

A co-created digital health intervention to enhance self-care capacities among women with gestational diabetes mellitus in Vietnam (VALID II project).

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Abstract

Background: Gestational diabetes mellitus (GDM) is associated with fetal overgrowth, increased risks of perinatal morbidity and mortality, and long-term complications for mother and child, including cardiovascular disease and type 2 diabetes (T2D). Innovative peer-based digital health interventions are emerging globally as a potential approach to assist and empower women in effective self-care and well-being during pregnancy. However, there remains substantial potential to develop and evaluate culturally sensitive digital health interventions for pregnant women with GDM, especially in low- and middle-income countries.

Objective: This study aimed to describe the co-creation and development of a culturally appropriate digital health intervention to enhance peer support and self-care capacities among women with GDM in northern Vietnam.

Methods: From December 2022 to February 2024, drawing on the WHO's conceptual framework for self-care and co-creation approach, we iteratively developed the "Healthy Pregnancy" intervention – a digital health intervention in four stages: 1) Scoping review, ethnographic study, and brainstorming; 2) Co-creation workshop with the target population and healthcare professionals (HCPs) regarding intervention content; 3) Design and development; and 4) Pilot testing.

Results: Within stage 1, we identified the key potential components of a digital health intervention, including the target digital platforms, a new set of visual educational materials, and the essential presence of family engagement and peer support. In stage 2, a co-creation workshop enabled participants and researchers to jointly refine and align identified needs with potential solutions. In stage 3, a structured and visualized set of educational materials, including eight leaflets and videos, was developed and underwent expert review and revision rounds. Finally, at stage 4, suggestions for digital health intervention from a pilot-test group of pregnant women with GDM were gathered to refine and optimize the educational materials and intervention modalities

before moving into the real intervention.

Conclusions: By integrating a co-creation approach throughout the "Healthy Pregnancy" digital health intervention development process, from identifying problems to developing and evaluating solutions, we constructed a locally and culturally tailored GDM self-care model. With this intervention, not only were the gaps in standard care bridged, but pregnant women with GDM were empowered and accompanied by a supportive multiple-stakeholder environment. Clinical Trial: NCT05744856

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Original Manuscript

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Abstract (367/450 words)

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Trial registration: NCT05744856

Keywords: Gestational diabetes mellitus; self-care; digital intervention; co-creation; peer support; intervention development; health promotion.

Introduction

Gestational diabetes mellitus (GDM) is a metabolic health condition that affects approximately 14% of pregnancies worldwide [1]. Characterized by glucose intolerance that first appears during pregnancy, GDM can lead to significant short- and long-term morbidity and mortality for both the mother and baby if inadequately managed. Notably, women with a history of GDM face a 10-fold higher risk of developing Type 2 Diabetes (T2D) [2]; meanwhile, their offspring not only confront fetal overgrowth/macrosomia, one of GDM's primary short-term complications [3], but are also likely to be overweight/obese [4] and at a higher risk of developing childhood- or youth-onset diabetes [5]. Lifestyle changes, including diet modifications, transitioning to an active lifestyle, and self-monitoring of blood glucose (SMBG), supplied by medication if necessary, are recommended to mitigate adverse health outcomes [6-9]. However, the complex nature of GDM and its management often poses significant challenges for women and their families [10-13]. Although education and counseling between healthcare professionals (HCPs) and women with GDM are the key components in both diabetes and pregnancy care, the standard care, especially in low- and middle-income countries (LMICs), faces numerous challenges [14].

The prevalence of GDM in Vietnam is relatively high. A study has shown that 21.8% of pregnant

women in Vietnam have GDM, making Vietnam one of the countries in the Asia-Pacific region with the highest prevalence of GDM [15]. However, the healthcare system for pregnant women with GDM has not been sufficiently adapted to handle this situation. Due to insufficient information from HCPs and inadequate/a lack of formal educational materials available [12, 16], many pregnant women with GDM lack adequate knowledge about GDM, its complications, and how to manage it appropriately. Additionally, cultural beliefs and traditional practices significantly affect women's diets and physical activities during pregnancy, posing challenges to their autonomy in making informed lifestyle modification decisions [11, 12].

Self-care is a well-established concept [17]; however, it has become increasingly prominent in the current era, especially since the COVID-19 pandemic [18]. To enhance the quality and equity in self-care intervention implementation, the World Health Organization (WHO) has introduced a conceptual framework for self-care within people-centred primary healthcare, where individuals have autonomy and are empowered to make health decisions [19]. They also require an enabling environment that includes peers, families, and healthcare professionals to support education and counseling, ensuring equitable access to resources [19]. Therefore, in the development of self-care interventions, co-creation involving the target population, stakeholders, and researchers is essential to meet the needs of the target users and to be culturally and contextually appropriate, thereby improving the acceptability and sustainability of the intervention [19-21].

Furthermore, in recent years, digital health interventions, including mobile applications, telehealth services, wearable devices, and online platforms, have emerged as promising tools for improving GDM management through on-time feedback, tailored personalized care, and peer support without geographical barriers [22-25]. The latest American Diabetes Association "Standards of Care in Diabetes 2025" guideline also acknowledged that combining telehealth and in-person visits could improve health outcomes for pregnant women with GDM, compared to in-person care alone [2]. However, research on co-creating and developing such digital health interventions remains limited in

Vietnam.

This study aims to describe the co-creation process of developing a culturally and contextually tailored digital health intervention to enhance peer support and self-care for women with GDM in northern Vietnam.

