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The Effect of Web-Based Education Programs on Self-Efficacy and Self-Care Behavior in Quality of Life among Diabetic Type 2 Patients in Public Hospital

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ABSTRACT

Objective: This study aims to identify the effects of web-based educational programs on diabetic self-efficacy management (DSEM), diabetic self-care behavior management (DSCM) in quality of life (QoL) among type 2 diabetes patients in public hospitals. **Methods:** This study used a quantitative quasi-experimental design of pre-test and post-test. Diabetic-N-Care program was conducted at Orthopedic Clinic Hospital Sultanah Nur Zahirah Kuala Terengganu for 34 days, where purposive sampling involved type 2 diabetic patients who were divided into intervention groups (IG) (n = 60) and control group (CG) (n = 60). Respondents are the same individual for each phase of measurement. **Results:** Data analysis method the general linear model repeated measures ANOVA, Split-plot ANOVA (SPANOVA) and paired t-test was conducted on 120 patients to see the effect of using Diabetic-N-Care on IG. The results of Split - plot ANOVA analysis showed a significant overall effect of DSEM, DSCM and QoL ($p = 0.000$) on IG. Meanwhile, paired t-test analysis there was a significant mean difference in DSEM, DSCM and QoL at pre-test and post-test ($p = 0.000$) to IG compared to CG. **Conclusion:** Web-based health education can have an impact on DSEM, DSCM in the QoL of type 2 diabetic patients where greater than before confidence, change the old behavior to new behavior to improve quality of life in the long-term planning. Therefore, this study concludes that web-based methods such as Diabetic-N-Care need to be widely adapted in current health education methods.

Keywords: Web-Based; Diabetic Self-Efficacy Management; Diabetic Self-Care Behavior Management; Quality of Life

INTRODUCTION

The phenomenon of diabetes mellitus is a global challenge today and has reached an alarming level. Several factors have triggered the development of 90% of type 2 diabetes and caused metabolic disorders characterized by a variety of complications (Abdullah *et al.*, 2018; Hameed *et al.*, 2015). Based on statistics from the Second National Health and Morbidity Survey, more than 3.4 million Malaysians were diagnosed with diabetes in 2010, which is about 11.8% of the total population in Malaysia and a dramatic increase of 4.5 million in 2020 (dan Analisis, 2018). The study from Abdullah *et al.* (2018) and Zanariah *et al.* (2015) believes that apart from the existing factors, cultural practice factors influence this epidemic because of Malaysia's multi-racial harmony and harmony in terms of customs and culture itself, in addition to the influence of family genetics. Cultural food practices that are still practiced, the influence of western food, and food modifications to look more appetizing cause an increase in diabetic statistics compared to treatment interventions.

Self-efficacy is considered the most important and key predictor of self-care behavior among type 2 diabetic patients (Lee, Lee, & Chae, 2020; Dehghan *et al.*, 2017; Sarkar, Fisher, & Schillinger, 2006). The concept of quality of life (QoL) related to improved health is increasingly recognized as an important outcome of rehabilitation programs and also as an indicator of how diabetic patients can adapt after a treatment or after discharge from the hospital (Dhatariya, Corsino, & Umpierrez, 2020). Technology has proven to be a support tool as a medium to conduct key interventions to improve patient health levels and adherence to health-related information communicated by the health

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profession (Zuhaida *et al.*, 2021; Rasoul *et al.*, 2019; Muegge & Tobin, 2016). 21st century patients and healthcare professionals need new tools to manage the growing burden of chronic disease (Muegge & Tobin, 2016).

Self-efficacy is able to influence attitudes towards self-care behavior for diabetics, but how to convey this concept is still disrupted and needs transformation in intervention (Karimy, Koohestani, & Araban, 2018; Nguyen, Jiang, & Poo, 2015). Meanwhile, education interventions for diabetic patients are inconsistent in controlling glucose levels effectively (Jiang *et al.*, 2019; Nguyen, Jiang, & Poo, 2015). If seen, health education has traditionally had certain limitations and has caused disconnection between health education and patients. Nevertheless, the absence of long-distance health education guidelines for the treatment of post-discharge disconnection contributes to a poor prognosis. The previous concept of transformation is not enough in health education, where there is an increase in the rate of diabetic patients with severe complications. This situation clearly occurs during a natural disaster or COVID-19 pandemic that causes major changes in diabetic life and management. Diabetic patients tend to have various levels of negative emotions, such as depression and anxiety (Banerjee, Chakraborty, & Pal, 2020), and the effects of this pandemic make them burdened because they have to do diabetic self-management and the standard practice of COVID-19 precaution. This situation will affect their effort, suppression, emotion, venting, and wishful thinking in the midst of the COVID-19 pandemic. This can be clearly seen when clinics are closed for patient rehabilitation, patients are transferred and wards are made for COVID-19 patients, and patients start returning home at their own risk for fear of COVID-19 spreading in hospitals when treatment is still needed. This condition will worsen in just 7 days if there is no appropriate intervention to help these diabetic patients (Wargny *et al.*, 2021). As can be seen, the traditional educational interventions performed are not sufficient to obtain the desired results because there are no reforms in educational programs, such as using theory (Jiang *et al.*, 2019). Diabetic web-based education intervention is a way of self-management that is encouraged in the individual and, in turn, improves the level of quality of life for a long period of time. The web-based educational intervention program is an innovation that addresses educational problems face-to-face (Pal *et al.*, 2013).

