Effect of Applying Telenursing Strategy on Foot Self-care among Diabetic Patients

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Abstract

Background: *Diabetic foot complications are a major cause of morbidity, often resulting from poor self-care and delayed treatment. Telenursing, nursing care remote delivery via technology can be in the form of videos, messaging apps like WhatsApp etc. These offer a practical solution to support diabetic patients. It enables nurses to educate, monitor, and guide patients in real-time, promoting better foot care practices. Studies proved that telenursing improves self-care adherence, reduces complications, and enhances access to care* ***Objective:*** *To evaluate the effect of applying telenursing strategy on foot self-care among diabetic patients.* ***Settings:*** *The study was carried out in the Main University Hospital outpatient diabetic clinic Alexandria, Egypt.* ***Subjects:*** *A convenient sample of 80 diabetic adult patients (one group pre-test post-test design).* ***Tools:*** *one tool was used "Diabetic Patients' frequency foot self- care Checklist questionnaire". An attachment sheet was added "Bio-socio-demographic data".* ***Results:*** *There was a significant improvement in foot self-care ($P<0.001$*) in both first, second evaluation post telenursing strategy application.* ***Conclusion:*** *Diabetic patients who received telenursing application- WhatsApp and YouTube videos- achieved higher scores in foot self-care than before the telenursing application.* ***Recommendations:*** *Continuous training and educational programs must be designed for diabetic patients through online applications to update their practice performance and enhance their foot self-care.*

Keywords:

Diabetic Patients - Foot Self -Care -Telenursing Strategy

Introduction

DM is a widespread global health issue that associated with several severe complications which pose a heavy load on global health systems. Notably, diabetic foot disease (DFD) usually is a common complication, which affects approximately 18.6 million individuals annually. It progresses to foot ulcer, leading to high rates of amputation 85% **(Guan et al., 2024).**

As evidenced, diabetes related foot disease includes one or more of the following; peripheral neuropathy, peripheral artery disease (PAD), infection, ulcer(s), neuro osteoarthropathy, gangrene, and /or amputation. However, foot ulceration is the most serious diabetic complications. It is also a source of reduced quality of life as well as financial costs for them. Moreover, it places a considerable burden on the person's family, healthcare professionals and facilities, as well as society in general **(Schaper et al., 2023)**. As reported DFD takes months to heal, intensive to treat additionally places people at high risk for hospital admission as well as amputation**(Zhang et al., 2021).**

Studies have shown that deficiencies in early preventive diabetic foot care, lack of patient education and provider management might contribute to increased amputation rates. Although American Diabetes Association recommended regular foot exams, only 30-33% of provider-patient visits adhere to this guideline. This leads to missed opportunities to address foot care in this population. Despite the prevalence of diabetes-related foot complications, foot care education and prevention programs for these patients are still lacking **(Ju et al., 2023).**

Early detection and reporting of diabetic foot problems are critical for preventing devastating outcomes and invasive treatment, thus improving quality of life. Diabetic patients might be not aware of their foot risks, nor equipped with necessary self-care skills. These effectively care for these conditions and delay foot problems development, at which time invasive treatment may be necessary. During the COVID-19 pandemic, globally diabetes-related amputation rates have increased. Therefore, there was an urgent need to engage patients in the early detection of foot problems, improve their understanding of foot risks, and avoid treatment delays. A major health care innovation had widespread the adoption of tele-health technology. This upsurge provided new communication tools for collaboration between patients and health care professionals **(Ju et al., 2023).**

Thus, tele-nursing can be considered as one of the aforesaid methods as documented. **Boroumand and Moeini, in 2016** highlighted that education; tele-nursing follow-up could establish connection to continuous dynamic management, followed by enhancing patients' quality of life. This would minimize health problems which might be take place. This could raise patient satisfaction, as well as improving health and service quality **(Kats & Shmueli, 2024).**

While, follow-up is one aspect of nursing care process, using tele-nursing approach would help in constant patients monitoring. This would manage their disease and learn how to adapt with their lifestyle quickly and successfully. This could also overcome restricted human resource availability, time, and costs when compared to traditional methods. Otherwise, through using phones, nurse can better grasp the patient's needs and assist in meeting them. This strategy can help to reduce patients' stress, worry, as well as, boost their self-esteem, and move patient's care from clinics or hospitals to home **(Gohari et al., 2021).**

Nowadays, nurses use tele-nursing as a method to assess the distance patients with diabetes. This could help in determining whether they are receiving enough care, and provide recommended nursing care as well as health teaching and guidance. This could be

done to ensure that, the patients are following the diabetic foot care regularly and routinely appropriate. It could detect diabetic foot ulcer warning signs, measures to prevent complications, and self-care **(Akbarirad et al., 2023;Elkashif et al., 2021).**

Significance of the study:

In Egypt tele-nursing is worth applying for diabetic patients' sake. It might improve their foot care self-efficacy, self-management and prevent foot complications **(Hildebrand et al., 2020; Mohamed et al., 2022).**

Aim of the Study

Assess the effect of applying telenursing on foot self-care among diabetic patients.

Hypothesis of the study

Diabetic patients who receive telenursing application achieve higher scores in foot self-care than before.

Materials and Methods

Materials

Design: A quasi-experimental (one group pre-test post-test design) was adopted.

Setting: The current study was conducted in outpatient diabetic clinic Main University Hospital Alexandria, Egypt.

