

# Effectiveness of Nursing Care Management Using Digital Education in Improving Dietary Adherence among Patients with Diabetes Mellitus

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## Article Info

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## ABSTRACT

Diabetes Mellitus (DM) is a chronic disease that requires long-term management, particularly with regard to dietary regulation. Dietary adherence remains one of the major challenges among patients with DM, as it is influenced by multiple factors, including knowledge, motivation, and continuous support from health care professionals. Advances in digital technology have created new opportunities for delivering health education in a more flexible and sustainable manner. This study aimed to analyze the effectiveness of nursing care management supported by digital education on dietary adherence among patients with Diabetes Mellitus in Langsa City, Aceh Province. This study employed a quasi-experimental design using a pretest–posttest approach with a control group. A total of 60 patients with type 2 Diabetes Mellitus were recruited and assigned to either an intervention group or a control group. The intervention consisted of digital education delivered through WhatsApp and visual educational materials over a 14-day period. Dietary adherence was assessed using the Summary of Diabetes Self-Care Activities (SDSCA) questionnaire. The results demonstrated a statistically significant improvement in dietary adherence scores in the intervention group compared with the control group ( $p < 0.05$ ). These findings indicate that digital education integrated into nursing care management is effective in improving dietary adherence among patients with Diabetes Mellitus. Therefore, digital education may serve as an alternative strategy in nursing practice to support the sustainable management of Diabetes Mellitus.

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## INTRODUCTION

Diabetes Mellitus (DM) is one of the chronic diseases whose prevalence continues to increase both globally and nationally. Reports from the International Diabetes Federation indicate a significant rise in the global number of people living with diabetes over the past five years, with developing countries, including Indonesia, contributing substantially to this increase (Atlas, 2021). This condition demonstrates that Diabetes Mellitus is not merely a clinical issue

but also a serious challenge for health care systems, particularly in terms of long-term disease management.

In Indonesia, the growing burden of Diabetes Mellitus is reflected in national data showing an increasing prevalence of DM among adults and older adults. The most recent Riskeudas report identifies DM as one of the fastest-growing non-communicable diseases, especially in urban and semi-urban areas (Syarifah Liza Munira, 2023). Aceh Province is not exempt from this trend. Regional health reports indicate that DM is among the ten most frequently treated diseases in both primary health care facilities and referral hospitals (Lukman, 2023).

The management of Diabetes Mellitus requires active patient involvement in self-care practices, particularly in dietary management. Poor dietary control directly contributes to unstable blood glucose levels and increases the risk of long-term complications such as neuropathy, nephropathy, and cardiovascular disease (Association, 2024). Nevertheless, dietary adherence remains one of the most challenging aspects of DM management, especially among patients who have lived with the disease for an extended period.

Several studies in Indonesia have shown that low dietary adherence among patients with DM is not always attributable to a lack of knowledge. National studies have found that although many patients possess adequate knowledge of diabetic diets, the implementation of this knowledge in daily life remains suboptimal due to habitual behaviors, social environments, and the lack of continuous support from health care professionals (Wibowo et al., 2024). Similar findings have been reported in studies conducted in Sumatra, which emphasize that one-way and short-term educational approaches are insufficient to produce consistent dietary behavior change (Drissianti et al., 2025).

Within the health care context, nurses play a strategic role in assisting patients with Diabetes Mellitus in managing their condition. Nursing care management extends beyond clinical interventions to include education, motivation, and continuous support aimed at fostering healthier lifestyle behaviors. Contemporary nursing textbooks emphasize that sustained educational interventions are an integral component of nursing care for patients with chronic diseases, including DM (Polit & Beck, 2021).

Alongside advances in information technology, digital health education approaches have increasingly been implemented in nursing practice. Digital education enables flexible, repetitive, and personalized information delivery tailored to patients' individual needs. Numerous international studies have demonstrated that digital media such as mobile applications, instant messaging, and educational videos are effective in improving dietary adherence and self-care behaviors among patients with Diabetes Mellitus (Kwan et al., 2025).

