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Cell Phone Vibration Education Through a Simulation Approach to Preventing Diabetic Foot Neuropathy Wounds

[1*]Sintawati Majid, [1]Siti Rahmani, [1]Juhelnita Bubun, [2]Syaiful Syaiful, [1]Nova Arwian
[1] Undergraduate Nursing Program, Megarezky University, Makassar, Indonesia
[2]Doctoral Program, Faculty of Nursing, University of Indonesia, Indonesia

*Corresponding Author : sintawatimajid@gmail.com

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Abstract:
Background: Effective prevention of diabetic neuropathy foot ulcers requires improved patient attitudes toward foot care and early self-detection. Conventional educational methods, such as in-room counseling, are often unsustainable and lack personalization.
Objective: To evaluate the impact of mobile phone vibration-based education, delivered through a simulation approach, on attitudes toward preventing diabetic neuropathy foot ulcers in patients with diabetes mellitus.
Methods: This quantitative study employed a one-group pretest-posttest design and was conducted from October 28 to November 12, 2025, at the Bangkala Community Health Center, Makassar City. Data were collected from 60 purposively sampled respondents using attitude questionnaires and neuropathy foot examinations utilizing mobile phone vibration.
Results: Respondents demonstrated improved attitudes toward prevention, with the proportion in the positive attitude category increasing from 10/60 (16.7%) to 45/60 (75.0%), and the negative attitude category decreasing from 30/60 (33.3%) to 5/60 (8.3%). The Wilcoxon test indicated that education on mobile phone vibration had a significant effect (p=0.000) on attitudes toward preventing diabetic foot neuropathy.
Conclusion: Education using mobile phone vibration can facilitate positive changes in attitudes toward preventing diabetic foot ulcers through diabetic neuropathy screening, thereby contributing to a reduction in diabetic foot ulcer complications. Future studies should be conducted with larger sample sizes.

Keywords: Diabetic Foot, Peripheral Neuropathy, Attitude, Mobile Phone Vibration

INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disease with complications of diabetic neuropathy that can lead to Diabetic Foot Ulcers (DFU) and amputation. Diabetic neuropathy is the main cause of DFU because it causes decreased perception or numbness, tingling, burning pain, and pressure in the feet (1). This condition leaves patients unaware of the wound, allowing infection to develop unnoticed. Globally, 30-70% of DM patients experience peripheral neuropathy, which is a major triggering factor for diabetic foot complications and amputations(2). Recent research indicates that more than 60% of DM patients who experience lower extremity amputations have a history of peripheral neuropathy. The main complication of DM in Indonesia is neuropathy, as many as 30-40% (3). Meanwhile, in South Sulawesi, especially in the city of Makassar, the number of cases of diabetic neuropathy is 56.5% (4). Our previous research found that 82% of DM patients experience peripheral neuropathy in the home care community(5). The high percentage of neuropathy in the community allows for an increase in lower

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extremity DFU. LKD can be avoided by conducting early screening for DM in the community. A strategy is needed to detect neuropathy in patients with DM.

Neuropathy in DM patients can be detected using the monofilament test, the gold standard with good sensitivity. However, it has several limitations, including the need for specialized expertise, relatively high cost, and limited availability in the community. Based on this, several approaches to evaluating neuropathy currently exist, including the light-touch Ipswich Touch Test (IpTT) (6) and mobile phone vibrations. This approach uses standard vibration stimuli on mobile phones to elicit the patient's peripheral nerve response (7,8).

Foot wound prevention efforts must begin with changing patients' attitudes toward independent foot care. Unfortunately, conventional education, such as in-room counseling, is often unsustainable and impersonal. Therefore, innovative educational methods that are sustainable, affordable, and targeted are needed. One such approach is simulation education, a method that directly involves patients in situations or scenarios that mimic real-life conditions. Simulation education is considered more effective than lectures because it is more interactive, provides direct experience, and improves patient understanding and information retention. Another innovative approach is education using cellphone vibrations as daily reminders (9).

Based on data from the Bangkala Community Health Center, the number of diabetes sufferers over the last six months was recorded at 606. Interviews with several patients revealed that most DM sufferers in the area lacked knowledge about the use of mobile phone vibrations as an early detection tool for peripheral neuropathy. The majority of respondents admitted to never having routine foot checks and to never having received education on using mobile phone vibrations to detect neuropathy symptoms. In fact, several patients expressed surprise and had just learned that mobile phone vibrations could be used as a simple method to identify early signs of peripheral nerve damage due to diabetes. Few researchers in Indonesia have explored the effectiveness of simple technology-based education, such as mobile phone vibrations, in effecting behavioral changes among patients with diabetes. This study aims to test the mobile phone vibration education method through a simulation approach to attitudes towards preventing foot neuropathy wounds in DM patients.