Methods

Study setting

Thái Bình Province is in northern Vietnam's Red River Delta Region, and currently belongs to a part of Hưng Yên Province from July 01, 2025, according to Resolution No. 202/2025/QH15 [26]. To ensure consistency with our VALID II project [27], we still use “Thái Bình Province” in this article. With a population of approximately two million, it is a rapidly developing industrial area characterized by significant socio-economic growth. However, like other rapidly developing areas, Thái Bình Province is facing emerging public health challenges, particularly the rising prevalence of non-communicable diseases such as hypertension, T2D, and GDM. In 2024, the prevalence of GDM in Thái Bình Province was reported to be 27.1% [28].

Standard care for GDM

In 2022, when we designed and developed the intervention, GDM screening was not yet a mandatory step in the antenatal care process, nor did the health insurance cover it [29]. In May 2024, a new guideline launched by Vietnam's Ministry of Health recommended GDM screening as one of the routine steps in standard antenatal care [30]. Furthermore, although pregnant women can be diagnosed with GDM at either the public maternity hospital or any private clinic, they are generally advised to modify their diet by reducing white rice and limiting sugar/sweets intake, as well as to increase exercise like walking. Subsequently, they are referred to an appointment with an endocrinologist at Thái Bình Provincial General Hospital for further professional counseling on diet, exercise, SMBG, and treating insulin if needed, as local ob-gyn doctors lack competencies in this

area. If the women do not attend this appointment, they will not receive GDM self-care guidelines from the HCP [11, 27].

Recruitment

The VALID-II project is a 2-arm non-randomised intervention study with two recruitment phases. In phase 1, pregnant women with GDM were recruited for the control group. Three months later, phase 2 recruited pregnant women with GDM, who participated in the co-created digital health intervention. We conducted the recruitment process in two healthcare settings, including Thái Bình Maternity Hospital and the Kim Ngan Clinic. These were two prestigious obstetrics facilities with many pregnant women visiting in the province. As a public hospital, Thái Bình Maternity Hospital is tasked with providing antenatal care and delivery services, handling approximately 11,000 births each year; meanwhile, Kim Ngan Clinic, a private health clinic, offers only antenatal care services. Detailed information on the VALID II project was reported in a protocol article [27].

Development of content and delivery platform

To ensure comprehensive and transparent reporting, this study followed the GUIDED (Guidance for Reporting Intervention Development Studies in Health Research) [31] and the TIDieR (Template for Intervention Description and Replication) [32] checklists. Full versions of the completed checklists are available in Multimedia Appendices [1](#) and [2](#).

Drawing on the WHO's conceptual framework for self-care and co-creation approach, a digital health intervention "Healthy Pregnancy" in the VALID II project was developed through four stages from December 2022 to February 2024 (see Figure 1).

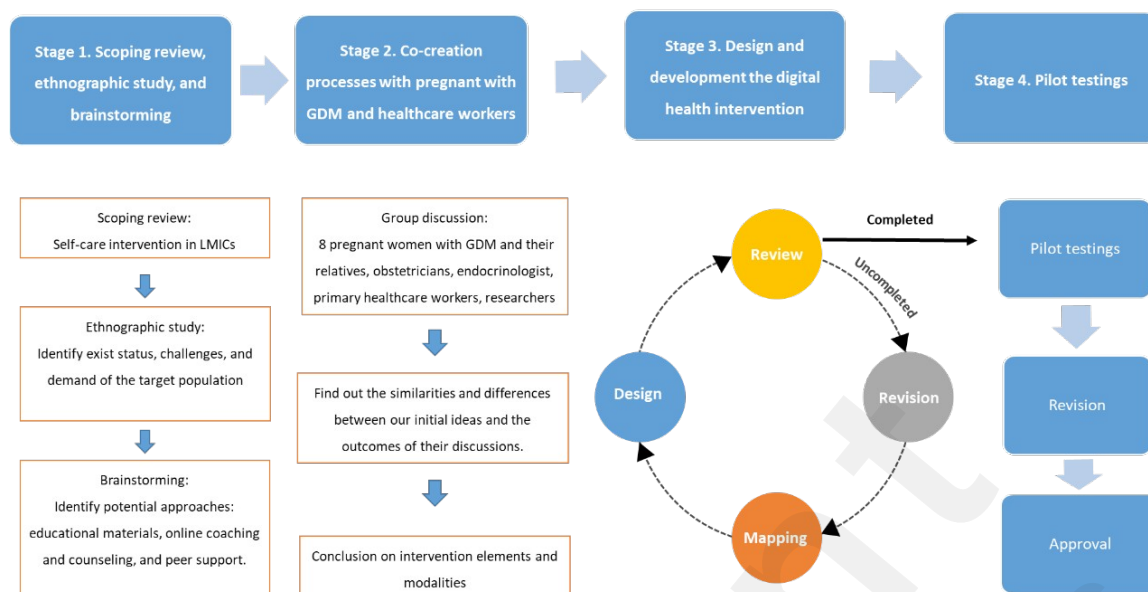


Figure 1. Overview of the “Healthy Pregnancy” digital health intervention development.

Stage 1. Scoping review, ethnographic study, and brainstorming

In the first stage, we aimed to gain insights into the current scientific evidence on self-care interventions for pregnant women with GDM, particularly in resource-limited areas such as LMICs. We also sought to explore culturally based self-care initiatives that address the demand for and barriers to self-care and lifestyle modifications for women and their families. To achieve this, we conducted a scoping review to summarize the content of self-care interventions for pregnant women with GDM in LMICs [33].

