REVISTA DA ESCOLA DE ENFERMAGEM DA USP
JOURNAL OF SCHOOL OF NURSING · UNIVERSITY OF SÃO PAULO

ORIGINAL ARTICLE

https://doi.org/10.1590/1980-220X-REEUSP-2026-0014en

The effect of mobile text messaging counseling on knowledge and self-efficacy in gestational diabetes: a randomized trial

El efecto del asesoramiento mediante mensajes de texto a través del móvil sobre los conocimientos y la autoeficacia en la diabetes gestacional: un ensayo aleatorizado

O efeito do aconselhamento por mensagens de texto em dispositivos móveis sobre o conhecimento e a autoeficácia na diabetes gestacional: um estudo randomizado

How to cite this article:
Yamaç SU, Vicdan N, Aydemir M, Gürsoy MY. The effect of mobile text messaging counseling on knowledge and self-efficacy in gestational diabetes: a randomized trial. Rev Esc Enferm USP. 2026;60:e20260014. https://doi.org/10.1590/1980-220X-REEUSP-2026-0014en

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ABSTRACT

Objective: To examine the effect of mobile text messaging counseling on diabetes knowledge and self-efficacy in gestational diabetes. **Method:** This randomized controlled trial included 95 pregnant women with gestational diabetes mellitus (GDM) at a university hospital in Türkiye. Participants received either structured Short Message Service (SMS)-based counseling plus routine care or routine care alone. The Gestational Diabetes Self-Efficacy Scale and Diabetes Knowledge Scale were administered at baseline and after 12 weeks. **Results:** Baseline characteristics were comparable except for age. At 12 weeks, the intervention group had significantly higher diabetes knowledge and self-efficacy scores than the control group ($p < 0.05$). Post-intervention diabetes knowledge was moderately associated with self-efficacy ($r = 0.53$, $p < 0.001$). **Conclusion:** SMS-based counseling was associated with greater diabetes knowledge and self-efficacy among women with GDM and may support self-management during pregnancy.

DESCRIPTORS

Diabetes, Gestational; Self Efficacy; Text Messaging; Telemedicine; Health Education; Prenatal Care.

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Received: 01/29/2026
Approved: 09/14/2026

INTRODUCTION

Gestational diabetes mellitus (GDM) is diabetes first diagnosed in the second or third trimester of pregnancy in an individual without clearly overt diabetes before pregnancy[1]. Prevalence varies widely depending on diagnostic criteria, ranging from 4% to over 30%[2]. GDM increases risks such as preeclampsia, cesarean delivery, macrosomia, and neonatal hypoglycemia[3,4]. Educational interventions that improve women's knowledge and self-care skills help reduce complications[3].

Effective GDM management requires appropriate diet, physical activity, and treatment adherence[5]. Health education improves knowledge, strengthens self-care behaviors, and reduces adverse outcomes[6,7]. However, traditional face-to-face education is often constrained by limited time, workforce shortages, and barriers to access, which may be further exacerbated during epidemics or by transportation-related challenges[8,9]. These limitations may impede women's ability to acquire adequate knowledge and develop effective self-management[7]. Therefore, accessible educational strategies that support self-efficacy are needed[10].

Tele-nursing, a component of telehealth, facilitates remote care through digital communication tools[10]. Evidence shows that web- and mobile-based interventions may improve glycemic control, motivation, and self-efficacy among women with GDM[11,12] and contribute to reductions in A1C and fasting and postprandial glucose levels, while supporting treatment adherence[13,14]. Although previous mobile health interventions for GDM have mainly involved smartphone applications, web-based platforms, remote glucose monitoring, or individualized feedback systems, evidence regarding structured Short Message Service (SMS)-based counseling remains limited. These technology-intensive interventions may also require internet access, application installation, or more complex digital infrastructure. SMS offers a simpler, lower-cost approach that can be used on basic mobile phones and may be more readily integrated into routine nursing care. Furthermore, limited evidence is available regarding the effect of structured SMS counseling on both diabetes knowledge and self-efficacy among women with GDM in Türkiye. Therefore, this study aimed to examine the effect of mobile text messaging counseling on diabetes knowledge and self-efficacy in gestational diabetes.