This article will briefly highlight some of the key developments in the field of diabetic health education and how this technology can be integrated into this practice.

METHODOLOGY

Quantitative quasi-experimental method approach (pre-test and post-test) repeated-measures design with intervention and control group. Pre-tests for this study were used to determine whether there were similarities between groups and as a statistical control. Meanwhile, post-test to determine the difference between the intervention group and control group Both groups received routine diabetes treatment, and the intervention group was given health education interventions based on Kurt Lewin's (1947) model of change theory and self-efficacy theory by Albert Bandura (1977) applied in web technology-based diabetes education program interventions (Figure 1).

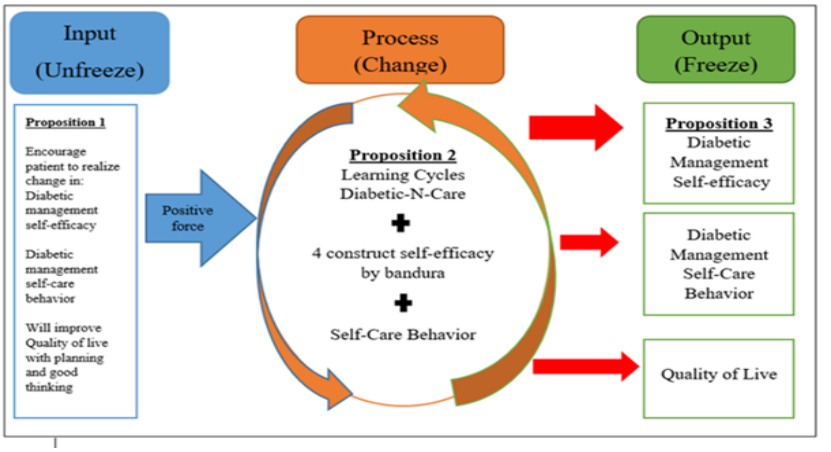

Figure 1: Conceptual Framework: Diabetic Web-Based Education Programs on Self-Efficacy and Self-Care Behavior in Quality of Life among Diabetic Type 2 Patients, Adapted from Nguyen, Jiang & Poo (2015)

Population and Sampling

The majority of patients were Malay, and non-probability purposive sampling techniques were used based on sample size using Raosoft's online sample calculator (Raosoft Incorporation, 2004). The population size that has been identified is 168, and the recommended sample size is 118 respondents. The sample size for this measure was rounded to 120 respondents for division into intervention (n = 60) and control groups (n = 60) in this study.

Research Instruments

This instrument was developed by a researcher based on previous studies (Sangruangake, Jirapornkul, & Hurst, 2017; Tharek *et al.,* 2018; John *et al.*, 2019). The questionnaire was translated into Bahasa Melayu through the back-to-back translation technique. The majority of questionnaires use the Likert scale from 1 to 5 (DSEM: Unsure to Extremely Confident; DSCM: Very Poor to Very Good; QoL: Strongly Disagree to Strongly Agree). The results showed a DSEM Cronbach's value α 0.83, DSCM Cronbach's value α 0.93 and a QoL Cronbach's value of 0.93. The next process is facing validity for relevance issues, comprehensiveness, and clarity (Lam *et al.*, 2018), where the researcher has determined 5 professional experts for the review of this study instrument, which consists of a research supervisor, orthopedic specialist doctors, a head nurse, and two nurses with diabetic post-basic courses.

Research Procedure

This study is divided into three phases to identify the effect of the use of web-based diabetic education among respondents. Diabetic-N-Care is a research tool used in educating patients related to diabetic knowledge through the web. Diabetic-N-Care was formed through the use of Google Sites. The three phases in this research were adapted from the three phases of Kurt Lewin's theory in addition to using the principles of Bandura's Social Cognitive Theory. Time 1 as a pre-test, Time 2 follow-up session after 14 days of the program, and Time 3 result as a post-test after 34 days of the program (Figure 2). For the selection of inclusion criteria, respondents aged between 20 and 59 years who were diagnosed with type 2 diabetes and had no vision or hearing problems for the exclusion criteria of respondents with a chronic diagnosis and unable to implement the program (e.g., multiple chronic diagnoses, e.g., spine and cancer), type 1 diabetes, and pregnant women. While the withdrawal criteria were that respondents could choose to withdraw at any time, the investigator considered it detrimental or risky for the subject to continue, and those who withdrew from the study before entering the follow-up phase would be replaced immediately and through the same process. If the respondent withdraws after the follow-up phase, it will not be replaced.