Subjects: A Convenient sample of 80 adult patients diagnosed with diabetes attending the above-mentioned setting was included. Epi info-7 tool was used to estimate the sample size using the following: Population size: 105 over 3 months (hospital statistics), expected frequency: 50%, acceptable error: 5%, confidence coefficient: 95% and min. sample size. 80 patients with inclusion criteria: 20-60 years old / smartphone and internet access / able to use WhatsApp / min. 6 months diagnosed with diabetes and free from foot ulcer or amputation.

Tools: One tool was used**: "Diabetic Patients Foot Self-Care Frequency Checklist Questionnaire"**

It was developed by the researcher based on related literature **(Embil et al., 2018; Diabetes Canada Clinical Practice Guidelines Expert Committee., 2018)** and translated into simple Arabic language.

It assessed diabetic patients' practices frequency regarding foot care. This checklist of questions form included washing, drying, applying lotion on foot as well as between toes, foot problems issues, trimming toenails, wearing shoes or any foot wear, wearing sock, standing issues and exercises.

Scoring system :

Each patient's frequency foot-care items response was scored on 3 points-Likert scale ranged from 0(never), 1(sometimes), and 2 (usually). Total responses were summed up and converted into percent scores.

A ≤ 50% score was considered poor, 51-65% moderate, and >65%, was considered good frequency practice. **(Alkalash et al., 2024 ; Amer Abdelhay et al., 2023)**

Telenursing Educational material:

- A foot-care video was developed depending on the developed tool, considering patients' engagement and guiding them on diabetic frequency foot self-care.
- A detailed script was clearly written in simple Arabic language to suit the patient especially medical terminology (2 months).
- A group of illustrative pictures were utilized as visual Aids for the educational target.
- It was then converted into a PowerPoint presentation (ppt) with 37 illustrative slides using Microsoft office version 2409 (Build. 20160)
- Slides outline included; explaining topic, its importance, foot self-care items, blood glucose level regulation related items.

- Each slide was for 30 sec. - 1 min.
- The animation and voiceover were then added to suit simplicity, complexity data, as well as the studied patients. The best version was chosen after several rehearsals.
- The developed PowerPoint presentation was finally exported to be a video suitable for YouTube channel uploading.

Method

Official written approvals to carry out the study were obtained from Research Ethical Committee -Faculty of Nursing, Alexandria University, general and diabetic outpatient clinics. Moreover permission was obtained to use the nursing lab (OSCE) Objective Structured Clinical Examination. 5 experts (jury) from Alexandria University (4 Medical-Surgical Nursing Professors and a professor diabetes and diabetic foot faculty of Medicine) tested the tool content validity. Then necessary modifications were done for both Arabic and English versions. Using Content validity index (CVI), its content validity, clarity and comprehensiveness were tested. Statistics revealed 89.7%. To test clarity, feasibility of the tool developed tool a pilot study 8 patient was conducted (10%), followed by necessary modifications. These were then excluded. Using Cronbach's alpha test for tool reliability, it was 0.85.

The study was conducted in phases; assessment, implementation, follow up and evaluation phase.

Assessment phase:

-At Diabetic Outpatient Clinic, a good relation was built, greeting and giving small introduction prior explaining study purpose.

- Each patient was asked to record mobile numbers with WhatsApp and/or e-mail for contacting (online application).

-The initial assessment was carried out to collect each patient's baseline data on foot self-care and its frequuency,10-15 min. (Using the tool)

Implementation phase:

-Each patient individualized or in group (availability, tolerance and needs) was instructed on the foot self-care and its frequency.

-The researcher raised awareness regarding proper foot wear and other related issues.

-It took 15-25 min.

- Each patient was instructed to fill the tool's form prior its uploading on WhatsApp.

Follow up phase

-WhatsApp follow-up and reinforcement took place using the prepared educational video link (on YouTube App).

-The researcher received patient inquiry via WhatsApp in a schedule time.

-If the patient detected any foot problem, it was shared, discussed, and then was referred to Diabetic foot clinic.

Evaluation phase

-Each patient was evaluated depending on the filled tool-form twice/ month (1^{st} , 2^{nd} evaluation) to observe telenursing strategy effectiveness on foot self-care.

-Video viewers on YouTube reached 129.

Ethical considerations:

- An ethical approval received from the Research Ethics Committee (REC) IRB00013620 (9/19/2025), Faculty of Nursing Alexandria University.
- Each patient's written informed consent was obtained. Each patient has right for withdrawal any time.
- Confidentiality of data was assured.
- Anonymity and privacy of these patients were assured.

Statistical Analys

Data were analyzed using IBM SPSS software package version 26.0. Qualitative data were described using number and percent. Quantitative data were described

using mean, standard deviation. Significance of the results was judged at the 5% level.

The used tests were ANOVA, Friedman, Pearson coefficient, Chi-square, and Monte Carlo correction test.

Results

Table I shows the frequency distribution of socio-demographic characteristics among the studied patients. Regarding gender, it was found that more than half of the studied patients were females while 42.5% were males. In relation to their age, it was noticed that highest percentage was 40 - ≤ 60 years old. As regard area of residence, this table also revealed that the highest percentage of them were urban. Concerning their educational level, it was evident that more than half had university education. It was found that around 70% were working, and married, half of them had sufficient monthly income to fulfill the daily.

Table II shows frequency distribution of studied patients according to clinical data. Regarding the duration of illness, it showed that more than third were diagnosed for 5-15 years, more than three quarters of them had DM II and more than two third were suffering of hypertension after being diagnosed with diabetes. Concerning medication more than half were on oral medication, and around third were on insulin and more than one tenth were on both. Almost 2/3 had uncontrolled blood glucose level, the majority was related it to stress and unhealthy diet. Regarding family history 72.5% of them had a DM II positive family history, 68.96% were from their mother side.