METHODS

This research is quantitative and uses a pre-experimental one-group pretest-posttest design. The research was conducted in the Bangkala Community Health Center area, Manggala District, Makassar City, South Sulawesi. The research was conducted from October 28 to November 12, 2025. Secondary data from the Bangkala Community Health Center for May, June, and July 2025 yielded population data on 143 patients. The sampling technique used in this study was purposive sampling based on the Slovin formula, resulting in a target sample of 60 people. The inclusion criteria were patients diagnosed with diabetes mellitus, DM duration ≥ 2 years, and willing to participate in education with cellphone vibration. The exclusion criteria were patients with hearing or cognitive impairment, patients with advanced foot wounds (Wagner III, IV, or V), and patients who had received cellphone vibration education. Data were collected using an observation sheet containing demographic data of respondents, including: respondent's name, age, duration of DM, gender, last education, occupation, marital status, history of foot wounds, ever received education on cellphone vibration, last blood sugar level examination, type of DM, and family history of DM. Attitude data were collected using an attitude questionnaire consisting of 11 questions adapted from previous research conducted by(7–10). Data analysis was carried out using a Kolmogorov-Smirnov test, and the statistical test was the Wilcoxon test. This study adheres to the principles of research ethics.

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RESULT AND DISCUSSION

RESULTS

Table 1. Characteristics of Type 2 DM Respondents

Characteristics	N (60)	%
Age		
37-40 year	3	5.0
45-59 year	39	65.0
60-74 t year	17	28.3
75-90 year	1	1.7
Gender		
Female	52	86.7
Male	8	13.3
Education		
No School	4	6.7
Elementary School	22	36.7
Juniar High School	7	11.7
Senior High School	23	38.3
Bachelor	4	6.7
Occupation		
Housewife	50	83.3
Labores	5	8.3
Entrepreneur	2	3.3
State civil servants	3	5.0
Marital status		
Married	59	98.3
single	1	1.7

Source: Primary Data, 2025

Based on Table 1, the characteristics of DM patient respondents show that the majority were aged 45-59 years (39/60, 65.0%), and one respondent was aged 50-79 years (1/60, 1.7%). By gender, women dominated, comprising 52/60 (86.7%) respondents, while men accounted for 8/60 (13.3%) respondents. In terms of education level, the majority of respondents had a high school education (23/60, 38.3%), followed by elementary school and a bachelor's degree (4/60, 6.7% each). In terms of occupational characteristics, housewives dominated the respondents' occupations (50/60, 83.3%); in terms of marital status characteristics, as many as 59/60 (98.3%) were married, and 1/60 (1.7%) were divorced.

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Table 2. Type 2 DM status

DM Status	n= 60	(%)
DM Duration		
1-5 year	51	85.5
6-10 year	9	15.5
Neuropathy Status		
Present	41	68.3
Absent	19	31.7
History of Foot Injuries		
Yes	58	96.7
No	2	3.3
Have received education		
Yes	0	0
No	60	100
Type DM		
Type 2	60	100
Type 1	0	0
Family History of DM		
Yes	41	68.3
No	19	31.7
DM Therapy		
Insulin	2	3.3
Oral	56	93.3
Herbs	2	3.3
Glycemic index		
100-200 mg/dl	56	93.3
300-400 mg/dl	3	5.0
≥500mg/dl	1	1.7

Source: Primary Data, 2025

Table 2 shows that the average number of respondents with a duration of 1–5 years of diabetes was 51/60 (85.0%), and 9/60 (15.5%) had a duration of 6–10 years. In the neuropathy examination, 41/60 (68.3%) respondents had neuropathy, and 19/60 (31.7%) had normal findings. Regarding the history of foot wounds, 58/60 (96.7%) respondents had never experienced them, and only 2/60 (3.3%) had. All respondents had never received or heard education about cellphone vibrations. Most respondents (41/60, 68.3%) had a family history of type 2 diabetes, while 19/60 (31.7%) did not. The majority of therapies used were oral medications (56/60, 93.3%), and 2/60 (3.3%) respondents used insulin and herbal remedies, respectively. In the neuropathy examination, most respondents had never had a foot examination. In the GDS results, the majority of respondents had a GDS value of 100–200 mg/dl (56/60, 93.3%), and only 1/60 (1.7%) had a GDS ≥500 mg/dl.

Table 3. Neuropathy Status

Neuropathy status	Right Foot		Left Foot	
	n	(%)	n	(%)
Negative	21	35.0	33	55.0

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Positive	39	65.0	27	45.0
Total	60	100.0	60	100.0

Source: Primary Data, 2025

In Table 3, a neuropathy examination was conducted on the right foot using cellphone vibrations so that the results obtained were those who felt cellphone vibrations (positive), as many as 39/60 (65.0%) respondents, and those who did not feel cellphone vibrations (negative), as many as 21/60 (35.0%). Furthermore, the neuropathy examination of the left foot using cellphone vibrations was positive for 27/60 (45.0%) respondents and negative for 33/60 (55.0%) respondents. The results of the normality test using the Kolmogorov-Smirnov test showed that the pretest had a p-value of 0.044, and the posttest had a p-value of 0.000. This value is smaller than α = 0.05, so it can be concluded that the pretest and posttest data were not normally distributed. Therefore, further data analysis used a nonparametric statistical test, namely the Wilcoxon signed-rank test.