In Indonesia, the application of digital education in Diabetes Mellitus management has expanded in recent years. National studies report that mobile health-based education significantly improves dietary adherence and self-care activities among patients with DM compared to conventional education methods (Drissianti et al., 2025). This approach is considered particularly suitable for contemporary Indonesian society, which has widespread access to smartphones and internet services, including in non-metropolitan areas.

Langsa City, as one of the rapidly developing urban areas in Aceh Province, has diverse social characteristics and a relatively high level of smartphone usage. These conditions present an opportunity to integrate digital education into nursing care management. However, empirical studies specifically examining the effectiveness of digital education on dietary adherence among patients with Diabetes Mellitus in Langsa City remain very limited. Most existing studies in Aceh have focused on the relationships between knowledge, attitudes, and family support and dietary adherence, without examining technology-based interventions (Husna et al., 2025).

Moreover, the cultural characteristics and dietary patterns of Acehnese communities have unique features that may influence the success of dietary management in Diabetes Mellitus. High consumption of carbohydrate and fat-rich foods, as well as socially and culturally embedded eating practices, pose distinct challenges in improving dietary adherence (Jamni et al., 2024). Therefore, contextualized and sustained educational approaches are essential.

Based on these considerations, empirical research is needed to examine the effectiveness of nursing care management based on digital education in improving dietary adherence among patients with Diabetes Mellitus in Langsa City, Aceh Province. This study is expected to provide scientific evidence regarding the benefits of digital education as a nursing intervention and to serve as a foundation for developing health care service models that are more adaptive to technological advancements and local community needs.

## METHODS

This study employed a quantitative approach using a quasi-experimental pretest–posttest design with a control group. This design was selected to allow the evaluation of changes in dietary adherence among patients with Diabetes Mellitus before and after the implementation of a digital education intervention, as well as to compare these changes with those observed in a control group that did not receive the same intervention. Quasi-experimental designs are widely applied in nursing research, particularly when full randomization is difficult to implement in real-world health care settings (Polit & Beck, 2021).

The study was conducted at the Regional General Hospital of Langsa City, Aceh Province, Indonesia. This hospital was selected due to its relatively high number of outpatient visits by patients with Diabetes Mellitus. The selection of this setting was further supported by data from the Aceh Provincial Health Office, which indicated that Langsa City has experienced a notable increase in outpatient Diabetes Mellitus cases in recent years (Lukman, 2023).

The study population consisted of all patients with type 2 Diabetes Mellitus receiving outpatient treatment at the Regional General Hospital of Langsa City. The sample was determined using a purposive sampling technique, with specific criteria applied to ensure alignment with the objectives of the study. This sampling approach is commonly used in nursing intervention research to ensure that participants meet the requirements necessary for effective intervention delivery (Creswell, J. W., & Creswell, 2018).

The inclusion criteria were as follows:

1. Patients diagnosed with type 2 Diabetes Mellitus aged 30–70 years
2. Having undergone treatment for at least six months
3. Owning or having access to a smartphone
4. Being able to read and communicate effectively
5. Providing informed consent to participate in the study.

Exclusion criteria included patients with severe complications, cognitive impairments, or other medical conditions that could interfere with their ability to participate fully in the intervention. A total of 60 respondents were enrolled in the study, consisting of 30 participants in the intervention group and 30 participants in the control group. This sample size meets the minimum requirements for quasi-experimental studies in nursing research (Hertzog, 2008).

Participants in the intervention group received nursing care management based on digital education for a period of 14 days. The intervention was delivered through WhatsApp using digital educational materials specifically designed for patients with Diabetes Mellitus. These materials included short educational videos on diabetic dietary management, infographics illustrating appropriate portion sizes, recommended meal schedules, and daily reminder messages aimed at reinforcing dietary adherence.