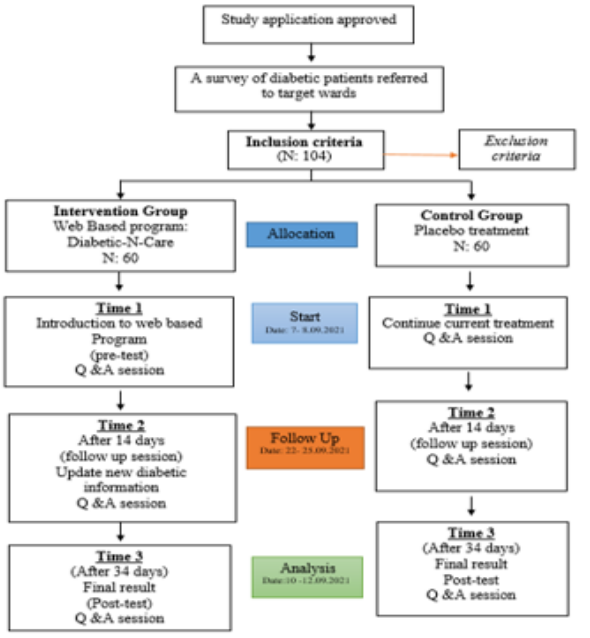

Figure 2: The Study Workflow

Data Collection Process

Step 1: Implement of Material Program

After the patient is examined by the doctor, the patient from the intervention group will answer the questionnaire first as a pre-test. After that, the researcher will explain the intervention process to the patient. Both groups will respond to the same questionnaire and routine interventions, for example, assessment, health education, and treatment by orthopedic doctors and clinic nurses.

Step 2: Education Program

The way to access this web is to simply scan the bar code provided as a button badge (Figure 3), and patients can see the information related to diabetics provided at any time for reference. After a 2-week intervention program, the intervention group will receive the latest information via the web related to daily diabetic management. The latest information is based on the lowest scores related to the daily management of diabetics, to increase patient understanding and confidence. Furthermore, IG will also receive orders via the WhatsApp application to log in and read new information updated by researchers.

Figure 3: QR code for Web-based Education Program

Step 3: Evaluation Program

After 34 days of the intervention program, this phase is a post-test to evaluate the effect of the program. The researcher met the patient during an appointment with the specialist to assess the patient's condition. Patients from the intervention group and the control group were asked to re-answer the same questionnaire. At the final stage of the program, program interventions will be performed on both groups.

Statistical Test

After the respondents completed the questionnaire according to the study phase, the data was then entered into the SPSS-version 25 software. The results were reported in statistical analysis formats such as descriptive statistics (frequency, mean, and standard deviation) and inferential statistics. The General Linear Model Repeated Measures ANOVA, Split-Plot ANOVA (SPANOVA), and Paired *t*-test were performed to see the effects and differences and make comparisons between two types of independent variables, one consisting of repeated data and interventions on each dependent variable separately in this study. On the other hand, Box's M and Levene's tests were p 0.05, and the Kolmogorov-Smirnov test performed showed values from all variables $p = 0.200$, which indicates that the SPANOVA test variance value equality condition has been met. The results of the study indicate that the Kolmogorov-Smirnov test is the best normality test because of its goodness of fit in measuring the fit between the distribution of a series of samples

with a specific frequency distribution (Justel, Pena, & Zamar, 1997). The data distribution has positive skewness (Skewness = 0.43, Kurtosis = 1.92). Data analysis was performed for each phase of the study to see the requirements and weaknesses of respondents through the new information to be uploaded in Diabetic-N-Care.

Ethical Consideration

The study was conducted according to guidelines and approved by the Medical Research Ethics Committee of the Ministry of Health Malaysia (MREC) on 9th September 2021 with reference number NMRR-21-1446-59624/KKM/NIHSEC/P21-1403.

RESULTS

Profile of the Sample

Table 1 shows the overall demographic data and Table 2 relates to the clinical characteristics' information of respondents for this study.

Table 1: Exploratory Analysis Data for Demographic Information of Respondents (N:120)

Variables	Category	Diabetic -N-Care Intervention Group (N:60)	N Missing	Mean S. D	Control Group (N: 60)	N Missing	Mean S. D
Age (years)	20-25 30-35 36-39 40-45 46-49 50-55 56-59	0 (0%) 8 (13.3%) 9 (15.0%) 11 (18.3%) 6 (10.0%) 6 (10.0%) 20 (33.3%)	0	5.883 1.8603	0 (0%) 3 (5.0%) 7 (11.7%) 12 (20.0%) 5 (8.3%) 12 (20.0%) 21 (35.0%)	0	6.317 1.6312
Gender	Male Female	37 (61.7%) 23 (38.3%)	0	1.383 0.4903	30 (50%) 30 (50%)	0	1.500 0.5042
Ethnic	Malay Chinese India Other	58 (96.0%) 3 (5.0%) 0 (0%) 0 (0%)	0	1.050 0.2198	57 (95%) 3 (5.0%) 0 (0%) 0 (0%)	0	1.050 0.2198
Education level	Primary Secondary Tertiary	22 (36.7%) 31 (51.7%) 7 (11.7%)	0	1.750 0.6542	29 (48.3%) 25 (41.7%) 6 (10.0%)	0	1.617 0.6662
Occupation status	Employed Unemployed	31 (51.7%) 29 (48.3)	0	1.483 0.5039	15 (25.0%) 45 (75.0%)	0	1.750 0.4367
Marital status	Single Married Widower Widow	1 (1.7%) 57 (95.0%) 2 (3.3%) 0 (0%)	0	2.050 0.3873	1 (1.7%) 57 (95.0%) 1 (1.7%) 1 (1.7%)	0	2.033 0.3171
	Total	**Sample N:**	**120**				

