

Original Article

Korean J Health Promot 2025;25(2):59-65
pISSN: 2234-2141 • eISSN: 2093-5676
<https://doi.org/10.15384/kjhp.2025.00052>

Mobile Health Education for Patients with Diabetes and Prediabetes: A Pilot Study on Knowledge, Motivation, and Lifestyle Change

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ABSTRACT

Background: To evaluate the effectiveness of a pilot smartphone-based digital health education program in improving diabetes-related knowledge, motivation for lifestyle change, and lifestyle behaviors among adults with diabetes or prediabetes.

Methods: We conducted a retrospective observational study using data from 38 adults (aged, 20–70 years; body mass index, ≥ 23 kg/m²) with diabetes or prediabetes who participated in an 8-week "Health Curation Service" pilot program in 2024. The intervention delivered personalized health information via a mobile messenger (KakaoTalk) twice weekly (16 sessions) focusing on blood sugar management, diet, and exercise. Participants completed an online survey at program end assessing perceived improvements in diabetes knowledge, motivation for behavior change, and program satisfaction. Lifestyle behaviors were evaluated before and after the program using the diet quality score (0–100) and self-reported physical activity (MET-min/wk). Pre- and post-intervention measures were compared with the Wilcoxon signed-rank test (for 13 respondents, 34.2% response rate).

Results: Participants reported high satisfaction with the program and perceived improvements in diabetes knowledge (mean score, 4.3/5) and motivation to change lifestyle behaviors (mean score, 4.0/5). The mean diet quality score showed no statistically significant change (79.8 pre-intervention vs. 79.4 post-intervention, $P=0.67$), although the number of participants classified as having "good" dietary habits (score ≥ 80) increased from 6 to 9. Physical activity levels increased from 1,003.1 to 1,290.5 MET-minutes per week, but this change was not statistically significant ($P=0.53$).

Conclusions: This pilot study suggests that a mobile health education program may be a feasible approach for delivering personalized health information to individuals with diabetes or prediabetes. However, no statistically significant changes were observed in diet quality or physical activity over the 8-week intervention. Further studies involving larger populations, extended follow-up periods, and more interactive components are needed to more rigorously evaluate the potential of mobile-based interventions for behavioral change in chronic disease management.

Keywords: Mobile applications, Digital health, Diabetes mellitus, Prediabetic state

Received: April 12, 2025; **Revised:** June 8, 2025; **Accepted:** June 13, 2025

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INTRODUCTION

The modern healthcare landscape is undergoing a significant transformation, shifting from institution-centered care to patient-centered services. Among chronic diseases, metabolic syndrome and diabetes pose substantial risks, particularly increasing the likelihood of cardiovascular complications. Effective prevention and long-term management are crucial in mitigating these risks. However, traditional single-session counseling and general health information dissemination often fall short of ensuring sustained disease management. To address this limitation, digital health platforms providing personalized health management have gained increasing attention [1,2].

Previous studies have demonstrated that digital health interventions can positively impact chronic disease management. For instance, studies have shown that smartphone-based diabetes management applications improve glycemic control and self-management skills [3-5]. Additionally, digital health platforms have been found to enhance lifestyle changes and interactions with healthcare providers, leading to improved treatment outcomes. Digital interventions for chronic diseases have also shown efficacy in promoting patient adherence to lifestyle modifications and medical treatments [2,6]. Mobile devices can also serve as valuable tools for patient education. Multiple small-scale studies suggest that mobile-based educational programs can aid diabetes patients in better self-management [7,8].

Building upon this background, the present study evaluates the effectiveness of a digital health program in improving patients' knowledge, motivation, and lifestyle behaviors. Furthermore, this study explores the potential of digital healthcare services in advancing patient-centered chronic disease management, particularly in the context of diabetes and metabolic syndrome, while providing insights into future directions for digital health interventions.