Fig I shows the patients' frequency distribution according to items of foot self-care regarding initial assessment, 1st and 2nd evaluation. Concerning this, it was noticed in the initial assessment that the majority usually washed their foot regularly, 53.75% never dried their feet nor between toes after washing, the majority never applied lotion on their feet nor between the toes.

The majority never removed the callus by using chemicals nor by using did a sharp tool and 40% never apply an antibiotic to self -treat foot ulcer. 60% applied this between sometimes and usually. Less than three quarters never trimmed toe nails straight across away.

Concerning wearing the suitable foot wear more than a third never did, and around two third between sometimes and usually did. Nearly three quarters usually walked bare footed at home. Concerning wearing suitable socks around one third did. It was observed that around half usually stand for a while without any rest, but never exercised walking.

In the 1st, 2nd evaluation all the patients washed their feet using warm water, dried their feet and between toes and apply lotions regularly but not between toes. Moreover all of them did not remove the callus using chemicals or sharp tools and never self-treat any foot ulcer. The majority trimmed their toenails straight, wore suitable shoes, socks, and never walked bare footed. Nearly three quarters never stood for a while and but usually exercised walking.

Fig II Shows comparison between the studied patients total scores of the according to initial assessment, 1st, 2nd evaluation of foot self-care. Concerning foot self-care, more than half of them had poor total scores in their initial assessment, while in the 1st, 2nd evaluation high parentage had good total scores with significant difference using Friedman test (P1=<0.001*) for the 1st evaluation and (P2=<0.001*) for the 2nd evaluation. There was also no significant difference between 1st and 2nd Evaluation where (p3=.052*). Using ANOVA test showed that there was significant difference between initial assessment, 1st and 2nd evaluation percent scores of foot self- care with Mean ± SD 86.1±12.0 in the first/ Mean ± SD 90.5±11.9 in the second evaluation with significant difference (p=<0.001**).

Table III shows the relation between the studied patients' responses to the researcher WhatsApp group vs privately and their

sociodemographic data. No statistically significant relationship between WhatsApp app responses with their gender, education level, marital status or living with their families respectively (p=0.293, 0.486, 0.614, 0.171). There was statistically significant relationship between WhatsApp responses with their age, residence area, occupation and income respectively (p=<0.001*, 0.004*, <0.001*, 0.021*)

Discussion

Diabetes-related foot illness is a major source of morbidity and mortality in diabetic patients. Interventions to lessen the burden of diabetic foot disease are extremely cost effective **(Elmansy & Elbqry, 2024) .** Almost more than 10% of diabetic patients experience foot ulcers. These problems can be alleviated with good education and practice **(de Lima et al., 2022).**

More importantly, as technology progresses, the model of care delivery may move from viewing a patient as a passive recipient of treatment to an active participant in the healthcare ecosystem. The implementation of this innovative care delivery model would enable remote care delivery to patients and would empower them to self-care. It is anticipated that Diabetic Foot Ulcer patients visit outpatient facilities 14 times/ year and are hospitalized 1.5 times/ year. Nurses should seek options to provide prompt care to patients with the presence or DFU risk. It is tempting to imagine that in the future may lead to some beneficial developments in healthcare for persons with chronic disease, notably in encouraging preventive and personalized care for people with DFU **(Mohamed et al., 2022).**

Telenursing has developed as a successful diabetes treatment strategy, especially in foot care and patient education. A nurse-led telemedicine program for diabetes foot care has shown feasibility and the ability to increase diabetes awareness and self-care behaviors **(Ju et al., 2023).**

Regarding the studied patients' gender, more than half of them were females. This can be justified by hormonal fluctuations, especially during menopause which can lead to insulin resistance. This was supported by **Pérez,(2023)** who highlighted the significant diabetes incidence were among women, as women experience increased DM II risk during menopause due to hormonal fluctuations, weight gain, and increased insulin resistance. These comes contradicting **Kaul et. al.(2022); Sharma et. al.(2024)** findings, as males aged 55-59 years had exhibited higher rates of diabetes incidence compared to females.

The present study illustrated that highest percentage of patient's age ranged 40-60 years old. This result can be justified by aging process leads to declining insulin sensitivity and pancreatic β-cell function, impacting insulin production and utilization. This was supported by **Yan et. al. (2023)** in "The Interaction between Age and Risk Factors for Diabetes and Prediabetes" they found that the diabetes risk and prediabetes was significantly higher with the aging process, suggesting that increased age is associated with diabetes. More over **Khalil et. al. (2018)** highlighted that diabetes was most common in those older than 50 in their sample of the adult population of Alexandria, Egypt. On the other hand **Wagenknecht et. al.(2023)** findings showed the growing burden of DM I, or DM II in younger populations.

In relation to their residence area the majority of patients were from Alexandria. This is justified that diabetes clinics in Alexandria has an easy access to its residence. This finding was supported by **Sidahmed et. al.(2023)** that urban areas showed higher diabetes prevalence compared to rural regions. **Okasha et. al., (2024)** study found an increasing prevalence and burden of DM II in urban areas in both North Africa and the Middle East. Similarly **Talukder et. al. (2024)** showed that urban areas in Bangladesh had a higher DM II prevalence compared to its rural areas. In contrast, **Dugani et. al. (2024)**

findings showed that rural areas showed higher crude incidence and diabetes prevalence rates.