Subsequently, we conducted in-depth ethnographic studies following 21 women out of 233 pregnant women diagnosed with GDM in phase 1 of the project [11, 12, 34-36], staying in contact with them from the time of diagnosis through the postpartum phase. These studies explored their perceptions, experiences, and challenges regarding GDM through an open-ended interview guide ([Multimedia Appendix 3](#)). All interviews were voice recorded with the participant's consent, transcribed verbatim by a trained transcription team, and verified by the interviewer. Subsequently, the data were analyzed using a thematic coding framework.

Finally, we organized a symposium in our multidisciplinary research team (VALID II team) to discuss and explore potential approaches for effective interventions. This symposium included Vietnamese and Danish experts and researchers experienced in conducting self-care interventions from three universities: Thai Binh University of Medicine and Pharmacy (TBUMP), the University of Copenhagen (UCPH), and the University of Southern Denmark (SDU). Participants came from various fields, including obstetrics, endocrinology, general practitioners, epidemiology, public health, nutrition, and ethnography. The discussions addressed a range of issues, including appropriate methods and modalities for the intervention, as well as the necessary staff and educational materials for GDM self-care intervention.

Stage 2. Co-creation processes with pregnant women with GDM and healthcare professionals

To strengthen and enrich our new scientific insights and initial ideas gathered from Stage 1 and collaboratively design an effective intervention, we organized a co-creation workshop in May 2023. In this workshop, we invited eight pregnant women and their families (typically their husbands), one obstetrician from Thái Bình Maternity Hospital, one obstetrician from Kim Ngan Clinic, one endocrinologist from Thai Binh Provincial General Hospital, one endocrinologist from TBUMP, some primary HCP, and the Danish and Vietnamese research teams (VALID II team). The pregnant women with GDM were recruited from phase 1 or referred by obstetricians from Thái Bình Maternity Hospital or Kim Ngan Clinic. In this workshop, we employed a mixed qualitative method, combining individual conversations and four group discussions. Individual conversations were conducted with the pregnant women and their families to further explore the thoughts, experiences, and unmet needs in GDM standard care within the current healthcare system. Simultaneously, conversational interviews with HCPs were supplemented to capture the current capacity of the provincial health system and present the experiences and existing issues/challenges they faced in the maternal care area.

Following the interviews, four group discussions were organized to propose effective interventions tailored to the target group. Each group discussion comprised two women and their families, one obstetrician or endocrinologist, and one to two HCPs. One to two researchers participated in each group to facilitate the group discussions, encourage active engagement, and take notes on the discussion. After group discussions, we provided feedback on the similarities and differences between new insights, our initial ideas, and the participants' contributions.

Stage 3. Design and development of the digital health intervention

Based on the inputs gathered from Stage 1 and co-creation workshops, we designed a digital health intervention model titled "Healthy Pregnancy," which supplements standard care for women with GDM. This model consists of three main components: online peer support groups organized via Zalo, a widely used mobile application in Vietnam, online video conferences conducted through Zoom, and a private (restricted-access) Facebook group for knowledge sharing and activity updates. Additionally, we planned to provide all pregnant women with GDM participating in the intervention with a set of educational materials, including leaflets and videos focused on topics such as diet, exercise, glucose monitoring, emotional well-being, and family support. To prepare the educational materials, we mapped and designed drafts before undergoing the experts' review rounds from TBUMP, UCPH, and SDU, including obstetricians, endocrinologists, nutritionists, and health communication experts, to provide feedback and revisions on both language and visuals.

Stage 4. Pilot testing

After developing and refining the educational materials, we conducted three pilot tests: one to assess the readability and visualization of the leaflets and videos, and two others to evaluate the feasibility and reliability of the Zalo groups and Zoom meetings. The pilot participants included eight women: four pregnant women with GDM and four women with prior GDM. They started engaging in the initial intervention evaluation process by reviewing the educational materials; afterward, they provided feedback and suggestions by completing an anonymous evaluation form ([Multimedia](#)

[Appendix 4](#)). The first four questions referred to their impressions and assessments of the GDM leaflet or video regarding the clarity of language, font size, visual appeal, and usefulness of the content, rated on a 10-point Likert scale (from 1 to 10). The descriptive statistics were utilized to analyze the results. The last question was open-ended, encouraging them to provide additional comments or suggestions to improve the quality of leaflets and videos. They were also invited to participate in the pilot Zalo group and Zoom meetings for a week, then provide comments on their experiences with the software used. The entire process was revised to ensure the feasibility and effectiveness of the actual intervention. By the end of this stage, we had finalized the intervention description and the educational materials that had received approval from the Department of Information and Communications of Thái Bình Province.

Ethical considerations

Ethical approval for this study was granted by the Ethics Council for Biomedical Research at Thai Binh University of Medicine and Pharmacy, Vietnam, on December 1, 2022 (IRB – VN01.009). The study was registered at ClinicalTrials.gov (NCT05744856). All participants agreed and signed the written informed consent after being fully informed about the study's objectives and procedures, including their right to withdraw at any time. All information was stored with strict confidentiality to protect participants' identities. For the ethnographic articles, the participants' names were changed to ensure anonymity.