METHODS

Study design and participants

This study is a retrospective observational analysis using survey data from the Health Curation Service, a digital wellness program conducted by the Seoul National University Hospital Healthcare System Gangnam Center in 2024. This retrospective analysis was conducted using anonymized data originally collected for service evaluation purposes, not for research. Therefore, Institutional Review Board approval was not sought,

in accordance with relevant guidelines for secondary use of non-identifiable data. The program was designed to provide personalized digital health information to patients with metabolic diseases. Before launching the full-scale service, a pilot program was implemented to assess the operational feasibility, potential challenges, and effectiveness of the intervention. Since the primary objective of this service was to provide personalized health information, internal discussions were held to define the target population and content in detail.

The inclusion criteria for participation were adults aged 20 to 70 years with a body mass index (BMI) of 23 kg/m² or higher and a diagnosis of diabetes or prediabetes. BMI was calculated using height and weight measurements obtained on the day of the health screening. Body weight and height were measured using a digital scale, and BMI was determined by dividing weight in kilograms by the square of height in meters. Diabetes and prediabetes status were identified based on either a self-reported diagnosis of diabetes in the medical questionnaire or blood test results that met prediabetes or diabetes criteria, specifically a fasting blood glucose level of at least 100 mg/dL or a glycated hemoglobin (HbA1c) level of 5.7% or higher. Blood samples were collected after a 12-hour overnight fast.

Participants were excluded if they did not own a smartphone or were unable to use the KakaoTalk messenger application. Individuals who did not consent to participate in the pilot service were also excluded. Eligible participants were identified through medical records, and those who visited the clinic for follow-up consultations regarding their health screening results were provided with detailed information about the program. Those who agreed to participate were enrolled. Recruitment for the pilot service took place over three weeks starting from July 1, 2024, and a total of 38 participants were enrolled.

Intervention

The Health Curation Service was implemented over an eight-week period from July to September 2024, during which participants received digital health information twice weekly, totaling 16 sessions. Participants who provided consent received personalized health content via KakaoTalk notifications, consisting of short-form card news and YouTube video clips. The content was tailored according to participants' clinical status—categorized into prediabetes and diabetes groups. Each card news segment comprised approximately 5 to 8 slides. For participants with prediabetes, the materials covered topics such as the significance of impaired fasting glucose, weight management, and

general lifestyle strategies for diabetes prevention. For those with diabetes, the content focused on disease-specific education, glycemic control targets, and more detailed dietary guidance, including intermittent fasting and low-carbohydrate diets. Of the 16 sessions, one or two included YouTube video clips of approximately 15 minutes in length, thematically aligned with the accompanying card news content.

Data collection

At the conclusion of the program, an online survey was conducted to assess participants' satisfaction and evaluate the effectiveness of the intervention. The collected data were retrospectively analyzed. The survey consisted of three sections. The first section measured health knowledge improvement and motivation for behavioral change using two items rated on a 5-point Likert scale. The second section evaluated program satisfaction with five items, also rated on a 5-point Likert scale. The third section assessed lifestyle habits, focusing on dietary patterns and physical activity.

Dietary habits were evaluated through a 10-item questionnaire that examined the frequency of consuming three meals per day, grains, protein sources, vegetables, dairy, and fruit. Additional items assessed the frequency of consuming fried or pan-fried foods, fatty meats, salty condiments such as soy sauce, and sugary snacks [9,10]. Based on these responses, a diet quality score was calculated, where each item was assigned 5 points for healthy habits, 3 points for moderate habits, and 1 point for unhealthy habits. The total score was then converted to a 100-point scale, with dietary habits categorized as follows: a score of 80 or higher was classified as good dietary habits, a score between 60 and 79 indicated the need for some dietary improvements, and a score of 59 or lower suggested the need for significant dietary changes. Physical activity was assessed using the Global Physical Activity Questionnaire which measures how many MET-min of physical activity is engaged during a typical week [11]. A MET value of 4 was assigned to walking and moderate-intensity exercise, and 8 to vigorous-intensity exercise. Based on calculated MET-min/wk, physical activity was categorized into low (<600), moderate (600–3,000), high (≥3,000). The dietary and physical activity questionnaires used in the post-program survey were identical to those administered during the initial health screening, allowing for a direct comparison of pre- and post-program lifestyle changes.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics. Baseline differences between survey responders and non-responders were assessed using the Mann-Whitney U-test for continuous variables and Fisher's exact test for categorical variables. To evaluate health knowledge, motivation, and satisfaction, mean scores were calculated from 5-point Likert scale responses. Pre- and post-intervention changes in diet quality scores and physical activity levels were analyzed using the Wilcoxon signed-rank test, appropriate for paired comparisons in a small sample. Categorical changes in diet and activity levels were assessed using the Stuart-Maxwell test for marginal homogeneity. All analyses were conducted using STATA version 14.0 (StataCorp LP), and a two-sided *P*-value <0.05 was considered statistically significant.