Regarding the patients' educational level this study revealed that all were educated whether university, secondary or preparatory. This finding could be related to the pre-established inclusion criteria of this study using telenursing would be easier for educated patients. This finding goes with **Mohamed et. al. (2022) ; Rusdiana et. al. (2018)** findings as diabetes self-management education were academy/university degrees patients.

Concerning occupation, around 70% of them were working. This is justified that higher Employment Opportunities in the cities has offered a wider range of jobs. This included office, manual, freelancing work. This could reveal that work place environment place could be risk factors for worker people to develop diabetes as sedentary jobs, unhealthy diets, high stress, and irregular sleep (especially in shift workers). This findings agree with **Chen & Yang, (2023); Negrato et. al. (2023)** as the higher incidence of diabetes was among employed and workers. Otherwise, this was contradicted by **Manickum et. al. (2021) results** who found that most their diabetic patients were unemployed.

As for the studied patients' marital status, around 70% were married. This finding goes with their age group ranged from 20 – 60 years. This goes with **Pourkazemi et. al. (2020)** results. However it was contradicted with **Karimi et. al.(2025); De Oliveira et. al. (2020)** who found that married individuals generally have a lower risk of developing DM II compared to unmarried.

Regarding income, the current study showed that half of studied patients did not have enough income. Diabetes management, including medication, medical visits, specialized foot care and necessary lifestyle modifications are expensive and give them high financial burden. This is justified why diabetic patients seeking care -within hands- from the main university. This in line with a study by **Tsega et. al. (2021)**in Ethiopia, who found that a high percentage of their studied diabetic patients had incurred catastrophic healthcare expenditures, with lower education, unemployment, and poverty being associated factors. On the other hand **Zaman et. al.(2020)** in Bangladesh found that the prevalence of diabetes was 11 times higher in the richest quartile compared to their poor eating habits.

The present study illustrated that more than one third of the patients diagnosed with diabetes for 5-15 years, more than three quarters have DM II, and with positive family history. This is justified by genetic predisposition plays a major role together with lifestyle factors as unhealthy diet, chronic stress etc. are significantly contributors to the diabetes type II. This finding agrees with **Zhu et. al. (2022)** results that revealed that the majority of their patients were diagnosed with DM type II. Moreover **Ramezankhani et. al. in 2022 concluded** that diabetes family history significantly had impact on developing DM II risk.

Concerning chronic diseases, more than two third of the present studied patients had chronic diseases specifically hypertension. This is justified by their positive hypertension family history. As well as diabetes itself leads to hypertension as high blood sugar damages blood vessels, causes kidney-related fluid retention, and promotes vessel constriction through insulin resistance and inflammation. **(Hezam et al., 2024)** Similarly **Ramezankhani et. al. (2022)** reported that the prevalence of hypertension in DM II patients was up to three times higher than in non-diabetic individuals.

The present results revealed that more than half of the patients were on oral hypoglycemics; more than one third were on insulin therapy and more than tenth on both. This finding might be related to the fact that most of them were DM II. Some of them used insulin due to uncontrolled hyperglycemia. Others were DM I were taking insulin. These findings matched with the study by **Mohajan and Mohajan, (2024)** reported that oral hypoglycemics are widely used medications for

managing DM II more convenient and acceptable. This contradict with **Fahmi and Urfiyya, (2022)** study who reported that in a Yogyakarta hospital, more than half of outpatients were on insulin due to uncontrolled glucose level.

Concerning regularity of blood glucose level with diabetic treatment, more than two third of them had uncontrolled blood glucose levels. Similarly **Thuy et al., (2021); Yabebal et al., (2024)** reported that uncontrolled blood glucose levels were prevalent among diabetic patients by 69-70.4%. The present results justification could be due to patients' stress, poor medication adherence, unhealthy diet, lack of exercise, and inadequate monitoring. This finding corresponds with **Susanti et al., (2022)** shows a strong link between stress and blood glucose levels in individuals with diabetes and prediabetes. Additionally high perceived stress was associated with poor glycemic control. Moreover, they found that this awas associated with severely stressed prediabetics and diabetics showing elevated HbA1c and fasting blood glucose levels**.**

Concerning foot-care, it was found that more than two third of the studied patients had poor total scores regarding the frequency effectively cleansing due being unaware, inadequate health education. Nevertheless it is worth saying that the majority of these patients was washing their feet regularly before prayer, but never dry feet, between toes nor applies foot lotions. This is similar with **Zhu et. al.(2022)** study who found that patients washed their foot regularly but never dry between toes and other study **Aljaouni et. al.(2024)** stated that more than half never moisturized feet or between toes.

Concerning trimming toenails, the majority had poor total scores due to improper practices as, often trimming the sides too short but not straight, this in line with **Yasin and Eldooma (2024)** reported that more than half did not trim toenails appropriately.

Concerning dealing with the foot problems it was found that the majority had good scores since the majority would avoid callus removal whether using chemicals or sharp tools if detected. This is due to fear of complications. This consistent with **Jumain and Rasiman (2024)** reported that the majority avoid using chemical agents or plasters to remove calluses or corns. Furthermore **Al Amri et. al. (2021)** reported that more than two third of studied patients had consulted their physician if detected any foot deformities, and/or wounds/ulcers.

