The Effectiveness of The Diapro Application in Improving Knowledge About the Prevention of Diabetes Mellitus Complications

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ABSTRACT

Diabetes mellitus (DM) is a chronic disease associated with a high risk of serious complications that can impair patients' quality of life. Educational efforts to prevent DM complications at Kalasan Public Health Centre (Puskesmas) have traditionally relied on conventional media, which are considered less effective. To overcome this limitation, the DIAPRO application was developed as a digital educational tool to enhance public knowledge of DM complication prevention. This study aimed to assess the effect of the DIAPRO application on knowledge levels regarding the prevention of DM complications in the catchment area of Kalasan Public Health Centre. A quasi-experimental pretest-posttest control group design was applied, involving 106 purposively selected respondents, equally divided into experimental and control groups (53 participants each). The experimental group received education using the DIAPRO application, whereas the control group used PowerPoint presentations. Data were analysed using the Wilcoxon and Mann-Whitney tests, revealing a significant improvement in knowledge in the experimental group ($p = 0.000$), with a higher mean post-test score compared to the control group ($p = 0.000$). These findings suggest that the DIAPRO application is effective in enhancing knowledge of DM complication prevention and holds promise as an alternative educational tool in primary healthcare services.

Keywords: DIAPRO application, diabetes mellitus, complication prevention

INTRODUCTION

Diabetes mellitus (DM) is one of the leading non-communicable diseases (NCDs) with a rising global prevalence, including in Indonesia. Often referred to as a "silent killer," DM is frequently asymptomatic in its early stages and affects individuals of all ages due to unhealthy lifestyles and increasing obesity rates (Astutisari, Darmini, and Wulandari 2022; Nurfalah and Kurniasari 2022). The International Diabetes Federation (2022) projects that the global number of DM cases will reach 783 million by 2045, with Indonesia ranking fifth worldwide. In the D.I. Yogyakarta province, the prevalence of DM is 3.6%, and the Kalasan Public Health Center has recorded the highest number of cases in Sleman Regency, totalling 1,477 patients (BPS 2023; Federation 2022). DM can lead to serious complications such as nephropathy (7–

35%), neuropathy (10–25%), retinopathy, coronary heart disease (7–17%), stroke, and diabetic ulcers (1–20%), all of which significantly impact patients' quality of life (Aikaeli et al. 2022).

Current educational efforts to prevent DM complications at Kalasan Public Health Centre rely primarily on conventional media such as leaflets, educational videos in waiting areas, and outreach through Posbindu. However, a preliminary study conducted by the researchers in October 2024 revealed that most respondents (7 out of 10) lacked a complete understanding of optimal measures to prevent DM complications, indicating a knowledge gap that may increase the risk of future complications. The DIAPRO application, offering interactive and accessible information on risk factors, management, and prevention of DM complications, presents a promising solution (Fitrah and Pulubuhu 2023). Similar digital tools have proven effective in enhancing patients' self-management knowledge (Ridad et al. 2020; Santoso, Qona'ah, and Erye Frety 2022).

This study aims to assess the impact of the DIAPRO application on public knowledge regarding the prevention of DM complications in the catchment area of Kalasan Public Health Centre. Specifically, it addresses the research question: Does using the DIAPRO application improve knowledge of preventing diabetes mellitus complications? The findings are expected to inform the development of digital health education tools in primary care settings and contribute to the scientific discourse on diabetes mellitus management.

MATERIAL AND METHOD

This study employed a quasi-experimental quantitative design with a pretest-posttest control group approach. The study was conducted from February to April 2025 at the Kalasan Public Health Centre. The population consisted of 222 individuals with diabetes mellitus who were registered and diagnosed at Kalasan Public Health Centre. The research sample was determined using a purposive sampling technique, resulting in 53 respondents for each group (experimental and control) who met the inclusion criteria, including being aged 15-64 years, diagnosed with diabetes mellitus, able to communicate well and fluently, able to read and write independently, owning a compatible Android smartphone, and willing to participate in the entire research process. Exclusion criteria included individuals with severe mental or physical health

disorders, who have participated in an education program related to diabetes complication prevention in the last 6 months, have language barriers, and diabetes mellitus patients with complications such as coronary heart disease, peripheral artery disease, stroke, retinopathy, neuropathy, and nephropathy. This research has obtained ethical clearance from the Health Research Committee of Poltekkes Kemenkes Yogyakarta, as indicated in the letter number DP.04.03/e-KEPK.1/185/2025. All participants have given written consent (informed consent). The data were processed and stored anonymously.