Results

Stage 1. Scoping review, ethnographic study, and brainstorming

Our scoping review identified 29 intervention programs on self-care interventions for women with GDM in LMICs according to the three health dimensions of the WHO, including physical, mental, and social health. Self-care interventions were complex and heterogeneous in content, duration, mode of delivery, follow-up time, and outcome measures. This heterogeneity complicated the

comparison and synthesis of study results and meta-analysis, making it difficult to conclusively demonstrate the superiority of specific intervention content or modalities. However, the scoping review revealed numerous gaps in the existing self-care interventions in LMICs. Most interventions predominantly focused on improving physical health while less frequently addressing the mental and social health dimensions. Moreover, digital interventions have emerged as a potential approach in self-care interventions to improve pregnant women's adherence and pregnancy outcomes [33]. Additionally, interventions were often implemented and followed up only during pregnancy, overlooking the sensitive transition postpartum. These findings motivated us to develop the VALID II – "Healthy Pregnancy" intervention, which utilized a digital health intervention to integrate support for three health dimensions (physical, mental, and social health) for pregnant women from the time they were diagnosed with GDM until four months postpartum.

Although the scoping review on self-care interventions for pregnant women identified studies from LMICs, no intervention studies from Vietnam were found [33]. Therefore, we performed ethnographic studies to explore the perceptions, experiences, and challenges that Vietnamese pregnant women faced in GDM self-care within the local context, where our intervention will be implemented and evaluated. The findings showed that after being diagnosed with GDM, pregnant women and their families were quite shocked about their illness [11, 34], as well as had difficulties in self-care and management of the disease [12].

Despite being a recognized medical condition requiring attention and care during pregnancy, women with GDM often receive insufficient counseling from specialists and inadequate support from family and society [11]. Consequently, the participants in our studies described their experience in self-retrieved online information and expressed uncertainty due to the heterogeneity and unofficial information sources, as well as limited counseling from HCP [35].

Additionally, when navigating the challenges of pregnancy complicated by GDM, most women in our study emphasized the vital role of their spouse's support in motivating them to adopt new

lifestyle changes [36]. The spouse's participation in our intervention is essential, as their involvement can significantly enhance and promote the family's overall awareness of GDM. The husbands will be aware of GDM's causes, effects, and management by accompanying their wives through the intervention. This newfound knowledge enabled them to support and share responsibilities for dietary planning, exercise, and SMBG. Additionally, husbands understand the psychological and practical challenges in GDM management, which, in turn, sympathize and offer emotional encouragement to reduce women's overwhelming feelings. Furthermore, in the patrilineal and patrilocal kinship relationship in Vietnam, husbands play a crucial role not only in making decisions but also in influencing other members' attitudes and involvement in maternal care. Hence, the husband's presence in the intervention could shift GDM management from a sole burden on women to a family-wide health concern, enabling a home environment that sustains self-care behaviors and improves maternal and fetal outcomes.

To stimulate brainstorming and the exchange of experiences between experts and researchers, we organized multiple online discussion meetings between TBUMP research members and Danish experts, who have extensive experience designing and developing community interventions for pregnant women with GDM. At the first discussion, we shared the findings of our scoping review and ethnographic interviews. Subsequently, many online meeting rounds of brainstorming and discussion activities took place. With the diversity of fields of the team members from both sides, we engaged in interdisciplinary and multi-dimensional discussions to develop an intervention program that is culturally appropriate and relevant to the context of Vietnam. The discussions highlighted the potential of applying a mobile application, namely Zalo, the most popular free mobile phone application in Vietnam that supports fast messaging, picture and video sharing, and offers stability [37]. Furthermore, due to COVID-19, Vietnam is advancing its digital industry and e-learning initiatives, leading to a growing familiarity with online teaching software like Zoom [38]. With its free 40-minute session, Zoom is an ideal platform for online instruction and Q&A sessions for

pregnant women with GDM.

As we concluded Stage 1, we identified two digital, interactive platforms to serve as the main intervention content for online coaching and counseling. Peer support and the involvement of spouses were essential elements of the intervention. Moreover, a new set of educational materials, including leaflets and videos, was developed to enhance all participants' awareness (Table 1). After completing the exploratory stage, we moved on to Stage 2, the co-creation phase, to compare, refine, and confirm the practical modalities of the intervention content.

Table 1. Overview of key findings from Stage 1.

Key findings	Intervention delivery	Sources (Articles of VALID II)
No specific intervention was identified as superior, and mental and social health were less addressed.	Integrate support for three health dimensions (physical, mental, and social health).	Scoping review [33].
Most interventions followed up within the pregnancy.	Duration: From the time diagnosed with GDM until four months postpartum.	Scoping review [33].
Engagement of spouses.	Spouses or family members can participate in the intervention.	Ethnographic studies [11, 12, 36].
On-time support and counseling from HCPs. Eliminate geographical barriers between healthcare services and pregnant women. Free platforms to serve all levels of the economy.	Online coaching and counseling. Online platforms: Zalo and Zoom meetings.	Scoping review [33]. Ethnographic studies [35]. Brainstorming and discussion meetings.
No blaming women and providing a space for exchanging experiences and emotions.	Peer support.	Brainstorming and discussion meetings.
The necessity of structured and visualized educational materials.	A set of leaflets and videos.	Ethnographic studies [35] Brainstorming and discussion meetings.

Stage 2. Co-creation processes with pregnant women with GDM and healthcare professionals

We advanced the intervention development process with a co-creation workshop in Stage 2. To gather comprehensive suggestions from all stakeholders, we invited pregnant women with GDM and their families (typically their husbands), obstetricians from the Thái Bình Maternity Hospital and Kim Ngan Clinic, endocrinologists from Thái Bình Provincial General Hospital and TBUMP Hospital, and primary HCPs to participate in our co-creation workshop.