Table 2: Clinical Characteristics Information of Respondents (n:120)

Variables	Category	Frequency (*f*)	Percent (%)
Duration of diabetic (years)	0-4	24	20.0
	5-9	41	34.2
	10-14	40	33.3
	15 +	15	12.5
	Total	**120**	**100.0**
Co-morbidities	Hypertension	52	43.3
	Heart problem	23	19.2
	Renal problem	8	6.7
	Stroke	3	2.5
Diabetic treatment management	Diet control	30	25.0
	Oral medication	52	43.3
	Injection insulin	55	45.8
	Other: Traditional	3	2.5
Smoking status (Male only)	Smoking	28	41.7
	Never	35	52.2
	Ex-smoker	4	5.9
	Total	**67**	**100**
Received diabetic education before	Yes	65	54.2
	No	55	45.8
	Total	**120**	**100.0**

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As can be seen from Table 3, the data value for descriptive analysis between the intervention and control groups on dependent variables (DSEM, DSCM, and QoL) according to three phases, namely pre-test, follow-up, and post-test, for 34 days of this study. Where the data value for each variable showed an increase in the mean value for the pre-test intervention group (44.85 ± 9.92) to post-test (64.13 ± 3.65) for DSEM, DSCM showed pre-test (30.6 ± 6.47) to post-test (39.75 ± 3.43), and QoL showed pre-test (56.91 ± 7.76) to post-test (62.30 ± 2.95). While the mean value for the control group showed recorded data and almost no change. Comparisons between the intervention and control groups using the Paired t-test showed statistically significant differences in the mean scores of each variable for each phase of the study (Table 4).

Table 3 : Analysis Descriptive Statistics (N=120)

Variables	**Group**		**Mean / Std. deviation**		**N**
		Pretest	**Follow-up**	**Post test**	
Self-Efficacy	Intervention	44.85 9.92	50.40 7.46	64.13 3.65	60
	Control	51.18 4.33	50.85 5.08	50.31 5.05	60
	Total	48.01 8.26	50.62 6.36	57.22 8.20	120

Self-Care Behavior	Intervention	30.6 6.47	36.31 4.02	39.75 3.43	60
	Control	26.95 2.91	28.88 2.70	28.23 2.72	60
	Total	28.77 5.32	32.60 5.05	33.99 6.55	120
Quality of Life	Intervention	56.91 7.76	60.53 4.51	62.30 2.95	60
	Control	55.11 3.21	56.11 3.09	55.80 3.55	60
	Total	56.01 5.98	58.32 4.44	59.05 4.61	120

Table 4: Paired T-Test Analysis between Intervention Group and Control Group (N=120)

Variable	**Intervention Group (IG) (n=60)**				**Control Group (CG) (n=60)**			
	The mean total M±SD		**Diff. (Pre-Post) M±SD**	**Paired *t* test, *p***	**The mean total M±SD**		**Diff. (Pre-Post) M±SD**	**Paired *t* test, *p***
	Pre – test	**Post – test**			**Pre-test**	**Post-test**		
DSEM	44.8 (9.92)	64.1 (3.65)	-19.2 (8.45)	0.000	51.7 (5.19)	50.3 (5.05)	1.4 (6.07)	0.079
DSCM	30.6 (6.47)	39.7 (3.43)	-9.15 (4.70)	0.000	26.9 (2.91)	28.23 (2.72)	-1.28 (2.79)	0.001
QoL	56.3 (7.76)	62.3 (2.95)	-5.38 (6.06)	0.000	55.1 (3.21)	55.8 (3.55)	-0.68 (3.48)	0.134

Objective and research questions were answered using inferential statistics. The general linear model repeated measures ANOVA, split-plot ANOVA (SPANOVA), to examine significant differences in mean scores of dependent variables (DSEM, DSCM, and QoL) among type 2 diabetic patients between groups of intervention and control. Table 5 presents the SPANOVA results that include within-subject and between-subject effects (intervention and control groups).

Table 5: The Generalized Linear Model, Split-Plot ANOVA for The Effect of Web-Based Education Programs on Self-Efficacy and Self-Care Behavior in Quality of Life Among Diabetic Type 2 Patients

Variable		**Sum of squares**	**df**	**Mean square**	**f**	**Sig.**
DSEM	**Within-subject**					
	DSEM	5406.272	1.612	3353.954	167.176	0.000
	DSEM * group	6441.739	1.612	3996.339	199.195	0.000
	Error (DSEM)	3815.989	190.205	20.062		
	Between-Subject					
	Group	494.678	1	494.678	5.715	0.018
	Error	10214.611	118	86.565		

DSCM	**Within-Subject**					
	DSCM	1751.239	1.543	1135.241	181.793	0.000
	DSCM * group	928.717	1.543	602.041	96.408	0.000
	Error (DSCM)	1136.711	182.029	6.245		
	Between-Subject					
	Group	5107.600	1	5107.600	138.243	0.000
	Error	4359.689	118	36.947		
QoL	**Within-Subject**					
	QoL	602.206	1.372	439.019	41.146	0.000
	QoL * group	332.772	1.372	242.597	22.737	0.000
	Error (QoL)	1727.022	161.862	10.670		
	Between-Subject					
	Group	1617.136	1	1617.136	34.878	0.000
	Error	5471.061	118	46.365		

Overall, the results through inferential analysis showed significant differences, and alternative hypotheses were accepted. Researchers have confirmed that there are significant differences in web-based educational programs on self-efficacy and self-care behaviors in improving quality of life among type 2 diabetes patients in this study.