Table 4. Pre-post test prevention attitudes

Attitude	*Pre-Test*		*Post-Test*		*p*
	n	(%)	n	(%)	
Good	10	16.7	45	75.0	
Enough	30	50.0	10	16.7	0,000.*
Lack	20	33.3	5	8.3	

* *Wilcoxon Signed Rank Test*

Based on Table 4, before receiving cellphone vibration education, 10/60 (16.7%) respondents had a good attitude, and 20/60 (33.3%) had a poor attitude. Then, after receiving cellphone vibration education, 45/60 (75.0%) respondents had a good attitude, and only 5/60 (8.3%) had a poor attitude. Based on the results of the Wilcoxon Signed Ranks Test, a P value of 0.000 was obtained. These results indicate a significant difference in attitudes before and after the foot examination education intervention using vibration. Thus, it can be concluded that education on cellphone vibration has an effect on attitudes towards preventing foot neuropathy-related wounds in patients with Diabetes Mellitus.

Discussion

This complication primarily affects the peripheral nervous system, resulting in reduced sensation in the extremities, particularly the feet, which serves as a key factor in the development of diabetic foot ulcer (DFU). Neuropathy examination results indicated that most respondents experienced neuropathy in the right foot. These findings suggest that neuropathy is more frequently detected in the right foot than in the left, likely due to the asymmetrical distribution of peripheral nerve junctions among individuals with diabetes. Bilateral differences in neuropathy are frequently reported in studies of diabetic peripheral neuropathy (DPN), with prevalence varying between extremities depending on disease duration, glycemic control, and other risk factors (10). Additional independent risk factors for diabetic neuropathy include smoking, alcohol abuse, increased height, and advanced age (1). Conversely, a study in Japan found that Japanese patients with diabetes are more likely to develop bilateral symmetric neuropathy (11). Boulton's theory posits that diabetic neuropathy develops progressively and can be influenced by local factors such as mechanical pressure, peripheral circulation, and uneven use of the extremities (12). The predominant use of the right foot in daily activities results in greater exposure to pressure and load, which may accelerate the onset of peripheral nerve damage compared to the left foot (12).

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Approximately half of diabetic peripheral neuropathy cases are asymptomatic (12), highlighting the importance of early neuropathy screening to prevent further complications. A vibration-based mobile phone application represents a practical screening tool for detecting neuropathy among individuals at risk for diabetic foot ulcer (DFU) (8). Educating patients with diabetes mellitus (DM) about using mobile phone vibrations serves as a preventive measure against DFU. In this study, participants demonstrated improved attitudes toward wound prevention following the educational intervention. Prior to receiving education on mobile phone vibrations, participants exhibited limited knowledge and awareness regarding the importance of foot neuropathy examination, particularly through the mobile phone vibration method, and likely engaged in suboptimal foot self-care practices. This finding aligns with existing literature indicating that DM patients often do not receive adequate education on foot care and the prevention of neuropathy complications. Similarly, research conducted in India reported that nearly all DM patients lack sufficient knowledge of foot care, and more than half are unaware of DM foot complications (13).

Nearly all DM patients in this study exhibited positive changes in preventive behavior following the educational intervention. These results support previous findings (14) that digital-based neuropathy education can significantly enhance DM patients' knowledge and attitudes toward preventing neuropathic complications. Additional studies have reported a positive correlation between knowledge and attitudes regarding diabetic foot care (15). The present study offers important insights for practitioners, indicating that many DM patients are willing and able to adopt preventive behaviors when provided with appropriate, accessible, and relevant information. This underscores the necessity of educational interventions as an integral component of DM management in primary care settings. However, prior research cautions that while education improves knowledge and attitudes, the sustainability of foot care behaviors requires ongoing reinforcement and support from healthcare providers, including regular follow-up, repeated education, or integration of education into routine patient management to ensure lasting behavioral change (16). Conversely, a study by Oktasari (2025) demonstrated that foot care, massage, and acupressure can prevent neurovascular dysfunction by improving peripheral perfusion (17). Collectively, these findings confirm that interventions increasing patient attention to foot health, whether through education or physical activity, have the potential to reduce the risk of diabetic foot complications.

CONCLUSION

Positive changes in attitudes toward preventing diabetic foot ulcers through diabetic neuropathy screening can be achieved by educating people with diabetes about the use of cell phone vibrations. This can help reduce diabetic foot complications**.**

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AUTHOR'S CONTRIBUTION STATEMENT

The first author contributed to the research concept and drafting the manuscript. The second and third authors provided guidance to the primary author in drafting the manuscript and directed the research implementation. The fourth author contributed to proofreading the manuscript. The fifth author served as the data collector and data analyst. All authors have read and approved the final version of this manuscript and have agreed to its submission.

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CONFLICT OF INTEREST

All author declare No conflict of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

None.

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