The digital education approach was grounded in the principles of Diabetes Self-Management Education (DSME), which emphasize continuous information delivery and behavioral reinforcement through accessible and patient-centered media (Association, 2024); (Drissianti et al., 2025). In contrast, the control group received conventional education according to standard care practices at the health facility, without additional digital educational support.

The primary instrument used to assess dietary adherence was the diet-related domain of the Summary of Diabetes Self-Care Activities (SDSCA) questionnaire. This instrument has been widely used internationally and has demonstrated good validity and reliability in measuring self-care behaviors among patients with Diabetes Mellitus (Toobert; et al., 2000).

In addition, a demographic characteristics questionnaire and a fasting blood glucose recording sheet obtained from patients' medical records were used to support the analysis. Prior to data collection, the research instruments were adapted to the Indonesian language and cultural context and reviewed by nursing experts to ensure content relevance and clarity of wording, as recommended in instrument-based nursing research (Polit & Beck, 2021).

Data collection was carried out in several stages. The first stage involved obtaining research permits and ethical approval. The second stage consisted of baseline data collection (pretest), which included completion of the dietary adherence questionnaire and recording of fasting blood glucose levels. Following this, the intervention group received digital education for 14 days, while the control group continued to receive standard care. After completion of the intervention period, posttest data were collected using the same instruments as those used at baseline. This procedure is consistent with established recommendations for behavioral intervention studies aimed at evaluating the effectiveness of educational programs (Creswell, J. W., & Creswell, 2018).

Data were analyzed using statistical software. Univariate analysis was conducted to describe respondents' characteristics and the distribution of dietary adherence scores. Bivariate analysis was performed using paired t-tests to examine differences in dietary adherence scores before and after the intervention within each group, and independent t-tests to compare changes in adherence scores between the intervention and control groups. The selection of these statistical tests was appropriate given the numerical nature of the data and the study design employed (Field, 2020).

## RESULTS AND DISCUSSION

### Results

#### Univariate Analysis

The characteristics of patients with type 2 Diabetes Mellitus included in this study are presented in Table 1. A total of 60 respondents participated, evenly divided into the intervention group (n = 30) and the control group (n = 30)

**Table 1.** Characteristics of Diabetes Mellitus Patients in Langsa City

Characteristics	Intervention Group (n = 30)	Control Group (n = 30)
Age (years)		
30–44	6 (20.0%)	5 (16.7%)
45–59	15 (50.0%)	16 (53.3%)
≥60	9 (30.0%)	9 (30.0%)
Gender		
Male	11 (36.7%)	12 (40.0%)
Female	19 (63.3%)	18 (60.0%)
Duration of Diabetes Mellitus		
<5 years	10 (33.3%)	9 (30.0%)
≥5 years	20 (66.7%)	21 (70.0%)
Educational Level		
Primary	8 (26.7%)	9 (30.0%)
Secondary	15 (50.0%)	14 (46.7%)
Higher	7 (23.3%)	7 (23.3%)

Source: Processed data, 2025

In terms of age distribution, most respondents in both groups were within the 45–59 year age range, accounting for 50.0% of the intervention group and 53.3% of the control group. Respondents aged 60 years and older comprised 30.0% of each group, while those aged 30–44 years represented the smallest proportion.

Regarding gender, the majority of respondents were female, accounting for 63.3% of the intervention group and 60.0% of the control group. With respect to disease duration, most respondents had been living with Diabetes Mellitus for five years or longer, both in the intervention group (66.7%) and the control group (70.0%).

In terms of educational background, most respondents had a secondary level of education, comprising 50.0% of the intervention group and 46.7% of the control group. The proportion of respondents with higher education was identical in both groups (23.3%).

Overall, the distribution of respondent characteristics between the intervention and control groups was relatively homogeneous. This indicates that both groups were comparable at baseline, allowing observed differences in outcomes to be more confidently attributed to the effects of the digital education intervention rather than to differences in demographic or clinical characteristics (Polit & Beck, 2021).