DISCUSSION

This study is an intervention in conveying diabetic daily treatment modification information and also as a moderator of confidence for action during limited movement of patients to seek counseling, such as in the last COVID-19 pandemic situation. This situation is necessary in identifying and revealing that the danger is if the patient only has the knowledge but not the element of confidence in performing management actions. The situation and variety of diabetic complications cause patients to become increasingly less confident and environmental situations to be less helpful. The results of this study are reinforced by the use of two theories: Kurt Lewin's change theory (1947) and Bandura's Four Sources of Self-Efficacy model (1977), which are elements of knowledge transfer and change for diabetic type 2 patients by allowing them to influence their choices and related behavior change to perform better, reduce stress levels, and have a lower risk of depression than those with low self-efficacy (Khademian, Ara, & Gholamzadeh, 2020; Hood *et al.*, 2015; Lee *et al.*, 2015).

The findings of this study have reported that web-based interventions through Diabetic-N-Care are significantly effective on DSEM, DSCM, and QoL changes among type 2 diabetic patients. The key to management is enhanced confidence, and this confidence needs to be applied to correct diabetics through interventions from professionals (Abedini *et al.*, 2020; Hurst, Rakkapao, & Hay, 2020; Beckerle & Lavin, 2013). DSEM is an indicator of a better quality of life (Rasoul *et al.*, 2019). This study is a learning approach known as 'mobile alert' to DSCM from IG after DSEM is enhanced. The findings of this study are a clear source of data because of the data collection process, the findings of the measured analysis, and the implementation of the program for 34 days during the MCO, where the face-to-face paralysis of the health education system is widespread. This is a picture of research in real-life situations using real-world data. Based on Kurt Lewin's change theory (1947) and Bandura's Four Sources of Self-Efficacy model (1977), a presentation can be implemented effectively and comprehensively, especially in providing new knowledge and practices such as food label reading, influence control, glucometer machine reading when exiting,

and more effective medication management. This learning cycle has also had an impact on improving quality of life by accepting health levels and trying to change to a more comfortable and productive lifestyle. While having an effect on QoL, self-efficacy interventions are able to influence behavior in improving quality of life through more effective chronic disease management by looking at health outcomes and making comparisons (Peters *et al.*, 2019; Sinha, Van den Heuvel, & Arokiasamy, 2011).

For this quantitative quasi-experimental study, it has been proven that the web-based Diabetic-N-Care diabetic education intervention has an effect on the variables of this study, namely DSEM, DCM, and QoL for type 2 diabetic patients of 60 people for IG. Figure 4 shows in one piece how the process of this study has been carried out and has shown the level of health that can be improved.

