evaluate GRACE Kitchen in diverse populations beyond breast cancer survivors, including individuals with cardiometabolic risk factors, to assess its potential to support behavior change among FIM program participants, including changes in motivation, skill development, and dietary patterns.

Conclusions

The GRACE Framework is intended to support sustained dietary practices and behavior change within FIM programs and promote health improvements. A key contribution of this work is the positioning of GRACE Kitchen as a complement to FIM programs, particularly those that provide fresh produce. We translated the GRACE Framework into GRACE Kitchen and obtained preliminary feedback on its utility. GRACE has the potential to strengthen practical culinary skills and help participants sustain healthy dietary and cooking practices beyond FIM programming.

Acknowledgments

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Data Availability

The data generated and analyzed during this study are not publicly available because the qualitative data may contain information that could lead to the deductive identification of participants. Deidentified data may be available from the corresponding author (SL) upon reasonable request.

Generative AI Use

The authors declare that generative AI was used in the creation of this manuscript. Generative AI (ChatGPT, Grammarly and Canva) was used for proofreading, editing, or language polishing; Help with identifying relevant articles, no summarization and to give ideas for figure development. The authors verified all outputs of the tool(s) used in the preparation of this manuscript and take full responsibility for the final content of the manuscript.

Authors' Contributions

Conceptualization: SL (lead), KW, EMD
Formal analysis: SL, TB, AA
Investigation: TR, MS, MK
Methodology: SL (lead), KW, EMD
Software: SL (lead); SS, SK
Writing – original draft: SL, TB, AA
Writing – reviewing and editing: SL, TB, TR, MK, SS, SK, MS, EMD, KW
All authors reviewed and provided final approval of the manuscript.

Conflicts of Interest

None Declared.

Multimedia Appendix 1

GUIDED (Guidance for the Reporting of Intervention Development) checklist.
[DOCX File , 525 KB-Multimedia Appendix 1]

Multimedia Appendix 2

Mobile App Usability Questionnaire survey.
[DOCX File , 38 KB-Multimedia Appendix 2]

Multimedia Appendix 3

Alignment of the GRACE (*g*et a base, round with *r*eal produce and proteins, add *a*romatics, *c*ook gently, and *e*nhance with flavor to align with dietary guidance) Framework and Kitchen with the COM-B (Capability, Opportunity, Motivation-Behavior) model.
[DOCX File , 374 KB-Multimedia Appendix 3]

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Abbreviations

COM-B: Capability, Opportunity, Motivation-Behavior
DASH: Dietary Approaches to Stop Hypertension
FIM-BCS: Food Is Medicine for Black Breast Cancer Survivors
FIM-HT: Food Is Medicine Healing Together
GRACE: get a base, round with real produce and proteins, add aromatics, cook gently, and enhance with flavor to align with dietary guidance
GUIDED: Guidance for the Reporting of Intervention Development
HIPAA: Health Insurance Portability and Accountability Act
MAUQ: Mobile App Usability Questionnaire
mHealth: mobile health
PI: principal investigator
PWA: progressive web application

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