### Bivariate Analysis

- a. Differences in Dietary Adherence Scores Before and After the Intervention

**Table 2.** Mean Dietary Adherence Scores Before and After the Intervention

Group	Pretest (Mean ± SD)	Posttest (Mean ± SD)	p-value*
Intervention	3.12 ± 0.58	4.21 ± 0.49	0.001
Control	3.15 ± 0.61	3.32 ± 0.57	0.087

\*Paired t-test

Source: Processed data, 2025.

The results of dietary adherence scores before and after the intervention are shown in Table 2. In the intervention group, the mean dietary adherence score increased from 3.12 ± 0.58 at baseline (pretest) to 4.21 ± 0.49 after the intervention (posttest). The paired t-test analysis revealed a p-value of 0.001 ( $p < 0.05$ ), indicating a statistically significant improvement in dietary adherence following the digital education intervention.

In contrast, the control group showed only a slight increase in the mean dietary adherence score, from 3.15 ± 0.61 at pretest to 3.32 ± 0.57 at posttest. The paired t-test for this group yielded a p-value of 0.087 ( $p > 0.05$ ), indicating that the observed change was not statistically significant. These findings suggest that a meaningful improvement in dietary adherence occurred only among patients who received the digital education intervention.

- b. Comparison of Changes in Dietary Adherence Scores Between Groups

**Table 3.** Comparison of Changes in Dietary Adherence Scores Between Groups

Group	Δ Dietary Adherence Score (Mean ± SD)	p-value**
Intervention	1.09 ± 0.41	
Control	0.17 ± 0.29	0.001

\*Independent t-test

Source: Processed data, 2025.

A comparison of changes in dietary adherence scores between the intervention and control groups is presented in Table 3. The mean change in dietary adherence score (Δ score) was 1.09 ± 0.41 in the intervention group, compared with only 0.17 ± 0.29 in the control group.

The independent t-test analysis yielded a p-value of 0.001 ( $p < 0.05$ ), indicating a statistically significant difference in dietary adherence improvement between the two groups. This finding demonstrates that the increase in dietary adherence was significantly greater among patients who received nursing care management supported by digital education.

- c. Changes in Dietary Adherence Categories

**Table 4.** Dietary Adherence Categories Before and After the Intervention

Adherence Category	Intervention Pretest	Intervention Posttest
Low	14 (46.7%)	3 (10.0%)

Adherence Category	Intervention Pretest	Intervention Posttest
Moderate	12 (40.0%)	11 (36.7%)
High	4 (13.3%)	16 (53.3%)

Source: Processed data, 2025.

Changes in dietary adherence categories among patients in the intervention group before and after the intervention are shown in Table 4. Prior to the intervention, nearly half of the respondents were classified as having low dietary adherence (46.7%), while only 13.3% were categorized as having high adherence.

Following the digital education intervention, the proportion of respondents with low dietary adherence decreased markedly to 10.0%, while the proportion with high dietary adherence increased to 53.3%. This shift indicates a clear improvement in dietary behavior after the implementation of digital nursing education.

Overall, the results demonstrate that nursing care management based on digital education had a positive and meaningful impact on dietary adherence among patients with Diabetes Mellitus in Langsa City. Significant improvements in adherence scores, differences in score changes between groups, and upward shifts in adherence categories collectively support the effectiveness of the intervention.

## Discussion

### Univariate Findings

The univariate analysis described the characteristics of respondents and the distribution of dietary adherence scores in both the intervention and control groups. As shown in Table 1, most respondents were aged 45–59 years, an age group recognized as having a high risk for type 2 Diabetes Mellitus. This makes the study population particularly relevant for examining dietary management interventions.

Most respondents were female, and the majority had been living with Diabetes Mellitus for five years or longer, indicating substantial experience with disease management. In terms of education, most participants had a secondary educational background. The relatively similar distribution of characteristics across groups suggests baseline homogeneity, strengthening the inference that post-intervention differences in dietary adherence were primarily driven by the digital education intervention rather than confounding variables (Polit & Beck, 2021).