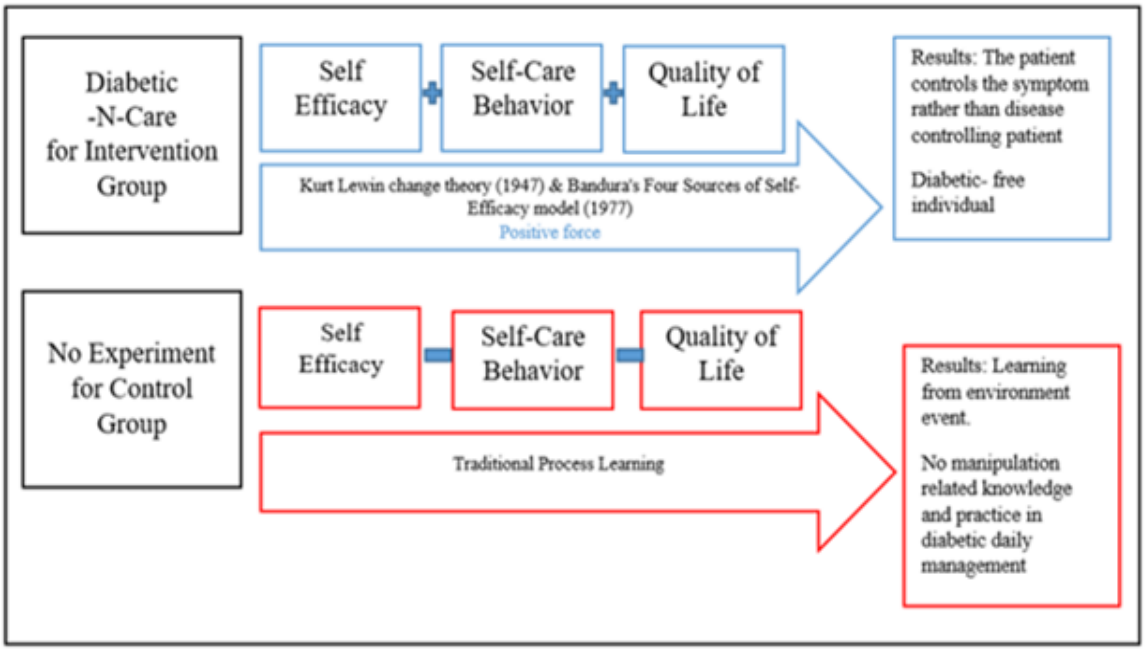

Figure 4: Overview of Diabetic-N-Care Intervention for DM Type 2 patients

However, researchers have detected some difficulties in changing the domain of physical activity and glucose management through glucose inspection before food intake and carrying a glucometer machine when going out. Once DSEM is enhanced, patients need to adapt to DSCM (Yee, Salmiah, & Rosliza, 2018). This cycle is important because it affects 50% of diabetic complications from unbalanced practices (Karimy, Koohestani, & Araban, 2018; Yee, Salmiah, & Rosliza, 2018). The results of subscale analysis of the physical activity domain still require an increase in the diversity of interventions (Hailu, Moen, & Hjortdahl, 2019), and unbalanced dietary pattern intake is still consistent with a significant increase in diabetic cases (Banerjee, Chakraborty, & Pal, 2020; Kuan *et al.*, 2021). In addition, researchers have detected a financial factor in failure, continuing treatment, and self-management among diabetic patients. This is in line with the findings of the studies of Raghavendran, Inbaraj, and Norman (2020), Cefalu *et al.* (2018), and Campbell *et al.* (2017), where this issue is increasingly worrisome for each consecutive year.

Implication

Through the development of industry 4.0 technology and widespread acceptance among the community, a privilege has been granted in the development of health education strategies. This study has given a new breath to web-based health education among type 2 diabetic patients at HSNZ Kuala Terengganu. The disconnection and treatment process when the patient is discharged from the ward is a matter that needs to be taken into consideration because the period of follow-up treatment at the health clinic takes a long time. This web-based tool is a medium for patients to enhance and reflect on each health education delivered in the ward when environmental and personal factors are not helpful.

Continuing health education can have a positive impact, and diversifying intervention strategies from the health profession itself can form a more complete treatment cycle. Through web-based education, Diabetic-N-Care has given patients the privilege of browsing information resources related to daily diabetic management and facilitated health educators such as nurses who always think about what patients will do after discharge from the ward. This situation has provided a privilege and facility to reduce the burden on various parties.

Limitation of the Study

This study was only conducted at the orthopedic clinic, HSNZ Kuala Terengganu, which only involved one hospital and clinic. This is because type 2 diabetic patients can be placed in any ward, such as the general surgical ward or the diabetic resource center, as outpatients. The limited population and sample during the data collection process of this study reflect the compliance with the SOP to COVID-19 at that time by the hospital and the head of department.

Recommendation

Findings from the study can be suggested by involving the psychological management of status among type 2 diabetic patients, especially among newly diagnosed patients. As can be seen, newly diagnosed patients are somewhat marginalized, perhaps because they have only one diagnosis or because the progress of their treatment is still stable. Acceptance of disease diagnosis at a young age and career can disrupt the level of psychology that disrupts individual function in the community.

CONCLUSION

Throughout this study, there were no side effects experienced by the patient, such as malpractice or death. Statistically significant effects have shown better improvement when compared to traditional learning methods such as face-to-face, oral methods, and current experience. The results of this study have given a new breath to educational and learning interventions related to the management of daily diabetics and diabetic patients, where greater than before, change the old behavior to new behavior to improve quality of life in the long term. Therefore, this study concludes that web-based methods such as Diabetic-N-Care need to be widely adapted into current health education methods.

Conflict of Interest

The authors declare that they have no conflict of interests.

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REFERENCES

Abdullah, N., Abdul Murad, N. A., Attia, J., Oldmeadow, C., Kamaruddin, M. A., Abd Jalal, N., ... & Holliday, E. G. (2018). Differing contributions of classical risk factors to type 2 diabetes in multi-ethnic Malaysian populations. *International Journal of Environmental Research and Public Health, 15*(12), 2813. https://doi.org/10.3390/ijerph15122813

Abedini, M. R., Bijari, B., Miri, Z., Emampour, F. S., & Abbasi, A. (2020). The quality of life of the patients with diabetes type 2 using EQ-5D-5 L in Birjand. *Health and Quality of Life Outcomes, 18*(1), 18. https://doi.org/10.1186/s12955-020-1277-8

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. https://psycnet.apa.org/doi/10.1037/0033-295X.84.2.191

Banerjee, M., Chakraborty, S., & Pal, R. (2020). Diabetes self-management amid COVID-19 pandemic. *Diabetes & Metabolic Syndrome, 14*(4), 351–354. https://doi.org/10.1016/j.dsx.2020.04.013

Beckerle, C. M., & Lavin, M. A. (2013). Association of self-efficacy and self-care with glycemic control in diabetes. *Diabetes Spectrum, 26*(3), 172-178. https://doi.org/10.2337/diaspect.26.3.172

Campbell, D. J., Manns, B. J., Hemmelgarn, B. R., Sanmartin, C., Edwards, A., & King-Shier, K. (2017). Understanding financial barriers to care in patients with diabetes: an exploratory qualitative study. *The Diabetes Educator, 43*(1), 78-86. https://doi.org/10.1177/0145721716679276