During the workshop, we focused on three key topics:

- What are the challenges and unmet needs related to GDM self-care among pregnant women and their families? (individual conversations)
- What are the status and challenges in GDM education and counseling in healthcare facilities? (individual conversations)
- What are the potential solutions for these challenges, including the content, modalities, and duration? (discussion groups)

The challenges and unmet needs related to GDM self-care among pregnant women and their families

Most pregnant women shared that they had limited knowledge about GDM. They often learned about GDM only upon receiving a diagnosis through the Oral Glucose Tolerance Test (OGTT) and were informed by the doctors, which left them feeling frustrated and uncertain why they had developed the condition.

In addition, women noted that currently, in Thái Bình Province, there is a lack of specific counseling on GDM self-care and intensive treatment in the maternal areas. The provincial general hospital, which has an endocrinology department for these purposes, has patients suffering from various endocrine diseases and has too few specialists. Consequently, it cannot meet all their needs, leading them to seek information online. However, the online information often confused them about blood sugar management, and they struggled to find reasonable solutions.

"I wanted to know what kind of diet is for people with GDM; I searched on the Internet and found that it is very dangerous for both mother and child. I adjusted my diet, but sometimes I had low blood sugar. My diet was not scientific, but I did not find a reasonable solution." (A 40-year-old pregnant woman)

Not only pregnant women but also their families felt confused about this new term.

"I want to know how GDM affects the health of mother and child. I also want to know the solution (intervention) for this problem." (Husband of a pregnant woman with GDM)

On the other hand, there are also many cases where families do not care much about this problem.

"I am more worried than others; everyone feels that it is normal, no need to worry." (A 35-year-old woman, pregnant after in vitro fertilization)

The status and challenges in GDM education and counseling in healthcare facilities

During the workshop, we also interviewed the HCPs to gather practical information about the health system's current state and the HCPs' challenges in examining and counseling pregnant women with GDM. The endocrinologists in the hospital did not express difficulty in their specialized field. However, they faced challenges related to insufficient equipment and limited awareness of GDM among pregnant women and the general community. Additionally, they emphasized the lack of local official information channels and the weak interaction between endocrinologists and obstetricians during follow-ups with pregnant women and childbirth.

On the other hand, the obstetricians noted their lack of confidence in counseling due to their limited specialized knowledge of endocrinology and inadequate formal training on GDM. In addition, pregnant women expect doctors to have comprehensive training on all diseases, so it is challenging to satisfy patients' high expectations.

Community health workers also noted that neither they nor the pregnant women were aware of

GDM. While many pregnant women felt anxious due to the lack of official information sources, others were indifferent and unconcerned about GDM.

The potential solutions for these challenges

The thoughts and needs for an effective intervention program were identified and confirmed through four group discussions. A shared priority was using digital platforms to provide knowledge to pregnant women, their families, and the broader community, helping to overcome geographical barriers. The two most preferred platforms were the Zalo mobile application and Zoom video conferencing. The participants also expressed interest in joining small Zalo groups of 15 to 20 members at a similar point in their GDM diagnosis. In these groups, pregnant women and their families mentioned the desire for advice from endocrinologists and obstetricians and shared it with peers. For Zoom sessions, the ideal time would be 30 to 40 minutes at 8 pm on a fixed day, covering different topics. A private Facebook group was also recommended to store educational materials and activities.

Regarding educational materials, the groups discussed and agreed that both leaflets and videos should be provided, offering guidance on diet, exercise, and home blood sugar monitoring. The educational materials should be clear, easy to follow, and written in simple, accessible language.

In addition, one group suggested that there should be training courses for HCPs on GDM at Thái Bình Maternity Hospital and obstetrics and gynecology clinics. Another group mentioned continuous glucose monitoring (CGM) could be considered in severe cases or for women in favorable economic situations.

After the groups presented their ideas, we shared the findings from the scoping review and ethnographic interviews, along with the concepts developed in Stage 1. Together, we compared and discussed potential solutions for implementation in the trial and for future scale-up (see Table 2).

Table 2. Comparison and agreement on the intervention approach content.

Intervention ideas from group discussion	Intervention delivery	Applying (Y/N)	Reason for applying or not
Small Zalo groups	- Consist of 15–20 members at similar gestational ages. - Have the support of HCPs and peers - 01 admin to manage, collect the information, and transfer the difficult questions to the specialists.	Yes	An ideal number of members. Similar ideas as outlined in Stage 1
Zoom meetings	- Lasted 30 - 40 minutes, starting at 8 pm on a fixed day - Discussion on a specific topic with specialists	Yes	A free version of Zoom meetings is 40 minutes, so it facilitates the trial and scaling up. Similar ideas as outlined in Stage 1.
Family group	- Invite husband or mother/mother-in-law for knowledge sharing	Yes	Similar ideas as outlined in Stage 1.
Private Facebook Group	- Admins (researcher team): moderate posts, answer the questions, share Zoom links, and record videos	Yes	Similar ideas as outlined in Stage 1.
Educational materials	- Leaflets - Videos	Yes	Similar ideas as outlined in Stage 1.
Training workshop for HCPs	Short courses for obstetricians and nurses	Yes	Need to improve the capacity of HCPs in the standard care for GDM.
Use Continuous Glucose Monitoring (CGM)	For severe cases or women in favorable economic situations.	No	CGM requires high costs and is unsuitable for the trial and scaling up.