Study Hypotheses

H1: Self-efficacy differs between women receiving SMS counseling and those receiving routine care.

H2: Diabetes knowledge levels differ between women receiving SMS counseling and those receiving routine care.

METHOD

Design

This study was designed as a randomized controlled trial and conducted in accordance with the Consolidated Standards of Reporting Trials (CONSORT) guidelines. The trial was registered at ClinicalTrials.gov (NCT06436443).

Participants and Setting

The study was conducted at the outpatient clinic of a university hospital in Türkiye between August 2021 and April 2022. The required sample size was calculated using G*Power software based on a medium effect size (d = 0.50), a power of 0.80, and a significance level of $\alpha = 0.05$, which indicated that at least 27 participants were required per group. To account for potential attrition, a larger sample was recruited. The participant flow through the study is shown in Figure 1.

Pregnant women were eligible for inclusion if they had been diagnosed with gestational diabetes mellitus, were at approximately the 30th week of gestation, owned a smartphone, were able to communicate effectively, and had no diagnosed psychiatric disorders. Women who were illiterate or had sensory impairments (hearing or visual problems) that could interfere with communication were excluded from the study.

Randomization and Intervention

After providing written informed consent, eligible participants completed baseline assessments, including a Descriptive Information Form, the Gestational Diabetes Self-Efficacy Scale, and the Diabetes Knowledge Scale.

Participants were randomly allocated to either the intervention group (SMS-based counseling plus routine care) or the control group (routine care alone) using 1:1 block randomization with a block size of four. A researcher not involved in participant recruitment generated the randomization sequence, which was concealed in an encrypted file to ensure allocation concealment and reduce selection bias.

The intervention group received a structured SMS-based counseling program in addition to routine clinical follow-up. The program was delivered over 12 weeks and consisted of standardized educational text messages sent weekly. Message content focused on gestational diabetes management, including nutrition, physical activity, blood glucose monitoring, prevention of complications, and adherence to medical therapy. All messages were developed by the research team based on current guidelines and literature and were identical for all participants in the intervention group. Participants in the control group continued to receive routine prenatal and diabetes care without additional SMS support.

Follow-up assessments were conducted 12 weeks after baseline using the same data collection tools in both groups.

Outcomes

The primary outcome was self-efficacy related to gestational diabetes management, assessed using the total score of the Self-Efficacy Scale in Gestational Diabetes. The secondary outcome was diabetes-related knowledge, assessed using the total score of the Diabetes Knowledge Scale. The subscale scores of the Self-Efficacy Scale in Gestational Diabetes—diet–weight management, complication precautions, nutrition education compliance, and medical treatment applications—were examined as additional secondary outcomes. All outcomes were assessed at baseline and at the end of the 12-week follow-up period. Higher scores indicated greater self-efficacy and diabetes-related knowledge, respectively.