Cefalu, W. T., Dawes, D. E., Gavlak, G., Goldman, D., Herman, W. H., Van Nuys, K., ... & Yatvin, A. L. (2018). Insulin access and affordability working group: conclusions and recommendations. *Diabetes Care, 41*(6), 1299-1311. https://doi.org/10.2337/dci18-0019

dan Analisis, J. P. K. (2018). Awareness of Diabetes Mellitus Among Public Attending the Primary Health Centres in Malaysia. *Journal of Quality Measurement and Analysis JQMA, 14*(2), 11-23. https://www.ukm.my/jqma/v14_2/jqma-14-2-paper2.pdf

Dehghan, H., Charkazi, A., Kouchaki, G. M., Zadeh, B. P., Dehghan, B. A., Matlabi, M., ... & Mehr, B. R. (2017). General self-efficacy and diabetes management self-efficacy of diabetic patients referred to diabetes clinic of Aq Qala, North of Iran. *Journal of Diabetes & Metabolic Disorders, 16*, 1-5. https://doi.org/10.1186/s40200-016-0285-z

Dhatariya, K., Corsino, L., & Umpierrez, G. E. (2020). *Management of Diabetes and Hyperglycemia in Hospitalized Patients. Endotext [Internet]*. http://www.diabetesed.net/wp-content/uploads/2015/06/Management-of-Diabetes-and-Hyperglycemia-in-Hospitalized-Patients-Endotext-NCBI-Bookshelf.pdf

Hailu, F. B., Moen, A., & Hjortdahl, P. (2019). Diabetes self-management education (DSME)–Effect on knowledge, self-care behavior, and self-efficacy among type 2 diabetes patients in Ethiopia: A controlled clinical trial. Diabetes, Metabolic Syndrome and Obesity: *Targets and Therapy*, 2489-2499. http://doi.org/10.2147/DMSO.S223123

Hameed, I., Masoodi, S. R., Mir, S. A., Nabi, M., Ghazanfar, K., & Ganai, B. A. (2015). Type 2 diabetes mellitus: From a metabolic disorder to an inflammatory condition. *World Journal of Diabetes, 6*(4), 598–612. https://doi.org/10.4239/wjd.v6.i4.598

Hood, K. K., Hilliard, M., Piatt, G., & Ievers-Landis, C. E. (2015). Effective strategies for encouraging behavior change in people with diabetes. *Diabetes Management (London, England), 5*(6), 499–510. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6086609/

Hurst, C. P., Rakkapao, N., & Hay, K. (2020). Impact of diabetes self-management, diabetes management self-efficacy and diabetes knowledge on glycemic control in people with Type 2 Diabetes (T2D): A multi-center study in Thailand. *PLoS One, 15*(12), e0244692. https://doi.org/10.1371/journal.pone.0244692

Jiang, X., Wang, J., Lu, Y., Jiang, H., & Li, M. (2019). Self-efficacy-focused education in persons with diabetes: a systematic review and meta-analysis. *Psychology Research and Behavior Management, 12*, 67. https://www.tandfonline.com/doi/full/10.2147/PRBM.S192571

John, R., Pise, S., Chaudhari, L., & Deshpande, P. R. (2019). Evaluation of Quality of Life in Type 2 Diabetes Mellitus Patients Using Quality of Life Instrument for Indian Diabetic Patients: A Cross-Sectional Study. *Journal of Mid-Life Health, 10*(2), 81–88. https://doi.org/10.4103/jmh.JMH_32_18

Justel, A., Peña, D., & Zamar, R. (1997). A multivariate Kolmogorov-Smirnov test of goodness of fit. *Statistics & Probability Letters, 35*(3), 251-259. https://doi.org/10.1016/S0167-7152(97)00020-5

Karimy, M., Koohestani, H. R., & Araban, M. (2018). The association between attitude, self-efficacy, and social support and adherence to diabetes self-care behavior. *Diabetology & Metabolic Syndrome, 10*(1), 1-6.

https://doi.org/10.1186/s13098-018-0386-6

Khademian, Z., Ara, F. K., & Gholamzadeh, S. (2020). The effect of self care education based on Orem's nursing theory on quality of life and self-efficacy in patients with hypertension: a quasi-experimental study. *International Journal of Community Based Nursing and Midwifery, 8*(2), 140-149. https://doi.org/10.30476%2FIJCBNM.2020.81690.0

Kuan, Y. C., Tong, C. V., Katiman, E., Tiong, X. T., Chan, P. L., Tan, F., & Noor, N. M. (2021). Effects of Movement Control Order (MCO) During Covid-19 Pandemic on Patients with Diabetes Mellitus (DM) in Malaysian Tertiary Centers. *Journal of the Endocrine Society, 5*(Supplement_1), A339-A340. https://doi.org/10.1210/jendso/bvab048.691

Lam, K. W., Hassan, A., Sulaiman, T., & Kamarudin, N. (2018). Evaluating the face and content validity of an instructional technology competency instrument for university lecturers in Malaysia. *International Journal of Academic Research in Business and Social Sciences, 8*(5), 367-385. http://dx.doi.org/10.6007/IJARBSS/v8-i5/4108

Lee, I., & Lee, K. (2015). The Internet of Things (IoT): Applications, investments, and challenges for enterprises. *Business Horizons, 58*(4), 431-440. https://doi.org/10.1016/j.bushor.2015.03.008

Lee, J., Lee, E. H., & Chae, D. (2020). Self-efficacy instruments for type 2 diabetes self-care: A systematic review of measurement properties. *Journal of Advanced Nursing, 76*(8), 2046-2059. https://doi.org/10.1111/jan.14411

Lewin, K. (1947). Frontiers in group dynamics: Concept, method and reality in social science; social equilibria and social change. *Human Relations, 1*(1), 5-41. https://doi.org/10.1177/001872674700100103

Muegge, B. D., & Tobin, G. S. (2016). Improving Diabetes Care with Technology and Information Management. *Missouri Medicine, 113*(5), 367–371.