This study collected both primary and secondary data. The primary data were obtained from the respondents by the researchers using a questionnaire that was tested twice, before and after education on the prevention of diabetes mellitus complications, using the DIAPRO application or PowerPoint. The secondary data were obtained by the researchers from documents at the Kalasan Public Health Centre to gain a general overview of the location and the research respondents. The experimental group received education using the DIAPRO application, while the control group received education using PowerPoint. The intervention consisted of two sessions delivered one month apart, corresponding to the pretest and post-test assessments. A one-month interval was applied in this study to evaluate changes and the long-term retention of information by respondents, allowing for the determination of how much information provided can be retained after a certain period (Zhao et al., 2021). During this period, participants in the experimental group were instructed to use the DIAPRO application independently at home two to three times a week, with weekly monitoring and evaluation conducted through a WhatsApp Group.

Data analysis was conducted using both univariate and bivariate analyses, starting with the Kolmogorov-Smirnov normality test, which indicated that the data were not normally distributed. This test was followed by the Wilcoxon and Mann-Whitney statistical tests, performed using SPSS 21. The independent variable in this study is education, as facilitated through the DIAPRO application. In contrast, the dependent variable is knowledge about diabetes complication prevention, measured using the standardised Diabetes Knowledge Questionnaire (DKQ-24) from the American Diabetes Association, which has been translated into Indonesian by a sworn translator. This instrument comprises 24 items, with a Cronbach’s alpha value of 0.78. The feasibility of the DIAPRO application was evaluated by nursing and information technology experts using a media validation questionnaire.

RESULTS AND DISCUSSION

Respondent Characteristics

Table 1. Frequency Distribution of Respondent Characteristics Based on Age, Gender, Education Level, Information Exposure, and Duration of DM Suffering

Characteristics	Group				Total	
	Intervention		Control		n	%
	n	%	n	%		
Age						
15-24	2	3,8	8	15,1	10	9,4
25-34	6	11,3	7	13,2	13	12,3
35-49	30	56,6	22	41,5	52	49,1
50-64	15	28,3	16	30,2	31	29,2
Total	**53**	**100**	**53**	**100**	**106**	**100**
Gender						
Male	7	13,2	20	37,7	27	25,5
Women	46	86,8	33	62,3	79	74,5
Total	**53**	**100**	**53**	**100**	**106**	**100**
Education						
Elementary School	2	3,8	4	7,6	6	5,7
Middle School	8	15,1	7	13,2	15	14,2
High School	33	62,3	32	60,4	65	61,3
University	10	18,9	10	18,9	20	18,9
Total	**53**	**100**	**53**	**100**	**106**	**100**
Duration of suffering from diabetes mellitus						
<1 year	4	7,6	3	5,7	7	6,6
1-5 years	34	64,2	33	62,3	67	63,2
6-10 years	11	20,8	11	20,8	22	20,8
>10 years	4	7,6	6	11,3	10	9,4
Total	**53**	**100**	**53**	**100**	**106**	**100**
Exposure to information						
Ever	11	20,8	22	41,5	33	31,1
Never	42	79,3	31	58,5	73	68,9
Total	**53**	**100**	**53**	**100**	**106**	**100**

Table 1, the characteristics of the respondents, shows that 49.1% of respondents are in the productive age range (35–49 years), an age group generally considered to have optimal cognitive abilities for receiving and understanding health information, including through digital media such as Android applications (Erlina et al. 2025). The predominance of female respondents in both groups, 86.8% in the experimental group and 74.5% in the control group, may contribute to the effectiveness of the intervention, as women are generally more concerned, knowledgeable, and adherent to diabetes management compared to men (Nora et al. 2025; Rizky Rohmatulloh et al. 2024).