Stage 3. Design and development of the digital health intervention process

Mapping and designing educational materials

To ensure an effective and engaging intervention, we developed a set of structured educational materials, including leaflets and videos, to support pregnant women with GDM in their self-care journey. The process began with mapping out core content based on findings from the scoping review, ethnographic study, and co-creation workshops. We identified essential topics covering physical, mental, and social aspects of GDM self-care, including dietary guidance, exercise recommendations, blood sugar monitoring techniques, stress management strategies, family support roles, and postpartum care.

Following the content mapping, we designed a series of educational materials consisting of eight leaflets (one printed and seven digital) and eight videos (see Table 3). These materials were carefully structured to ensure clarity, cultural relevance, and accessibility. Visual elements were integrated to enhance engagement, with simple language, illustrations, and real-life scenarios making the information more relatable. The materials were designed so that pregnant women and their families could easily understand and apply self-care principles daily.

Table 3. Overview of leaflets and videos.

No	Topic	Format	Place/Platform
1	GDM – Things to know	01 printed leaflet 01 video	Thái Bình Maternity Hospital/ Kim Ngan Clinic Zalo groups, Private Facebook group
2	Nutrition therapy	01 digital leaflet 01 video	Zalo groups, Private Facebook group
3	Serving and portion guide	01 digital leaflet 01 video	Zalo groups, Private Facebook group
4	Physical activities - Prenatal yoga	01 digital leaflet 02 videos	Zalo groups, Private Facebook group
5	SMBG at home	01 digital leaflet 01 video	Zalo groups, Private Facebook group
6	Family support	01 digital leaflet	Zalo groups, Private Facebook group
7	Mental health - Meditation	01 digital leaflet	Zalo groups, Private Facebook group

	and breathing	01 video	
8	Childbirth and postpartum care	01 digital leaflet 01 video	Zalo groups, Private Facebook group

Expert Review and Revisions

Once the initial drafts of the educational materials were completed, we sought feedback from diverse experts, including obstetricians, endocrinologists, public health professionals, and health communication specialists. Their insights helped refine the content to ensure medical accuracy, feasibility, and effective message delivery. Recommendations included simplifying the language, enhancing visual presentation, and improving cultural relevance, resulting in an improved version of the materials.

Stage 4. Pilot testings

Pilot testing with educational materials

Table 4 demonstrates the expression of pilot participants on educational materials in the intervention. Most of the pilot participants (87.5%) rated the language used in the leaflets and videos in the range of 7 to 9, indicating understandable language, while one woman (12.5%) rated it 6. The mean rating was 7.6 ± 0.92 . Regarding the font size readability, most (75%) gave positive ratings of 7 or 8 for being easy to read, while one-fourth rated it at 6. The visual elements were rated with an average score of 7; most found them attractive and engaging (7 or 8 points), while one rated them 6 and another rated them 5. For the usefulness of the content, all participants rated it a high score from 7 to 10, with an average score of 8.6.

Table 4. Language and cultural adaptations.

Criteria	Mean $\pm$ SD	Min - Max
Language	7.6 ± 0.92	6 - 9
Font size	7.3 ± 0.89	6 - 8
Visualization	7.0 ± 1.07	5 - 8

Content	8.6 ± 0.92	7 - 10
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For the open-ended question, most of them appreciated our educational materials. They suggested revising the wording to be closer to pregnant women, explaining medical terms, making the font larger for easier reading, and using images of pregnant women and foods reflecting Vietnamese culture.

Pilot testing with the intervention process

We also gathered feedback from the pilot participants on the necessary elements and the structure of the intervention. Most (6 out of 8) emphasized that the intervention had to have a formal logo that increases the participant's trust. Moreover, all agreed that the health staff in the Zalo groups and Zoom meetings should use their full names and professional titles to avoid confusion and enhance credibility. QR codes were also highlighted as a practical solution to facilitate women's session access. Most participants provided feedback on the structure of the Zoom sessions and the flow of leaflets and videos, emphasizing their importance in maintaining participant engagement.

After refining the intervention through multiple rounds of feedback and revisions, we submitted the educational materials for official approval to the Department of Information and Communications of Thái Bình Province.

We also completed the online health intervention description applying to the intervention for pregnant women with GDM (see Figure 2)