RESULTS

Participant characteristics

A total of 38 participants were included in the Health Curation Service pilot program, with 12 classified in the diabetes group and 26 in the prediabetes group. The mean age of participants was 60.5 years, and the mean BMI was 26.2. Of the 38 participants, 13 completed the post-intervention survey, yielding a response rate of 34.2%. Baseline characteristics were generally comparable between survey responders and non-responders, with no statistically significant differences observed in demographic or clinical variables. However, baseline diet quality scores were significantly higher among responders compared to non-responders ($P<0.01$) (Table 1).

Health knowledge, motivation, and satisfaction

At the end of the program, an online survey was conducted to assess participants' perceived improvement in diabetes-related knowledge, motivation for lifestyle modification, and overall satisfaction with the program. The mean score for perceived knowledge improvement was 4.3, and for motivation to change lifestyle behaviors, 4.0, on a 5-point Likert scale. Satisfaction with the program was high across all items, with an average score of 4.3. Detailed survey responses are summarized in Table 2.

Lifestyle changes

Pre- and post-intervention comparisons were conducted to evaluate changes in dietary habits and physical activity levels (Table 3). The mean diet quality score, derived from a ten-

Table 1. Baseline characteristics of participants by survey response status

Variable	Responder (n=13)	Non-responder (n=25)	P-value
Age (yr)	62.5±6.6	59.4±7.0	0.17
Female sex	4 (30.8)	6 (24)	0.71
Body mass index (kg/m ²)	26.4±3.7	26.0±2.8	0.98
Waist circumference (cm)	93.5±9.1	93.8±8.4	0.91
Fasting blood glucose (mg/dL)	112.5±9.9	112.0±8.8	0.98
HbA1c (%)	6.1±0.4	6.1±0.4	0.69
Diabetes	6 (46.2)	6 (24.0)	0.27
Antidiabetic medication use	5 (38.5)	6 (24.0)	0.46
Antihypertensive medication use	4 (30.8)	13 (52.0)	0.31
Lipid-lowering medication use	8 (61.5)	17 (68.0)	0.73
Cardiovascular disease	5 (38.5)	16 (64.0)	0.18
Baseline diet quality score	79.8±13.4	66.3±11.0	<0.01
Baseline physical activity (Met-min/wk)	1,003.1±957.6	1,481.6±3,662.2	0.37

Values are presented as mean±standard deviation or number (%). *P*-values were calculated using Fisher's exact test for categorical variables and the Mann-Whitney U-test for continuous variables.

Table 2. Knowledge, motivation and satisfaction

Question	Score
Did the health information help answer your questions about diabetes?	4.3/5.0
Did the provided information motivate you to improve your lifestyle?	4.0/5.0
Were you satisfied with the structure and content of the program?	4.3/5.0
Were you satisfied with receiving health information via KakaoTalk notifications?	4.2/5.0
How does receiving health information via KakaoTalk compare to printed materials, e-mails, or SMS?	4.5/5.0
Did the Health Curation Service make you feel that hospital is actively managing your health?	4.0/5.0
Would you like to continue receiving this service?	4.2/5.0

SMS, short message service.