Nguyen, H. D., Jiang, X., & Poo, D. C. C. (2015). Designing a social mobile platform for diabetes self-management: a theory-driven perspective. In Social Computing and Social Media: 7th International Conference, SCSM 2015, Held as Part of HCI International 2015, Los Angeles, CA, USA, August 2–7, 2015, *Proceedings 7* (pp. 67-77). Springer International Publishing. https://doi.org/10.1007/978-3-319-20367-6_8

Pal, S., Mukherjee, S., Choudhury, P., Nandi, S., & Debnath, N. C. (2013, February). M-learning in university campus scenario-Design and implementation issues. In 2013 IEEE International Conference on Industrial Technology (ICIT) (pp. 1851-1856). IEEE. https://doi.org/10.1109/ICIT.2013.6505958

Peters, M., Potter, C. M., Kelly, L., & Fitzpatrick, R. (2019). Self-efficacy and health-related quality of life: a cross-sectional study of primary care patients with multi-morbidity. *Health and Quality of Life Outcomes, 17*(1), 1-11. https://doi.org/10.1186/s12955-019-1103-3

Raghavendran, S., Inbaraj, L. R., & Norman, G. (2020). Reason for refusal of insulin therapy among type 2 diabetes mellitus patients in primary care clinic in Bangalore. *Journal of family Medicine and Primary Care, 9*(2), 854–858. https://doi.org/10.4103/jfmpc.jfmpc_973_19

Raosoft Incorporation (2004). *Raosoft Sample Size Online Calculator. (Internet) c2004*. http://www.raosoft.com/samplesize.html

Rasoul, A. M., Jalali, R., Abdi, A., Salari, N., Rahimi, M., & Mohammadi, M. (2019). The effect of self-management education through weblogs on the quality of life of diabetic patients. *BMC Medical Informatics and Decision Making, 19*(1), 1-12. https://doi.org/10.1186/s12911-019-0941-6

Sangruangake, M., Jirapornkul, C., & Hurst, C. (2017). Psychometric properties of diabetes management self-efficacy in Thai type 2 diabetes mellitus patients: a multicenter study. *International Journal of Endocrinology, 2017*. https://doi.org/10.1155/2017/2503156

Sarkar, U., Fisher, L., & Schillinger, D. (2006). Is self-efficacy associated with diabetes self-management across

race/ethnicity and health literacy? *Diabetes Care, 29*(4), 823-829. https://doi.org/10.2337/diacare.29.04.06.dc05-1615

Sinha, R., Van den heuvel, W. J., & Arokiasamy, P. (2011). Factors affecting quality of life in lower limb amputees. *Prosthetics and Orthotics International, 35*(1), 90-96. https://doi.org/10.1177/0309364610397087

Tharek, Z., Ramli, A. S., Whitford, D. L., Ismail, Z., Mohd Zulkifli, M., Ahmad Sharoni, S. K., ... & Jayaraman, T. (2018). Relationship between self-efficacy, self-care behaviour and glycaemic control among patients with type 2 diabetes mellitus in the Malaysian primary care setting. *BMC Family Practice, 19*(1), 1-10. https://doi.org/10.1186/s12875-018-0725-6

Wargny, M., Potier, L., Gourdy, P., Pichelin, M., Amadou, C., Benhamou, P. Y., ... & CORONADO investigators. (2021). Predictors of hospital discharge and mortality in patients with diabetes and COVID-19: updated results from the nationwide CORONADO study. *Diabetologia, 64*, 778-794. https://doi.org/10.1007/s00125-020-05351-w

Yee, K. C., Salmiah Md Said, & Rosliza Abdul Manaf. (2018). Identifying self-care behaviour and its predictors among type 2 diabetes mellitus patients at a district of Northern Peninsular Malaysia. *Malaysian Journal of Medicine and Health Sciences, 14*(2), 17-29.

Zanariah Hussein, Taher, S. W., Singh, H. K. G., & Swee, W. C. S. (2015). Diabetes care in Malaysia: problems, new models, and solutions. *Annals of Global Health, 81*(6), 851-862. https://doi.org/10.1016/j.aogh.2015.12.016

Zuhaida, H. S., Chung, H. C., Said, F. M., Tumingan, K., Shah, N. S., Hanim, S., & Bakar, A. (2021). The Best Online Tools Based on Media Preference Reflected by Health Information Received on social media amongst Diabetic Patients in Hospital Canselor Tuanku Muhriz, Kuala Lumpur, Malaysia. *The Malaysian Journal of Medical Sciences: MJMS, 28*(3), 118-128. https://doi.org/10.21315/mjms2021.28.3.11