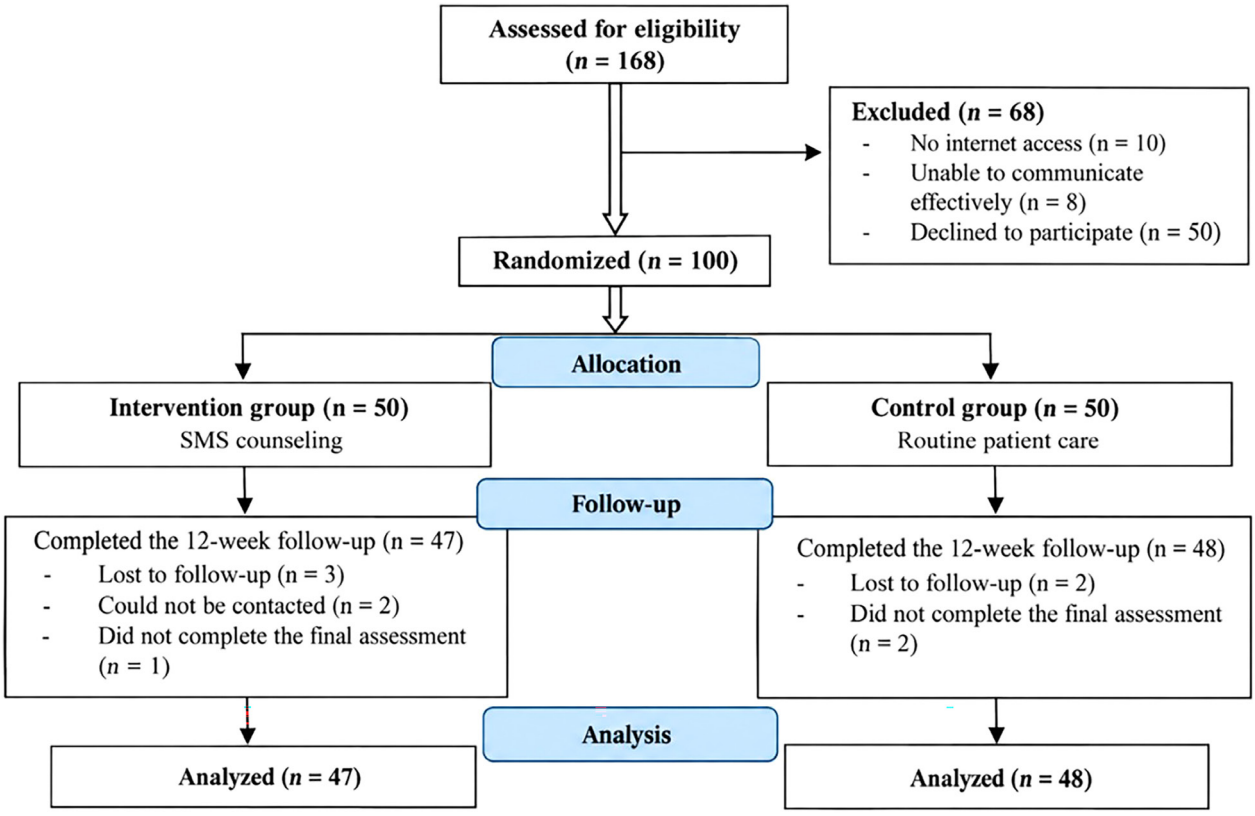

Figure 1 – CONSORT flow diagram of participant recruitment, allocation, follow-up, and analysis, Antalya, Türkiye, 2022.

Data Collection Instruments

Descriptive Information Form: This form was prepared by the researchers following a literature review[13,14]. It includes five questions about participants' descriptive characteristics and six questions about their disease.

Diabetes Knowledge Scale: This scale was first developed by Dunn et al. to measure diabetes knowledge[15]. It was subsequently adapted by Carolan et al. to assess three domains: pregnant women's GDM knowledge, nutritional values, and GDM self-management principles. The scale consists of 18 questions. Cronbach's alpha for the total scale was determined as 0.77[16,17].

Self-Efficacy Scale in Gestational Diabetes: This is a 23-item, five-point Likert-type instrument developed and validated in Türkiye by Polat and Avdal to assess self-efficacy among women with gestational diabetes. The scale comprises four subscales: diet–weight management, complication precautions, nutrition education compliance, and medical treatment applications. Higher total scores indicate greater self-efficacy. The original study reported a Cronbach's alpha coefficient of 0.87 for the total scale[18].