Table 3. Change in dietary habits and physical activity

	Before	After	P-value
Diet quality score	79.8±13.4	79.4±14.1	0.67
≥80 (good dietary habits)	6	9	0.25
60–79 (needs some improvement)	7	3	
0–59 (needs significant improvement)	0	1	
Physical activity (MET, min/wk)	1,003.1±957.6	1,290.5±1,198.3	0.53
≥3,000 (high)	1	1	0.61
600–3,000 (moderate)	7	7	
<600 (low)	5	5	

Values are presented as mean±standard deviation or number. *P*-values were derived by Wilcoxon signed-rank test and Stuart-Maxwell test.

item dietary assessment, showed minimal change—from 79.8 at baseline to 79.4 post-intervention (*P*=0.67)—indicating no statistically significant improvement. While the number of participants classified as having good dietary habits (score≥80) increased from 6 to 9 and those requiring some dietary improvement (score 60–79) decreased from seven to three, this categorical shift was not statistically significant (Stuart-Maxwell test: *P*=0.25).

Similarly, the average weekly physical activity level increased

from 1,003.1 to 1,290.5 MET-minutes (a 28.7% increase), though the change was not statistically significant (*P*=0.53). When categorized into physical activity levels (low, moderate, high), the distribution of participants remained largely unchanged (Stuart-Maxwell test: *P*=0.61).

DISCUSSION

This study evaluated the effectiveness of a smartphone-based

digital health intervention, the Health Curation Service, in delivering tailored health information to individuals with diabetes and prediabetes. Survey respondents expressed satisfaction with the program and reported perceived improvements in their understanding of diabetes and motivation for lifestyle change; however, these findings should be interpreted with caution given the low response rate. Moreover, objective measures showed no statistically significant changes in diet quality or physical activity levels following the intervention.

While the number of participants classified as having good dietary habits increased, the overall diet quality score remained unchanged. Similarly, physical activity levels increased on average, but the change was not statistically significant. These findings suggest that although digital interventions may encourage positive perceptions and engagement, their short-term impact on behavioral outcomes may be limited. The consistently high satisfaction ratings indicate strong acceptability of the mobile-based approach, which is noteworthy given the challenges in sustaining user engagement with many digital health apps [12]. Delivering content through a familiar and widely used platform such as KakaoTalk may have contributed to this high level of engagement, supporting the potential utility of such tools in clinical practice.

The results of this study align with a growing body of evidence suggesting that mobile-based health services can support patient engagement and chronic disease self-management. A meta-analysis of 41 randomized trials demonstrated that app-based interventions significantly improved glycemic control and promoted self-care behaviors among patients with diabetes [13]. Previous research has shown that smartphone applications for diabetes management can improve glycemic control and adherence to self-care behaviors, but the extent of their effectiveness in long-term lifestyle modification remains unclear [3]. In our study, the lack of a structured, interactive dietary coaching component may have limited the effect on dietary habits. This interpretation is consistent with behavior change theories that emphasize the importance of tailored feedback and sustained support to facilitate long-term lifestyle modification [14]. In contrast, the provision of consistent prompts through messaging may have served as a more effective cue for encouraging physical activity.

Interpretation of the findings must consider the variability of results across previous studies on digital health interventions for chronic disease management. While some studies have reported significant improvements in both diet and physical

activity, others have found limited effects on long-term adherence to lifestyle modifications. A recent randomized controlled trial showed that a mobile health-enabled lifestyle intervention significantly improved diet quality and reduced sugar and sodium intake in adults with prediabetes [15]. Similarly, a clinical trial conducted in rural South Korea showed that combining a mobile app with a wearable device significantly increased moderate-to-vigorous physical activity and step counts, along with improvements in BMI, waist circumference, and HbA1c among individuals at risk for metabolic syndrome [16]. However, systematic reviews of mobile text messaging interventions have reported mixed results, with limited improvements in physical activity or glycemic control [17]. Likewise, a 6-month mobile text messaging trial did not significantly improve dietary behavior in patients with type 2 diabetes [18], suggesting that information delivery alone may be insufficient to alter entrenched dietary habits. Discrepancies in outcomes across studies may reflect differences in study design, intervention duration, degree of content personalization, and participant characteristics. Indeed, a recent review identified personalization, regular reminders, intuitive user interfaces, and the inclusion of human support as critical factors in driving adherence to mobile health programs [14]. Interventions lacking these elements may yield more modest effects, potentially explaining the mixed evidence in the literature. Furthermore, there are relatively few studies focusing on mobile-based education and health services for diabetes and metabolic syndrome, making direct comparisons difficult. Our study contributes to filling this research gap by providing preliminary evidence on the feasibility and impact of mobile-based interventions for diabetes and prediabetes patients in a real-world setting.