Concerning the foot wear, more than two third had poor frequency total scores. This is due to improper practices as wearing unsuitable shoes, frequent use of plastic footwear, wearing open-toe, flip flop slippers. Moreover they rationale this by it is due to hot weather. Moreover did not wear cushioned slippers at home but rather barefooted as the floors are covered with carpets and clean. Moreover, more than two third had also poor frequency total scores this was seen in the infrequent changing of socks, and or wearing unsuitable materials of socks. This in line with **Elmansy and Elbqry (2024)** who stated that most of their studied patients did not follow proper foot wear or socks. **Furthermore Aljaouni et. al.(2024)** reported that more than half of their patients walked barefooted, worn shoes without socks and preferred walking out door with sandals.

Regarding standing, more than two third had poor frequency total scores in standing items. As present results revealed that around half usually stand for a while without any rest, and never exercised walking. This could be due to lack of awareness about bad lifestyle habits that contribute to increased pressure on the feet and leading to foot complications. This comes in line with **Ataseven et. al.(2020) who studied** patients standing long time without assuming exercises even walking**. They** concluded that bad habits of prolonged standing activities could reduce foot blood flow. Thus would enhance neuropathy complications.

The majority had good frequency total scores in all foot care items with significant marked improvement in the 1st , 2nd evaluation (fig II) This might be attributed to increased patient awareness, adherence to instructions, re-demonstrating during first session, constant follow-up via shared YouTube educational videos. This comes in accordance with **AkbariRad et. al. (2023)** study titled "The Effect of Telenursing on Disease Outcomes in People with Type 2 Diabetes Mellitus" concluding that using the telenursing was effective in patients' health education. They found foot care practice improvement especially among those who were keen to acquire knowledge and skills to improve their health. Moreover, **Hailu et. al. (2019)** found significant foot care adherence improvement post diabetes self-management education.

Furthermore, the relationship between patients' responses whether through the group or private WhatsApp messages as that most of them preferred to communicate via private text messages rather than in group. This preference may be attributed to concerns about data security and personal privacy, no statistically significant were found between communication preferences and their socio-demographic characteristics specially gender, level of education, marital status, or whether the patient lived with their families revealed.

Moreover younger, urban, and employed patients with lower income levels were more likely to prefer private messages (table7). Younger individuals might be embarrassed to participate in groups, while urban residents tend to favor direct and individualized communication. Employed patients may also prefer private messages to maintain concise communication due to time constraints. A statistically significance was found with age, area of residence, occupation, and income.

These findings contradicted with **Fauziansyah et. al. (2024) ; Alhazmy et. al. (2024)** revealed that Group WhatsApp showed enhancement in their patient knowledge and self-care behaviors, particularly among those with chronic conditions; as heart failure and type II diabetes mellitus. It had been associated with improved foot care practices among diabetic patients, ultimately leading to better health outcomes.

It is concluded that private use of WhatsApp had facilitated professional communication among healthcare providers and the patients as well as for individualized patient-doctor consultations privately **(Mbada et al., 2023)**. It is stated that WhatsApp has emerged as an efficient medium for interpersonal communication, particularly for minor illnesses **(Rafi et al., 2023)**.

To summarize, the results of this study support the research hypothesis that telenursing strategy had a statistically significant positive effect on diabetic patients' foot self-care through online Applications as has emerged a valuable tool in the management and prevention of complications related to diabetic foot care furthermore can remotely assess, educate, and support diabetic patients in maintaining proper foot hygiene, monitoring wounds, and adhering to treatment plans, allows for regular follow-ups, early detection of foot ulcers, and timely intervention, reducing the risk of severe complications such as infections and amputations. Additionally, it enhances patient engagement by providing real-time consultations and personalized guidance, especially for individuals in remote or underserved areas. The integration of telenursing into diabetic foot care not only improves patient outcomes but also reduces healthcare costs by minimizing hospital visits and preventing avoidable complications. This finding agrees with **Fitriadi, et. al.(2021)**, who reported that foot care education through telenursing applications impacts knowledge and foot care practice for diabetic patients.

This in line with **Wahyuni et. al. (2023)** study that found telenursing treatments, generally administered via telephone follow-ups and WhatsApp, have been demonstrated to improve medication adherence, glycemic control, and self-management in patients with DM II as the telephone communication model

has several advantages such as convenient and fast, wide and unlimited coverage, suitable for urgent cases, no separate infrastructure is needed, patient privacy is guaranteed and it is real-time interaction. In addition, can increase the involvement of more respondents and can be used easily by all groups, furthermore telenursing improved patient access to diabetes treatment, prevention, and education **(Thome, 2023).** These studies collectively highlight the potential of telenursing in improving diabetes care, particularly in areas such as foot care, patient education, and self-management.

So, the present results proved that telenursing strategy had a statistically significant positive effect on diabetic patients' foot self -care through online applications (research hypothesis).

Conclusion

Based on the present findings, it can be concluded that diabetic patients who received the telenursing applications via WhatsApp and YouTube videos achieved higher scores than before.

Moreover, both group and private chat WhatsApp can be an effective tool for patient education, professional collaboration, and healthcare delivery.

Limitations

Although this research was carefully prepared, some limitations were found as:

1- 10 patients did not complete the research although receiving the all-training program and excluded from the study.

2-Refusal of the patients to use the zoom as a telenursing method

- lack of trust
- Security concerns
- Compatibility and accessibility Issues
- Not familiarity with uploading, using of zoom features during meeting
- Difficulty of opening the zoom meeting in home because of the distractions and relatives
- The appointment was not suitable for all patients

Recommendations

In line with the findings of the study, the following recommendations are made:

- Continuous training and educational programs via online diabetic patients teaching designed to update their foot self-care knowledge and practice.
- Nurses should be trained in using telenursing platforms and technologies like video calls, messaging apps (e.g., WhatsApp), and remote monitoring tools.
- Nurses should adopt this new era of using telenursing in teaching their patients.
- Applying this research method on a larger sample size that involves participants and nurses from other regions in Egypt.