Furthermore, 61.3% of respondents had completed high school education, a factor that influences their ability to comprehend health concepts, especially when conveyed through information technology (Manutama et al., 2024). Higher educational attainment is generally associated with a lower risk of DM due to increased awareness of healthy lifestyle practices (Divianty, Diani, and Nasution 2021).

Regarding the duration of diabetes diagnosis, 63.2% of respondents had been living with DM for 1–5 years, representing the early phase of adaptation to a chronic condition, during which individuals may be more receptive to educational interventions (Manutama et al., 2024). Notably, 68.9% of respondents had never previously received information about DM but demonstrated improved knowledge following exposure to the DIAPRO application. This finding supports the assertion by Bati & Rahmat (2023) that exposure to information substantially influences knowledge and behavior in disease prevention. Understanding these respondent characteristics is therefore essential for designing tailored health education interventions that can maximize impact (Rissa & Urfiyya, 2023).

Knowledge Before and After Intervention in the Experimental and Control Groups

Table 2. The Effect of Knowledge Improvement Before and After Intervention in the Experimental and Control Groups

Group		n	Max	Min	Mean ± SD	p value
Experimental	Pre Test	53	71	29	51.5 ± 8.5	0.000
	Post Test	53	92	46	73.1 ± 10.3	
Control	Pre Test	53	71	29	52.8 ± 9.4	0.000
	Post Test	53	92	42	65.0 ± 11.8	

Table 2 shows a significant increase in knowledge scores in both the experimental and control groups following the intervention. In the experimental group, which received education via the DIAPRO application, the mean score significantly increased from 51.5 (SD 8.5) to 73.1 (SD 10.3). The Wilcoxon test yielded a p-value of 0.000 ($p < 0.05$), confirming the high effectiveness of the digital application-based intervention in enhancing respondents' knowledge of diabetes mellitus. These findings suggest that interactive digital media effectively enhances participants' comprehension of educational content, consistent with the study by Bati & Rahmat (2023), who argue that digital technology helps overcome barriers to health information access and promotes positive health behavior changes.

Meanwhile, the control group, which received education using PowerPoint media, also demonstrated an improvement in knowledge scores, from a mean of 52.8 (SD 9.4) to 65.0 (SD 11.8), with a p-value of 0.000. While the increase was statistically significant, the extent of improvement was less pronounced than that observed in the experimental group. This condition suggests that conventional health education methods remain beneficial, though potentially less effective compared to interactive, application-based approaches. According to Manutama et al. (2024), information delivery through interactive media may enhance information retention, particularly among individuals in the productive age group who are generally more familiar with technology.

Differences in Knowledge After Intervention in the Experimental and Control Groups

Table 3. Differences in Knowledge After Intervention in the Experimental and Control Groups

	n	*Mean Rank*	*Sum of Ranks*	*Z*	*p value*
Post-test Experimental	53	64.25	3405.50	-3.623	0.000
Post-test Control	53	42.75	22.65		

Table 3. The Mann-Whitney test result indicates a significant difference in post-test knowledge levels between the experimental and control groups (Z = -3.623; p = 0.000), suggesting that the DIAPRO application-based intervention is more effective than conventional PowerPoint-based education. The advantage of the DIAPRO application lies in its interactive and flexible nature, allowing participants to access materials independently and repeatedly, which facilitates a more profound understanding. These findings are consistent with studies by Erlina et al. (2025) and Fitrah & Pulubuhu (2023), which demonstrated that Android-based educational applications can significantly improve the knowledge of patients with diabetes compared to conventional methods. Additionally, some research suggests that mobile technology provides a personalised learning experience and directly enhances health literacy and promotes behaviour change (Pratiwi et al., 2024).