A key strength of this study is that it evaluated a real-world digital health intervention, enhancing the practical relevance of the findings. Unlike traditional clinical trials, which are often highly controlled and structured, this study reflects the actual implementation of a mobile-based health service in a health-care setting. However, several limitations should be noted. First, the retrospective observational design limits the ability to draw causal inferences about the intervention's effectiveness. A randomized controlled trial with a comparison group receiving standard care would offer stronger evidence. The absence of a control group makes it impossible to determine whether the observed changes resulted from the intervention or from natural variation over time. Second, the small sample size and low survey response rate (34.2%) restrict the generalizability of

the findings. The limited sample size also raises the possibility of a Type II error, in which the study may have failed to detect statistically significant effects despite the presence of modest true effects. The low survey response rate may have been influenced by various factors, such as digital fatigue, the lack of reminders or incentives, and the voluntary nature of participation. Additionally, the absence of interactive components may have reduced participants' motivation to complete the follow-up survey. However, the precise reasons for nonresponse remain uncertain. Third, the voluntary nature of participation introduces the possibility of selection bias. Notably, participants who responded to the follow-up survey had significantly higher baseline diet quality scores than non-respondents ($P < 0.01$), suggesting that more health-conscious individuals may have been more likely to remain engaged and provide feedback—potentially leading to an overestimation of the program's effectiveness. Fourth, improvements in diabetes knowledge and motivation for lifestyle change were assessed using self-reported Likert scale items. While practical for a pilot study, these are subjective measures. Future studies should employ validated instruments and objective measures to assess knowledge and motivation more rigorously. In addition, objective health indicators such as fasting blood glucose or HbA1c levels could be incorporated to provide more robust outcome data. Fifth, reliance on self-reported measures for diet and physical activity may introduce recall and response bias. Finally, the relatively short intervention period (8 weeks) may not have been sufficient to produce meaningful or sustained behavioral change, particularly in dietary habits. Long-term follow-up was not conducted, so it remains unclear whether any improvements were maintained after the program ended.

From a clinical perspective, this study supports the feasibility of integrating mobile health interventions into chronic disease management. By providing personalized health information through a platform familiar to patients, the Health Curation Service enabled continued patient engagement beyond the clinical setting. Such digital strategies may enhance communication and continuity of care between patients and providers [2]. Successful implementation requires attention to user experience and alignment with patient preferences. The high satisfaction and engagement observed here suggest that well-designed, accessible digital tools may be a promising complement to traditional care. As digital health becomes more widely adopted, such interventions can reinforce lifestyle counseling, monitor progress, and enable timely support for behavior change.

In conclusion, the Health Curation Service demonstrated high user satisfaction and perceived motivational benefit but did not yield statistically significant changes in diet quality or physical activity over the 8-week period. These results highlight both the promise and the limitations of short-term, message-based digital interventions. Future programs should incorporate more personalized, interactive features and consider longer durations to maximize their impact on sustained lifestyle change.

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AUTHOR CONTRIBUTIONS

Dr. Seung-Won OH had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors reviewed this manuscript and agreed to individual contributions.

Conceptualization: JSP, SHP, YC, JEY, and SWO. Data curation: JSP, SHP, KC, IL, KJH, JP, YC, and SWO. Formal analysis: JSP, SHP, and SWO. Methodology: JEY, EKC, and SWO. Software: JSP, SHP, and SWO. Writing—original draft: JSP, SHP, and SWO. Writing—review & editing: all authors.

CONFLICTS OF INTEREST

No existing or potential conflict of interest relevant to this article was reported.

FUNDING

None.

DATA AVAILABILITY

The data presented in this study are available upon reasonable request from the corresponding author.

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