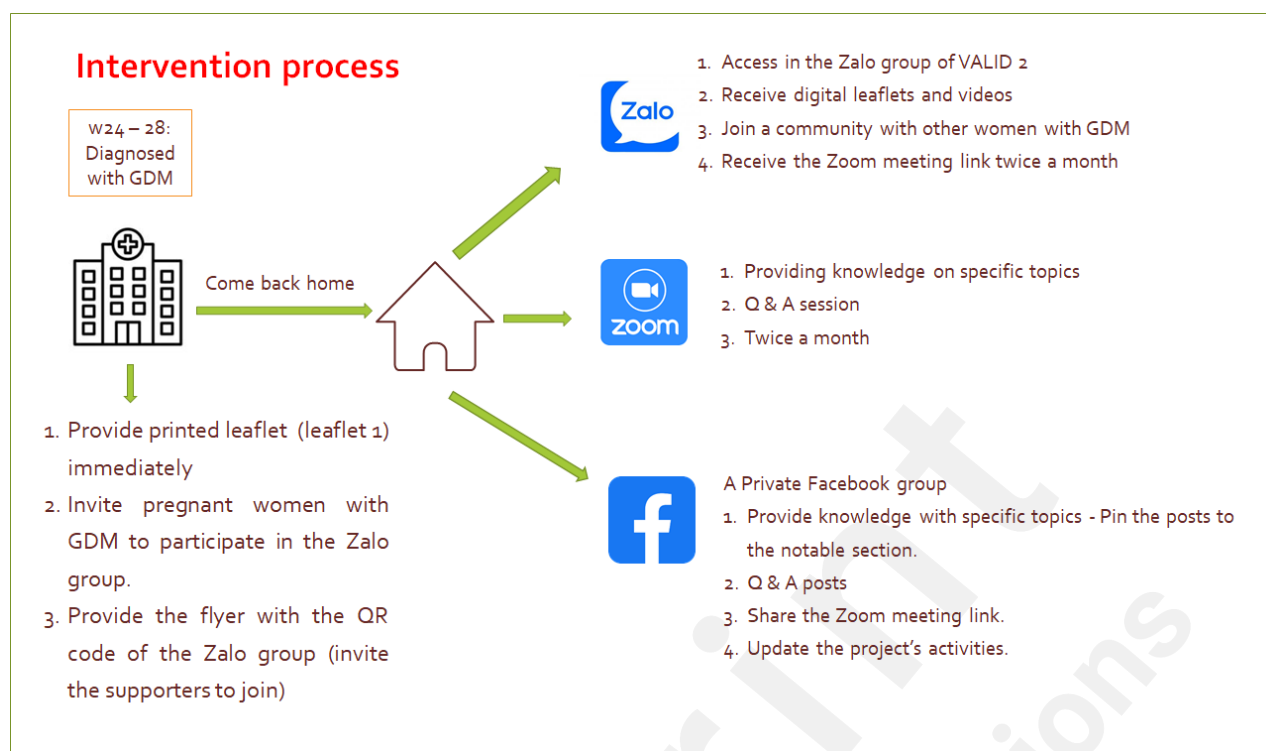


Figure 2. Intervention process.

Upon diagnosis with GDM, the pregnant woman was informed by a researcher about the intervention's purposes and structure. Subsequently, she was invited to participate in the intervention program by entering a Zalo group via the QR code. A new QR code for a new Zalo group was launched whenever a group reached approximately 20 participants.

In the Zalo group chat, each participant received a welcoming message along with a set of GDM self-care leaflets and instructional videos. Furthermore, they were notified weekly about a specific self-care topic and encouraged to ask questions, share comments, and exchange experiences with the other women daily. To foster a more engaging group atmosphere, we invited one or two pregnant women to serve as active members (“thành viên tích cực”), who regularly shared their personal experiences, such as daily meals, physical activities, SMBG results, and aspects of their pregnancy journey. If questions regarding emergencies or complex issues were left unanswered or addressed incorrectly, an HCP intervened to provide accurate information, adding to the knowledge shared through leaflets, videos, and peer discussions. Furthermore, video consultations were held via Zoom every second Friday, allowing pregnant women to receive professional counseling from specialists

and share experiences in real time. Each Zalo group remained active until 4 months postpartum.

Discussion

Principal findings

This study provides evidence base to co-create and develop a digital health intervention model to improve peer support and self-care among pregnant women with GDM in Vietnam, a lower-middle-income country. Through a multi-stage process, we identified key self-care challenges and developed a tailored "Healthy Pregnancy" intervention for pregnant women and families affected by GDM. The intervention included leaflets and videos on diet, physical activity, SMBG, emotional well-being, and postpartum care. These educational materials were reviewed and revised in collaboration with women with GDM, healthcare professionals, and communication experts. The pilot tests with target users allowed final refinements before getting official approval. Although the development process was complex and time-consuming, with 14 months before embarking on the trial phase, this comprehensive approach ensured that the intervention was grounded in real-world experiences and responsive to the needs of women managing GDM in their everyday lives.

Strengths and limitations

To the best of our knowledge, this study is the first to describe the multi-stage development of a digital health intervention program for pregnant women with GDM in Vietnam. One of the key strengths of our study was its comprehensive, participatory, and contextualized approach with the presence of the WHO's conceptual framework for self-care and the co-creation method across multiple stages. Drawing on the WHO's conceptual framework for self-care [19], we set up a self-care digital health intervention focused on people-centred primary healthcare. Based on our insights into the participants' needs and desires, we offer online coaching and counseling alongside educational materials to support and empower pregnant women to independently make informed decisions and adhere to daily self-care behaviors. Additionally, we provided an enabling

environment where they can openly share and receive support regarding GDM and other aspects of life, through peer support on digital platforms and by mobilizing family engagement in daily routines. Meanwhile, engaging the target users and multiple stakeholders, the co-creation approach enabled the intervention content and modalities to be adjusted relevantly to the target group's context and preferences [20, 39, 40]. Additional pilot tests with the target group were required to contribute to an innovative and effective intervention program [20]. This systematic yet flexible procedure allowed us to apply up-to-date scientific insights effectively and modify the intervention program according to the context and needs of the target audience locally. It also aligns with the design of complex interventions, particularly in resource-limited settings, where cultural appropriateness and stakeholder engagement are key elements for effectiveness and sustainability.