Data Analysis

Data were analyzed using SPSS version 21.0. Descriptive statistics were used to summarize participant characteristics. The normality of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro–Wilk tests. Between-group comparisons were performed using Student's t-test or the Mann-Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Within-group comparisons were conducted using paired t-tests or Wilcoxon signed-rank tests. Associations between diabetes knowledge and self-efficacy were examined using Spearman's correlation coefficients. For the primary and secondary outcomes, unadjusted between-group mean differences at follow-up were calculated with 95% confidence intervals. Standardized effect sizes were estimated using Hedges' g, with values of approximately 0.20, 0.50, and 0.80 interpreted as small, moderate, and large effects, respectively. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Non-Interventional Clinical Research Ethics Committee of Burdur Mehmet Akif Ersoy University (Approval No: GO 2020/193, Meeting No: 2020/8, Date: August 20, 2020). All participants were informed about the study's purpose and procedures. In addition, they were assured that participation was voluntary and that they could withdraw at any time without any consequences.

RESULTS

Participant Flow

A total of 168 women were assessed for eligibility. Sixty-eight were excluded because they had no internet access (n = 10),

were unable to communicate effectively (n = 8), or declined to participate (n = 50). The remaining 100 participants were randomized equally to the intervention and control groups. During the 12-week follow-up, three participants in the intervention group and two in the control group did not complete the final assessment. The final analysis included 47 participants in the intervention group and 48 in the control group (Figure 1).

Baseline Characteristics

A total of 95 pregnant women diagnosed with gestational diabetes mellitus were included in the study, with 47 participants allocated to the intervention group and 48 to the control group. Table 1 presents the baseline sociodemographic and clinical characteristics of the participants. The two groups were comparable in terms of residential area, education level, smoking status, family history of type 2 diabetes mellitus, and previous history of gestational diabetes ($p > 0.05$ for all variables). However, the mean age of participants was significantly higher in the intervention group than in the control group (33.61 ± 5.57 vs. 30.45 ± 4.08 years; $p = 0.010$).

Effects of the Intervention on Self-Efficacy

Baseline scores of the total Self-Efficacy Scale in Gestational Diabetes and all its subscales did not differ significantly between the intervention and control groups ($p > 0.05$). Table 2 shows comparisons of baseline and follow-up self-efficacy scores between the two groups.

Following the 12-week intervention period, participants in the intervention group demonstrated significantly higher follow-up scores than those in the control group across all self-efficacy subscales, including diet-weight management ($p = 0.001$), complication precautions ($p = 0.003$), nutrition education compliance ($p = 0.035$), and medical treatment applications ($p = 0.012$). In addition, the total self-efficacy score at follow-up was significantly higher in the intervention group than in the control group ($p = 0.002$).

Within-group analyses indicated statistically significant changes in total self-efficacy in both groups; however, the direction of change differed, with an increase in the intervention group and a decrease in the control group. Significant increases were also observed across all self-efficacy subscales in the intervention group. At follow-up, the unadjusted mean difference in total self-efficacy between the intervention and control groups was 11.38 points (95% CI 5.57 to 17.19), corresponding to a Hedges' g of 0.79.

Effects of the Intervention on Diabetes Knowledge

Baseline Diabetes Knowledge Scale scores were similar between the intervention and control groups ($p > 0.05$). Diabetes knowledge scores increased significantly from baseline to follow-up in both the intervention group (9.23 ± 4.10 to 10.85 ± 3.68; $p < 0.001$) and the control group (8.84 ± 3.06 to 9.45 ± 3.00; $p = 0.001$). At follow-up, the intervention group had a significantly higher mean diabetes knowledge score than the control group (10.85 ± 3.68 vs. 9.45 ± 3.00; $p = 0.017$). The unadjusted between-group mean difference at follow-up was 1.40 points (95% CI 0.03 to 2.77), corresponding to a Hedges' g of 0.41.

Relationship Between Diabetes Knowledge and Self-Efficacy

After the intervention, a statistically significant positive correlation was observed between Diabetes Knowledge Scale scores and both the total and subscale scores of the Self-Efficacy Scale in Gestational Diabetes ($p < 0.05$), indicating that higher levels of diabetes-related knowledge were associated with greater self-efficacy (Table 3).

Table 1 – Baseline sociodemographic and clinical characteristics of participants by group – Antalya, Türkiye, 2022.