### Bivariate Findings

#### a. Changes in Dietary Adherence Before and After the Intervention

The paired t-test analysis demonstrated a statistically significant increase in dietary adherence scores in the intervention group following the digital education program, whereas no significant improvement was observed in the control group. These findings suggest that conventional education alone may be insufficient to produce meaningful changes in dietary behavior among patients with Diabetes Mellitus.

#### b. Comparison of Dietary Adherence Improvements Between Groups

The independent t-test results confirmed that the magnitude of improvement in dietary adherence was significantly greater in the intervention group than in the control group. This

finding highlights the added value of integrating digital education into nursing care management compared with standard education practices.

c. Changes in Dietary Adherence Categories

In addition to numerical improvements, categorical analysis revealed a clear shift from low to high dietary adherence following the digital intervention. This shift indicates that digital education not only improved adherence scores statistically but also resulted in clinically meaningful behavioral changes. Such changes reflect the success of digital education in helping patients understand, internalize, and apply dietary recommendations in their daily lives.

### Implications of the Findings

Overall, the findings indicate that nursing care management supported by digital education is effective in improving dietary adherence among patients with Diabetes Mellitus in Langsa City. These results reinforce the strategic role of nurses not only as providers of clinical care but also as educators who can leverage technology to support sustained behavioral change.

The effectiveness of the intervention can be explained through the Diabetes Self-Management Education (DSME) framework, which emphasizes continuous, flexible, and patient-centered education. Digital education allows patients to access information repeatedly and at their own pace, thereby enhancing understanding, confidence, and adherence to dietary recommendations (Association, 2024)

These findings are consistent with international studies reporting that mobile applications and digital messaging interventions significantly improve dietary adherence and glycemic control among patients with type 2 Diabetes Mellitus (Wang et al., 2017). Digital education is often more effective than one-time face-to-face education because it provides ongoing behavioral reinforcement.

In the local Aceh context, these results are particularly relevant given the traditional dietary patterns characterized by high carbohydrate and fat intake, which pose challenges for Diabetes Mellitus management (Jamni et al., 2024) dan (Andala et al., 2019). Contextualized digital education enables nurses to tailor messages to local eating habits, making dietary guidance more acceptable and actionable for patients.

The use of WhatsApp as an educational platform was also advantageous, as it is widely used and familiar to the community. This supports nursing theories suggesting that interventions are more effective when aligned with patients' social and technological contexts (Haris et al., 2020).

Despite its strengths, this study has limitations, including the relatively short intervention duration and the absence of long-term outcome measures such as glycemic control. Future research is recommended to adopt longitudinal designs and to combine digital education with periodic face-to-face interactions to enhance long-term effectiveness.

## CONCLUSION

Based on the findings of this study, it can be concluded that nursing care management supported by digital education is effective in improving dietary adherence among patients

with Diabetes Mellitus in Langsa City, Aceh Province. The structured and continuous delivery of digital education resulted in a statistically significant improvement in dietary adherence in the intervention group compared with the control group, which received conventional education only. This improvement was reflected not only in higher mean adherence scores but also in a clear shift in adherence levels from low to high. These findings indicate that digital education goes beyond increasing patients' knowledge and contributes to meaningful changes in dietary behavior in daily life. The relatively homogeneous characteristics of respondents in both the intervention and control groups further support the conclusion that the observed improvement in dietary adherence was primarily attributable to the digital education intervention, rather than to confounding factors such as age, gender, or duration of illness. Therefore, integrating digital education into nursing care management represents an effective and relevant approach to Diabetes Mellitus management, particularly in settings with high levels of technology use such as Langsa City. Nurses working in health care facilities are encouraged to incorporate digital education as part of routine nursing care to enhance dietary adherence and promote patient self-management. In addition, health care institutions are advised to support the development of culturally appropriate and context-sensitive digital education programs. Future studies are recommended to employ longitudinal designs with longer intervention periods and to examine the impact of digital education on additional clinical outcomes, including HbA1c levels and the occurrence of Diabetes Mellitus-related complications..

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