Author contributions

Amira Abd El Wahab Ibrahim, Demonstrator: She played a significant role in data collection, analysis, and interpretation. She wrote the draft and revised the dissertation and contributed to the methodology and statistical analysis.

Nesrine Ezzat Mohamed Abdel-Karim, Assistant Professor Emeritus: She contributed to the study design, data analysis, and interpretation. She assisted in editing and revising the dissertation. She supervised and provided expert guidance throughout the study.

Soheir Abo El Fadl, Lecturer Emeritus:

She offered critical revisions and expertise in results interpretation. She provided insights into the findings clinical application and assisted in the overall scientific dissertation.

Table I: Patients' Frequency Distribution according to Sociodemographic Data (n = 80)

Patient's socio-demographic data	No.	%
Gender		
• Male	34	42.50
• Female	46	57.50
Age (years)		
• 20 < 40	26	32.50
• 40< 60	54	67.50
Mean ± SD	42.35 ± 3.9	
Area of residence		
• Urban	66	82.50
• Rural	14	17.50
Level of education		
• No university	36	45.00
• University/ Post graduate	44	55.00
Occupation		
• Working	57	71.25
• Not working	23	28.75
Marital Status		
• Married	56	70.00
• Not married	24	30.00
Sufficient Income from the patient`s view		
• Enough	40	50.00
• Not enough	40	50.00

Table II: Patients' Frequency Distribution according to Clinical Data (n = 80)

Patient's clinical data	No.	%
Onset of diabetes		
• 1 > 5 years	23	28.70
• 5 > 15 years	30	37.50
• 15 - 20 years	27	33.80
Mean ± SD	6.50 ± 9.67	
Type of diabetes		
• DM Type I	19	23.80
• DM Type II	61	76.20
Chronic diseases		
• **No**	27	33.75
• **Yes***	53	66.25
o Heart Diseases	16	30.18
o Hypertension	33	62.26
o Kidney diseases	13	24.52
o Others	16	30.18
Medication for diabetes		
• Insulin	25	31.25
• Oral Hypoglycemic	43	53.75
• Both	12	15.00

If controlled, specify how*		
• Healthy, balanced diet	30	96.77
• Medical Follow up	17	54.83
• Exercises	3	9.67
• Compliance to medication	10	32.25
If Uncontrolled, specify the reason *		
• Stress and anxiety	40	81.63
• Unhealthy diet	34	69.39
• Careless	12	24.49
• Noncompliance to medication only	8	16.33
Diabetic Family history		
• **No**	22	27.5
• **Yes***	58	72.5
o Father or Mother	40	68.96
o Grand father or mother	4	6.89
o Siblings	22	37.93
family member suffered from		
• Diabetes I	3	5.17
• Diabetes II	55	94.82

Fig I (A,B,C): Distribution of Foot Self-Care Items in Initial Assessment, 1st and 2nd Evaluation.