Characteristic		Groups		*p-value*
		Intervention (n = 47)	Control (n = 48)	
Age (years)	*Mean ± SD*	33.61 ± 5.57	30.45 ± 4.08	0.010†
Residential area	Province	41 (87.2)	43 (89.6)	0.759‡
	District	6 (12.8)	5 (10.4)	
Education level	Primary school or below	15 (31.9)	22 (45.8)	0.551‡
	Middle school	2 (4.3)	2 (4.2)	
	High school	21 (44.7)	17 (35.4)	
	University	9 (19.1)	7 (14.6)	
Smoking	Yes	31 (66.0)	26 (54.2)	0.241‡
	No	16 (34.0)	22 (45.8)	
Family history of T2DM	Yes	18 (38.3)	18 (37.5)	0.936‡
	No	29 (61.7)	30 (62.5)	
Previous history of GDM	Yes	0	1 (2.1)	0.505§
	No	47 (100)	47 (97.9)	

†Student's t-test, ‡Chi-square test, §Fisher's exact test.

Table 2 – Comparison of self-efficacy and diabetes knowledge scores between the intervention and control groups at baseline and follow-up – Antalya, Türkiye, 2022.

Self-Efficacy Scale in Gestational Diabetes	Time	Intervention (n = 47) Mean ± SD	Control (n = 48) Mean ± SD	p-value (between groups)
Diet-weight management	Baseline	15.94 ± 3.90	14.60 ± 3.63	0.153
	Follow-up	16.94 ± 3.88	13.45 ± 4.64	**0.001**
	p-value (within group)	**0.007**	0.553	
Complication precautions	Baseline	25.79 ± 6.55	24.27 ± 5.34	0.303
	Follow-up	27.17 ± 5.29	23.33 ± 3.27	**0.003**
	p-value (within group)	**0.036**	0.056	
Nutrition education compliance	Baseline	14.20 ± 2.93	12.81 ± 3.69	0.093
	Follow-up	14.67 ± 2.99	12.93 ± 3.57	**0.035**
	p-value (within group)	**0.035**	0.222	
Medical treatment applications	Baseline	22.11 ± 5.77	18.84 ± 7.62	0.052
	Follow-up	23.02 ± 5.40	18.84 ± 7.62	**0.012**
	p-value (within group)	**0.018**	0.117	
Total self-efficacy score	Baseline	78.05 ± 13.56	71.51 ± 14.10	0.057
	Follow-up	81.44 ± 12.59	70.06 ± 15.75	**0.002**
	p-value (within group)	**0.009**	0.001	
Diabetes knowledge scale	Baseline	9.23 ± 4.10	8.84 ± 3.06	0.089
	Follow-up	10.85 ± 3.68	9.45 ± 3.00	**0.017**
	p-value (within group)	**< 0.001**	0.001	

Between-group comparisons: Student's t-test or Mann-Whitney U test; Within-group comparisons: Paired t-test or Wilcoxon signed-rank test.

Table 3 – Correlation between Diabetes Knowledge Scale scores and self-efficacy after the intervention – Antalya, Türkiye, 2022.

Diabetes Knowledge Scale	Diet-weight management	Complication precautions	Nutrition education compliance	Medical treatment applications	Total
r	0.471	0.520	0.472	0.246	0.527
p-value	< 0.001	< 0.001	< 0.001	0.044	< 0.001

Spearman's correlation coefficients. $p < 0.05$ was considered statistically significant.

DISCUSSION

The main findings of this randomized controlled trial were that women receiving SMS-based counseling had higher total self-efficacy and diabetes knowledge scores at the 12-week follow-up than women receiving routine care. Higher follow-up scores were also observed across all self-efficacy subscales. Diabetes knowledge increased significantly in both groups, although the intervention group had a higher knowledge score at follow-up. In addition, diabetes knowledge was moderately and positively associated with self-efficacy. These results suggest that structured SMS-based counseling may support educational and psychosocial aspects of GDM self-management; however, the baseline age imbalance and absence of age-adjusted analyses should be considered when interpreting the findings.