These findings suggest that the DIAPRO application is effective at enhancing knowledge of DM complication prevention and can serve as an alternative educational tool within primary healthcare services. Moreover, the results support integrating digital technology into public health promotion strategies. This study has several

limitations, including potential exposure to information from external sources during the one-month interval, which could not be fully controlled for. Additionally, differences in digital literacy levels and device ownership among respondents may have affected the intervention's effectiveness. The geographic scope of this research was also limited to the Kalasan Public Health Centre area, thereby limiting the generalizability of these findings to broader populations. Furthermore, this study did not account for anthropometric data such as Body Mass Index (BMI) or other detailed respondent characteristics that may influence individual educational needs.

CONCLUSION

This study demonstrates that using the DIAPRO application significantly improves respondents' knowledge of preventing diabetes mellitus complications compared with conventional educational media. These findings highlight the potential of interactive digital applications as effective educational tools, particularly among the working-age population who may have limited access to health information and structured education. Furthermore, the DIAPRO application's success in enhancing knowledge underscores the importance of integrating digital technology into health promotion efforts in primary care settings. The future development of similar applications should consider several factors, such as access to technology, users' digital literacy, and ongoing educational support, to enhance patients' understanding and self-management in preventing diabetes mellitus complications.

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DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request. All data were collected and analysed specifically for this research and are not publicly available due to privacy and institutional restrictions.

REFERENCE

Aikaeli, Faith, Tsi Njim, Stefanie Gissing, Faith Moyo, Uazman Alam, Sayoki G. Mfinanga, Joseph Okebe, Kaushik Ramaiya, Emily L. Webb, Shabbar Jaffar, and Anupam Garrib. 2022. "Prevalence of Microvascular and Macrovascular Complications of Diabetes in Newly Diagnosed Type 2 Diabetes in Low-and Middle-Income Countries: A Systematic Review and Meta-Analysis." *PLOS Global Public Health* 2(6):1–21. doi: 10.1371/journal.pgph.0000599.

Astutisari, I. Dewa Ayu Eka Candra, AAA Yuliati Darmini, and Ida Ayu Putri Wulandari. 2022. "Hubungan Pola Makan Dan Aktivitas Fisik Dengan Kadar Gula Darah Pada Pasien Diabetes Melitus Tipe 2 Di Puskesmas Manggis I." *Jurnal Riset Kesehatan Nasional* 6(2):79–87. doi: 10.37294/jrkn.v6i2.350.

Bati, Mazin Lilianing, and Angga Saeful Rahmat. 2023. "Pencegahan Diabetes Mellitus Gestasional Di Rs Sentra Medika Cikarang." *Cakrawala Medika: Journal of Health Sciences* 01(02):184–92. doi: 10.59981/sfq95x68.

BPS. 2023. *Survei Kesehatan Indonesia (SKI)*. Jakarta: Badan Pusat Statisik.

Divianty, Rika, Noor Diani, and Tina Handayani Nasution. 2021. "Karakteristik Pasien Diabetes Melitus Dengan Pengetahuan Tentang Hipoglikemia." *Dunia Keperawatan: Jurnal Keperawatan Dan Kesehatan* 9(3):443. doi: 10.20527/dk.v9i3.9737.

Erlina, Lina, Dhea Sena Kurnia Putri, Nandang A. Waluya, and Ali Hamzah. 2025. "Penggunaan Aplikasi Le-Diabet Dalam Pengelolaan Diabetes Melitus : Studi Kesiapan Dengan Technology Acceptance Model." *Media Penelitian Dan Pengembangan Kesehatan* 35(1):326–37. doi: https://doi.org/10.34011/jmp2k.v35i1.3135 326.

Federation, International Diabetes. 2022. "Diabetes around the World."

Fitrah, Fitrah, and Dita Pulubuhu. 2023. "Edukasi Gizi Berbasis Aplikasi Android Meningkatkan Pengetahuan Empat Pilar Penatalaksanaan Diabetes Melitus Pada Peserta Prolanis Fitrah Fitrah Inovasi Pada Berbagai Bidang , Salah Satunya Adalah Bidang Pendidikan Kesehatan Yang Bahwa Penyakit Diabetes M." *Jurnal Ilmu Kesehatan Dan Gizi (JIG)* 1(3):279–87. doi: https://doi.org/10.55606/jikg.v1i3.2865.