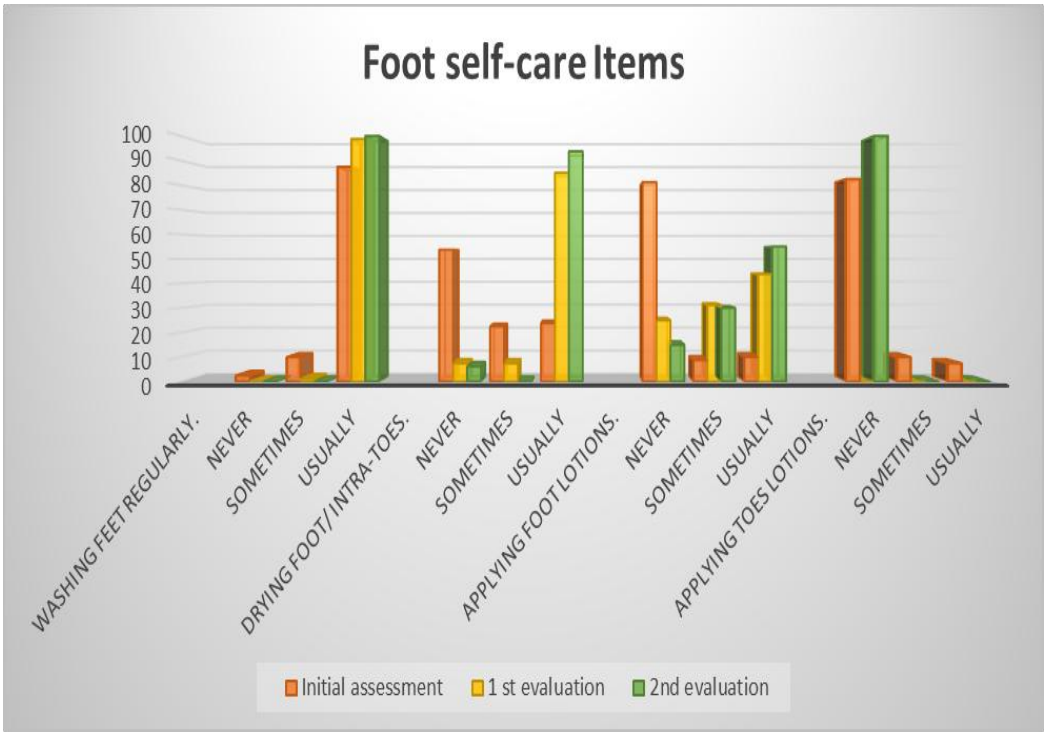


Fig 1 A

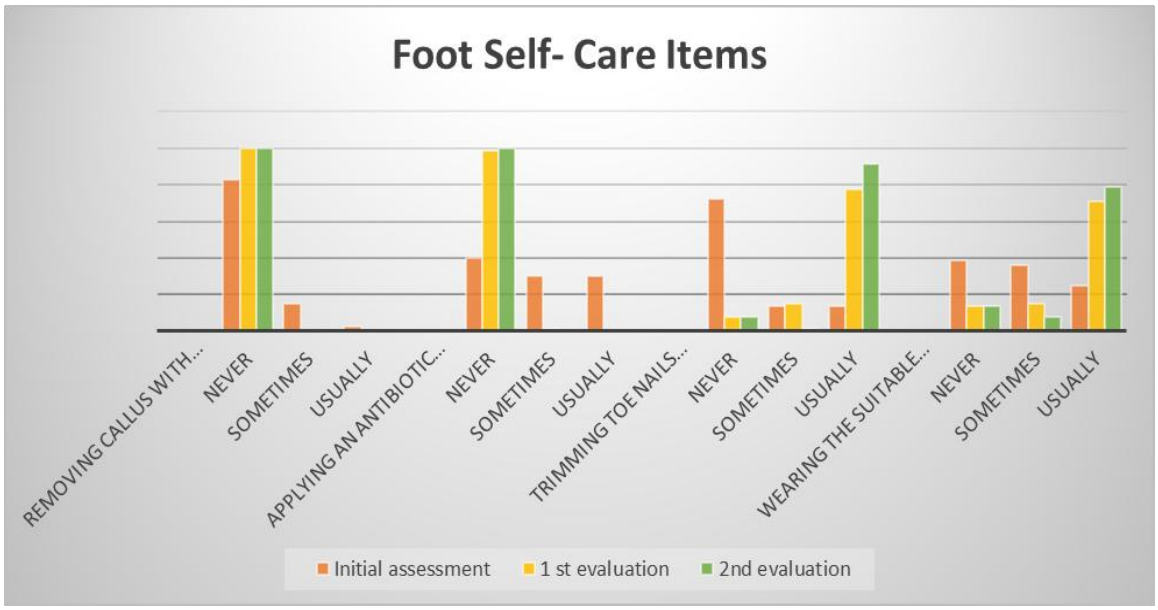

Foot Self- Care Items
REMOVING CALLUS WITH...
NEVER
SOMETIMES
USUALLY
APPLYING AN ANTIBIOTIC...
NEVER
SOMETIMES
USUALLY
TRIMMING TOE NAILS...
NEVER
SOMETIMES
USUALLY
WEARING THE SUITABLE...
NEVER
SOMETIMES
USUALLY
Initial assessment
1 st evaluation
2nd evaluation