Another strength of our study was the ability to leverage widely available and nearly free digital platforms, specifically Zalo and Zoom meetings. Zalo, a free, widely used messaging application accessible on smartphones and websites in Vietnam [37], was expected to facilitate equitable access to our intervention for most pregnant women and families. Meanwhile, due to the COVID-19 pandemic and the 4.0 era, online conference platforms have emerged as a solution for remote learning and working [38]. Consequently, many Vietnamese people are becoming increasingly familiar with online platforms, such as Zoom, which is a common choice due to its high video and sound quality, as well as its free version that supports up to 100 participants within 40 minutes [41]. Beyond the familiarity and feasibility of Vietnam's technological infrastructure, these digital tools contributed to blurring geographical barriers, facilitating timely support and counseling, thereby reducing the burdens on pregnant women with GDM and the professional healthcare system. Such integration promises to open up opportunities to sustain and scale up our model in LMIC settings like Vietnam. Moreover, the companionship of peer support and family involvement in the intervention was highly recommended for enhancing motivation and behavior change by the role model from active members in the group, as well as family support in daily life [42-44].

However, our study had several limitations. First, the digital health intervention was designed specifically for pregnant women with GDM in Thái Bình Province in Northern Vietnam, leading to its highly context-specific nature. Although its design and development process could be fully transferable, replicating the model may encounter difficulties without adapting to cultural and social norms, digital access, online platforms, or the healthcare system.

Second, although 79.1% of the population in Vietnam has internet access [45], and we tried to employ freely accessible digital platforms locally, it still may not fully cover individuals without stable internet access. This may inadvertently limit the socioeconomically disadvantaged groups' access to the intervention.

Third, while we expected the intervention to be feasible for integration into standard maternal care, it still required an available staff team for management and moderation and a specialist team for education and timely counseling. Another potential limitation of online peer group interventions is the reluctance of some participants to share their thoughts and emotions with unfamiliar members, which may hinder group cohesion and reduce the overall effectiveness of the intervention. However, these participants may still benefit from the information or experiences shared by other members and professional advice from healthcare workers in the group. Additionally, the design and development process took a long time, 14 months. Therefore, it may not achieve ideal cost-effectiveness in this period. Nevertheless, this process serves as an essential stepping stone as we can leverage its advantages and results in the next phase of the VALID study.

Implementations

Given the growing burden of diabetes, particularly GDM in Vietnam and other LMICs, digital health interventions promise to be an effective solution to enhance maternal and child health outcomes. Given the current incomprehensive status of the maternal care system, we aim to contribute evidence and results that can support embedding digital health models into national health programs. It addresses existing gaps in GDM educational communication and ensures continuous maternal care

beyond professional healthcare.

Notably, the rapid digital transformation and widespread smartphone use in Vietnam are ushering in an era of integrated technology into every corner of life, including healthcare. Therefore, increasing the use of digital health is feasible and appropriate in maternal care. Additionally, integrating AI-driven tools, such as intelligent chatbots, tailored reminders, or behavior-tracking tools, into future interventions may enhance individualization and responsiveness, providing a better and more supportive experience for pregnant women with GDM.

Conclusion

This study illustrates a rigorous, co-creation approach to design and develop a culturally tailored digital health intervention that empowers and supports self-care among pregnant women with GDM in Vietnam. By integrating local perspective, scientific evidence, and iterative co-creation, the “Healthy Pregnancy” intervention addressed the lived needs of women and their families in a lower-middle-income context. Beyond addressing current gaps in GDM standard care, our model indicates the potential integration of digital self-care interventions into national maternal health systems. Moreover, this study offers a replicable model for co-creation and developing inclusive, sustainable, and locally relevant digital health innovations in resource-limited settings.

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Conflicts of interest

None declared.

Date availability

The datasets generated or analyzed during this study are not publicly available due to protecting the participants' privacy, but are available from the corresponding author on reasonable request.

Authors' contributions

Conceptualization: N-ATD, JS, TMG

Data curation: N-ATD, DKN, TAN, HML, TKDV, TMG

Funding acquisition: TMG

Investigation: N-ATD, DKN, TAN, HML, TKDV, TMG

Methodology: N-ATD, JS

Project administration: TMG, TDN

Supervision: TMG, JS, DWM

Visualization: N-ATD

Writing – original draft: N-ATD, JS

Writing – review & editing: All

Abbreviations

GDM	Gestational diabetes mellitus
T2D	Type 2 diabetes
LMICs	Low- and middle-income countries
TBUMP	Thai Binh University of Medicine and Pharmacy
UCPH	University of Copenhagen
SDU	University of Southern Denmark
WHO	World Health Organization
SMBG	Self-monitoring blood glucose
OGTT	Oral glucose tolerance test
CGM	Continuous glucose monitoring

Multimedia Appendix 1. GUIDED checklist.**Multimedia Appendix 2. TIDieR checklist.****Multimedia Appendix 3. Open-ended interview guide.****Multimedia Appendix 4. Evaluation form for educational materials.****References**

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Supplementary Files

Multimedia Appendixes

GUIDED checklist.

URL: <http://asset.jmir.pub/assets/faffd7af863c7b04395e2462cf3834eb.docx>

TIDieR checklist.

URL: <http://asset.jmir.pub/assets/512b2f67575aaea9adf394d6dd1cb62e.docx>

Open-ended interview guide.

URL: <http://asset.jmir.pub/assets/19aded567a7d818dd16f7e6b2e5c95f6.docx>

Evaluation form for educational materials.

URL: <http://asset.jmir.pub/assets/14ec06e5c57b8ba4f5238254c8530541.docx>

CONSORT (or other) checklists

GUIDED checklist.

URL: <http://asset.jmir.pub/assets/300922d7237b19ff5a82c3b7b45c0793.pdf>

TIDieR checklist.

URL: <http://asset.jmir.pub/assets/951a8fe7a5d4a8201cf9cc9bf1d9b476.pdf>