Manutama, Putu Agi Abhimana, I. Putu Dedy Arjita, I. Putu Bayu Agus Saputra, and Mamang

Bagiansah. 2024. “Hubungan Lama Sakit, Tingkat Pendidikan, Motivasi Pasien, Dan Dukungan Keluarga Dengan Kepatuhan Diet Pasien Diabetes Melitus Tipe II Di Rumah Sakit Daerah (RSD) Mangusada Kabupaten Badung Bali.” *MAHESA : Malahayati Health Student Journal* 4(6):2323–34. doi: 10.33024/mahesa.v4i6.14470.

Nora, Putri, Novayanti Gultom, Fauziyah Harahap, Syahmi Edi, and Herbert Sipahutar. 2025. “Hubungan Antara Jenis Kelamin Dan Usia Pada Penyakit Diabetes Melitus Di Puskemas Kota Medan Tahun 2024-2025.” *Jurnal Bioshell* 14(1):142–50. doi: 10.56013/bio.v14i1.3960.

Nurfalah, Zahra Anisa, and Ratih Kurniasari. 2022. “Pengaruh Media Video Edukasi Dan Website Terhadap Pengetahuan Masyarakat Dewasa Mengenai Diabetes Mellitus.” *Jurnal Untuk Masyarakat Sehat (JUKMAS)* 6(2):177–82. doi: 10.52643/jukmas.v6i2.2142.

Pratiwi, Amali Rica, Aftulesi Nurhayati, Alfariz Irfan Nabila, and Dini Eria Paramita. 2024. “Edukasi Dan Promosi Kesehatan Tentang Diet Pada Pasien Diabetes Melitus Tipe 2 Di Puskesmas Rejosari Kecamatan Pringsewu.” *MULTIPLE (Journal of Global and Multidisciplinary)* 2(12):4305–12.

Ridad, Geraldine S., Val Clinton S. Maybituin, Carlito Y. Bella, Karla Mae R. Cañete, Omar Khayyam M. Usman, and Erik Louwe R. Sala. 2020. “Project DiabEHT: An Approach to Improve Self-Care Management of Diabetes.” *Enfermeria Clinica* 30(2019):234–39. doi: 10.1016/j.enfcli.2020.04.004.

Rissa, Mexsi Mutia, and Qarriy ‘Aina Urfiyya. 2023. “Edukasi Diabetes Mellitus Sebagai Upaya Menurunkan Prevalensi.” *Indonesian Journal of Empowerment and Community Services*, 4(2), 54–59. doi: https://doi.org/10.32585/ijecs.v4i2.3418.

Rizky Rohmatulloh, Vanda, Riskiyah, Bambang Pardjianto, and Larasati Sekar Kinasih. 2024. “Hubungan Usia Dan Jenis Kelamin Terhadap Angka Kejadian Diabetes Melitus Tipe 2 Berdasarkan 4 Kriteria Diagnosis Di Poliklinik Penyakit Dalam RSUD Karsa Husada Kota Batu.” *Jurnal Kesehatan Masyarakat* 8(1):2528–43. doi: https://doi.org/10.31004/prepotif.v8i1.27198.

Santoso, Bagus Jati, Arina Qona’ah, and Endyka Erye Frety. 2022. “Digitalisasi Tatalaksana Pasien Diabetes Melitus (DM) Melalui Aplikasi DM Assistant Sebagai Upaya Peningkatan Kepatuhan Pilar Diabetes Melitus.” *Jurnal Inovasi Pengabdian Dan Pemberdayaan Masyarakat* 2(2):67–74. doi: https://doi.org/10.54082/jippm.23.

Zhao, Yang, Zong Yi Yuan, Han Ying Zhang, Xue Yang, Duo Qian, Jing Yan Lin, Tao Zhu, and Hai bo Song. 2021. “Simulation-Based Training Following a Theoretical Lecture Enhances the Performance of Medical Students in the Interpretation and Short-Term Retention of 20 Cross-Sectional Transesophageal Echocardiographic Views: A Prospective, Randomized, Controlled Trial.” *BMC Medical Education* 21(1):1–24. doi: 10.1186/s12909-021-02753-1.