Fig 1 B

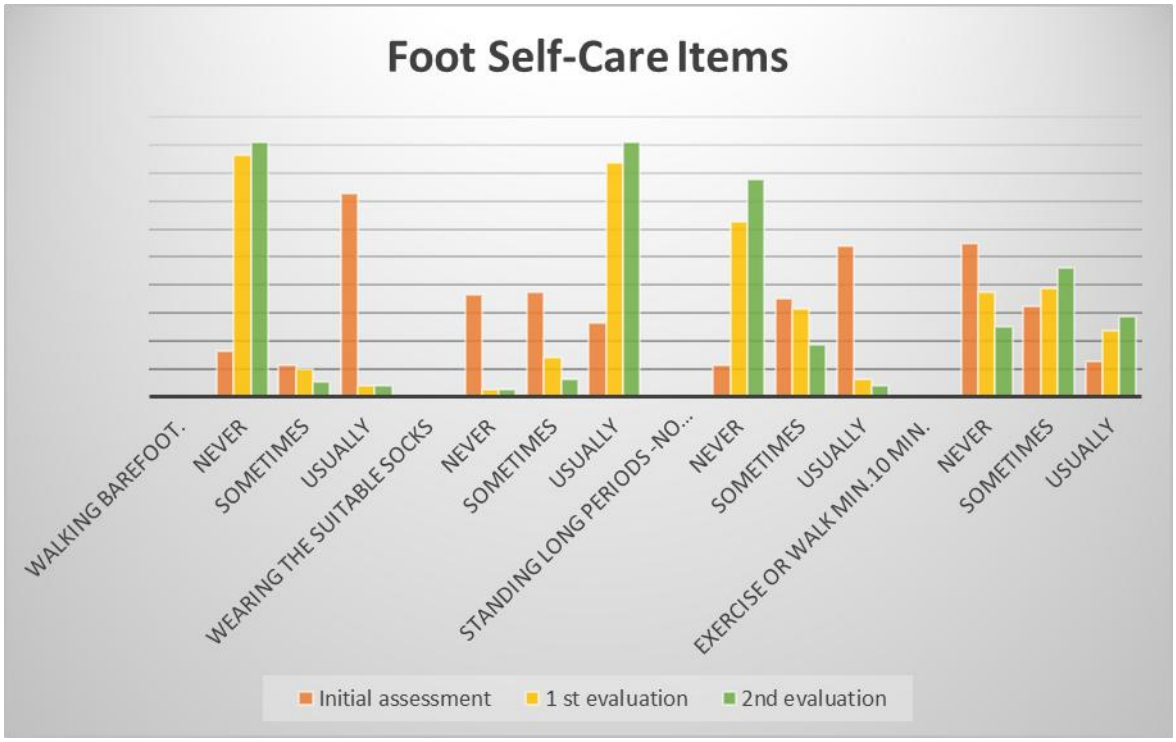
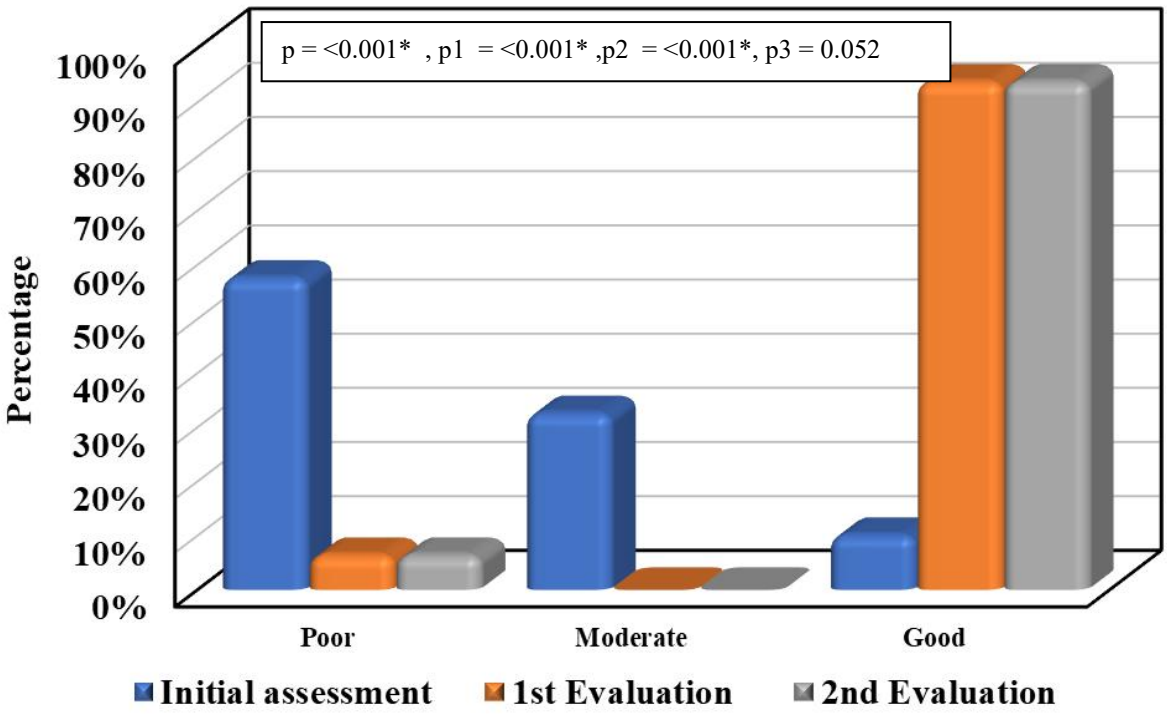

Foot Self-Care Items
WALKING BAREFOOT.
NEVER
SOMETIMES
USUALLY
WEARING THE SUITABLE SOCKS
NEVER
SOMETIMES
USUALLY
STANDING LONG PERIODS -NO...
NEVER
SOMETIMES
USUALLY
EXERCISE OR WALK MIN.10 MIN.
NEVER
SOMETIMES
USUALLY
Initial assessment
1 st evaluation
2nd evaluation

Fig 1 C

Fig II: Comparison between the Studied Patients Total Scores according to Initial Assessment, 1st, 2nd Evaluation of Foot Self-Care.



F: F test (ANOVA) with repeated measures **Fr: Friedman test**

p: p value for comparing between three periodsp_1: p value for comparing between Initial assessment and first Eva.

p_2: p value for comparing between Initial assessment and second Eva

.p_3: p value for comparing between first, second Eva.

*: Statistically significant at $p \leq 0.05$

Table III: Relation between the Patients' Responses to WhatsApp Group vs Privately and Socio-Demographic Data.

Responses of patients to WhatsApp	Privately(50)		Group (30)		χ^2	P
Patient's socio-demographic data	No	%	No	%		
Gender						
• Male	19	38.0	15	50.0	1.105	0.293
• Female	31	62.0	15	50.0		
Age (years)						
• 20 < 40	26	52.0	0	0.0	23.11*	<0.001*
• 40 ≤ 60	24	48.0	30	100.0		
Area of residence						
• Urban	46	92.0	20	66.6	8.335*	0.004*
• Rural	4	8.0	10	33.3		
Level of education						
• No university	24	48.0	12	40.0	0.485	0.486
• University/ Post graduate	26	52.0	18	60.0		
Occupation						
• Working	47	94.0	10	33.3	33.688*	<0.001*
• Not working	3	6.0	20	66.6		
Marital Status						
• Married	36	72.0	20	66.6	0.254	0.614
• Not married	14	28.0	10	33.3		
Income						
• Enough	20	40.0	20	66.6	5.333*	0.021*
• Not enough	30	60.0	10	33.3		
Living with the family						
• Yes	47	94.0	30	100.0	1.870	0.171
• No	3	6.0	0	0.0		

χ^2: **Chi square test**
*: Statistically significant at p ≤ 0.0

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