Adequate nutrition is essential for maintaining maternal and fetal health, and pregnant women are particularly vulnerable to nutritional imbalances[19]. In the present study, baseline scores for the diet-weight management and nutrition education compliance subscales were comparable between the intervention and control groups. Following the 12-week intervention, however, women who received SMS-based counseling demonstrated significantly higher scores in both domains ($p < 0.05$), suggesting improved adherence to dietary recommendations. These findings are consistent with a randomized controlled trial showing that daily smartphone-based feedback from a dietitian improved dietary adherence among women with GDM[13]. Similarly, a smartphone application-based lifestyle intervention was associated with reductions in fasting and postprandial glucose values,

although it did not significantly reduce excessive gestational weight gain[20]. The improved dietary compliance observed in the present study may be related to enhanced communication, timely reminders, reinforced nutrition-related knowledge, and increased motivation facilitated by mobile-based support.

Regarding complication-related behaviors, post-intervention scores were significantly higher in the intervention group than in the control group, indicating better adoption of preventive practices. This finding is consistent with evidence from a meta-analysis demonstrating that both generalized and individualized self-management and nutrition education interventions can improve glycemic control and reduce adverse outcomes in women with GDM[21]. In addition, a randomized controlled trial reported lower rates of hypertension and hypoglycemia among women receiving a mobile phone-based intervention compared with those receiving standard care[14]. The intervention was also associated with a significant improvement in overall self-efficacy and its subdomains. This finding reinforces previous evidence suggesting that remote support strategies, including mobile text messaging and follow-up contacts, can enhance diabetes self-management behaviors in women with GDM[21-23]. Likewise, an integrated online–offline care model was reported to improve women's self-care abilities and attitudes[12]. Collectively, these findings underscore the potential of mobile health interventions to strengthen self-efficacy, which is a key determinant of effective diabetes management during pregnancy.

In addition to self-efficacy, diabetes-related knowledge increased significantly among women in the intervention group after the education period ($p < 0.05$). Similar improvements have been reported in studies showing that smartphone applications enhanced knowledge of GDM and that web-based counseling resulted in higher knowledge levels than standard care[24,25]. Consistent with previous research, these findings indicate that educational interventions can significantly improve diabetes-related knowledge among women with GDM[3,26]. Importantly, the present study also demonstrated a moderate positive association between diabetes knowledge and self-efficacy after the intervention, suggesting that increased knowledge may contribute to greater confidence in self-management behaviors. The outcomes assessed in this study were educational and psychosocial rather than clinical. Improvements in diabetes knowledge and self-efficacy indicate greater perceived preparedness for self-management; however, they should not be interpreted as evidence of improved glycemic control or better maternal and neonatal outcomes. The study did not assess fasting or postprandial glucose, HbA1c, insulin use, pregnancy complications, mode of delivery, birthweight, neonatal hypoglycemia, or other maternal and neonatal outcomes. Therefore, the clinical effectiveness of the intervention remains uncertain.

Several strengths of this study should be acknowledged. The randomized design, trial registration, use of established measurement instruments, and adherence to CONSORT guidelines strengthened the study's methodological quality. Nevertheless, several limitations should be considered. Although randomization was performed, participants in the intervention group were older than those in the control group at baseline. Age may be associated with previous health experiences, familiarity with diabetes-related information, and engagement with mobile health interventions. Because an age-adjusted analysis could not be performed, residual confounding by age cannot be excluded, and the findings should therefore be interpreted cautiously. The study was conducted at a single university hospital, which may limit external validity and the applicability of the findings to women receiving care in other healthcare settings or regions. Outcomes were assessed only once, at the end of the 12-week intervention period. Therefore, it was not possible to determine when the observed improvements emerged during follow-up. In addition, no long-term assessment was conducted to determine whether these improvements were sustained after the intervention ended. A formally validated Turkish version of the Diabetes Knowledge Scale was not available, which may limit the measurement validity of the knowledge outcome. The study also relied on self-reported measures, which may have introduced response bias. Furthermore, intervention adherence could not be objectively quantified because message opening and reading were not systematically monitored. Future multicenter studies should include larger samples, repeated and long-term assessments, analyses adjusted for relevant baseline imbalances, objective measures of intervention adherence, and glycemic, maternal, and neonatal outcomes.

CONCLUSION

This randomized controlled trial showed that SMS-based counseling was associated with higher levels of diabetes-related knowledge and self-efficacy among women with gestational diabetes mellitus. The findings suggest that simple mobile communication tools can support patient education and facilitate self-management during pregnancy. SMS-based counseling may represent a practical adjunct to routine maternal healthcare because of its ease of delivery and limited technological requirements. Future studies with larger samples and longer follow-up periods are warranted to further evaluate the effectiveness and sustainability of mobile-supported educational interventions in gestational diabetes management.

DATA AVAILABILITY

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and institutional restrictions.

RESUMEN

Objetivo: Evaluar el efecto del asesoramiento mediante mensajes de texto por teléfono móvil sobre el conocimiento acerca de la diabetes y la autoeficacia en mujeres con diabetes gestacional. **Método:** Este ensayo clínico aleatorizado incluyó a 95 mujeres embarazadas con diabetes mellitus gestacional (DMG) atendidas en un hospital universitario de Turquía. Las participantes recibieron asesoramiento estructurado mediante mensajes de texto (SMS, del inglés *Short Message Service*) además de la atención habitual, o únicamente la atención habitual. La Escala de Autoeficacia en Diabetes Gestacional y la Escala de Conocimientos sobre Diabetes se administraron al inicio del estudio y a las 12 semanas. **Resultados:** Las características basales fueron comparables entre los grupos, excepto en la edad. A las 12 semanas, el grupo de

intervención presentó puntuaciones significativamente más altas en conocimientos sobre la diabetes y en autoeficacia que el grupo de control (p < 0,05). El conocimiento sobre la diabetes tras la intervención se asoció moderadamente con la autoeficacia (r = 0,53; p < 0,001). **Conclusión:** El asesoramiento mediante SMS se asoció con un mayor conocimiento sobre la diabetes y una mayor autoeficacia entre las mujeres con DMG y puede favorecer el autocontrol durante el embarazo.

DESCRIPTORES

Diabetes Gestacional; Autoeficacia; Envío de Mensajes de Texto; Telemedicina; Educación en Salud; Atención Prenatal.

RESUMO

Objetivo: Examinar o efeito do aconselhamento por mensagens de texto via celular sobre o conhecimento em diabetes e a autoeficácia em mulheres com diabetes gestacional. **Método:** Este ensaio clínico randomizado incluiu 95 gestantes com diabetes mellitus gestacional (DMG) atendidas em um hospital universitário na Turquia. As participantes receberam aconselhamento estruturado por mensagens de texto (SMS, do inglês *Short Message Service*), além dos cuidados de rotina, ou apenas os cuidados de rotina. A Escala de Autoeficácia em Diabetes Gestacional e a Escala de Conhecimento sobre Diabetes foram aplicadas no início do estudo e após 12 semanas. **Resultados:** As características basais foram comparáveis entre os grupos, exceto quanto à idade. Após 12 semanas, o grupo de intervenção apresentou escores significativamente mais elevados de conhecimento sobre diabetes e autoeficácia em comparação com o grupo controle (p < 0,05). O conhecimento sobre diabetes após a intervenção apresentou associação moderada com a autoeficácia (r = 0,53; p < 0,001). **Conclusão:** O aconselhamento baseado em SMS esteve associado a maiores níveis de conhecimento sobre diabetes e de autoeficácia entre mulheres com DMG e pode contribuir para o autogerenciamento durante a gestação.

DESCRITORES

Diabetes Gestacional; Autoeficácia; Envio de Mensagens de Texto; Telemedicina; Educação em Saúde; Cuidado Pré-Natal.

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