ORIGINAL ARTICLE

Impact of Healthy Lifestyle Education among Patients with Diabetes Mellitus in a Primary Care Clinic

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ABSTRACT

Introduction: Four out of five diabetic Malaysians were unable to achieve good glycaemic targets. Insufficient health literacy among patients with diabetes is associated with worse glycaemic control. Thus this research is aimed to determine the impact of the Healthy Lifestyle Education (HLE) course to the diabetic control. **Methods:** This is a comparative cross-sectional study. Medical records of patients with diabetes who either attended or not attended HLE course at Simpang Health Clinic from April 2018 to September 2018 were reviewed and study data extracted. Wilcoxon signed-ranks test, Pearson chi-square test, Fisher's exact test and Binary logistic regression were employed. **Results:** A total of 220 medical records including 106 HLE attendees and 114 non-attendees were recruited. Mean ages of attendees and non-attendees were 57.5±11.9 years and 60.8±9.9 years respectively. The attendees achieved reduction in glycosylated haemoglobin (HbA1c), fasting blood sugar (FBS) and total cholesterol after HLE course ($p<0.05$). Those non-attendees had significant weight lost but increment in systolic blood pressure, HbA1c, LDL and insulin's total daily dose ($p<0.05$). Reduction in Fasting Blood Sugar (FBS) among the HLE Attendees was independently associated with HbA1c reduction [$p=0.015$, odds ratio (95% CI) = 3.83 (1.30-11.27)]. **Conclusion:** Our work suggests that HLE has improved glycaemic and lipid control among patients with diabetes. Hence it should be executed at the primary care settings.

Keywords: Diabetes mellitus, Healthy lifestyle education, Primary care clinic

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INTRODUCTION

The National Health and Morbidity Survey (NHMS) 2019 reported that one in five adults above the age of 18 years in Malaysia have diabetes mellitus (DM) (1). According to National Diabetes Registry 2009-2012, only 23.8% of patients with diabetes in primary care were able to achieve good glycaemic targets (2). In primary care settings, integrating diabetes education provides shared-decision making in diabetic management between patients and healthcare providers, increases patient satisfaction, improves doctors' diabetes skills and knowledge and reduces referrals to secondary care (3).

A study done by Świątoniowska et al (4) reviewed that diabetes education is prerequisite for good diabetes control, other than diet, exercise, oral hypoglycaemic agents and insulin treatment. The goals that diabetes education should accomplish include not only providing knowledge and awareness of cardiovascular risk factors, but also to increase their compliance to therapeutic recommendations, empowering them for self-care, establishing a partnership with healthcare providers via shared decision making for the treatment process (4).

A meta-analysis found that interactive group education was effective in improving knowledge, fasting blood sugar (FBS), glycosylated haemoglobin (HbA1c), blood pressure and medications compliance in diabetic patients (5). A systematic review by Norris et al. (6) revealed the teaching of healthy lifestyles and the glycaemic control were equally effective in both individual and group education. However, more time and man-power are required to run a one-to-one education. Group diabetes education is more cost-effective in the delivery of diabetes education programs (7). Group education also provides a platform for the sharing of experiences and increasing motivation for self-care among the patients (4).

The knowledge level of diabetes among Malaysian population either from remote or urban settlement in Peninsular Malaysia was poor (8). A local study revealed that many of the patients had poor knowledge on the diabetic complications, food proportion and exercise

regime (9). Insufficient health literacy among patients with diabetes is independently associated with worse glycaemic control and higher morbidity and mortality as a result of its complications (10). In year 2017, quality assurance DM clinical audit at Simpang Health Clinic indicated that only 18% of patients with diabetes achieved HbA1c less than 6.5%. Shortfall in quality investigation (SIQ) 2017 revealed that only minority of the patients with diabetes at Simpang Health Clinic achieved good knowledge in DM. Therefore, we run the "Healthy Lifestyle Education" (HLE) course at our clinic for our patients with diabetes since year 2018 to improve the diabetic control. Our aim of this study was to determine the impact of the HLE course to the glycaemic and other metabolic control. Secondary objective was to evaluate the associated factors of HbA1c reduction post-HLE attendance.

MATERIALS AND METHODS

Study Design & Setting

This is a comparative cross-sectional study to assess the changes in biomedical measures between the attendees and non-attendees of the "Healthy Lifestyle Education" (HLE) course at Simpang Health Clinic in the district of Larut, Matang and Selama, Taiping Perak from April 2018 to September 2018. Attendees were defined as those patients with diabetic who attended the HLE course. Non-attendees were those patients with diabetic who were invited but unable to attend the HLE course.

Healthy Lifestyle Education (HLE) is a structured group educational 3-hour course from 2pm to 5pm within the same day that delivered at Simpang Health Clinic since April 2018 monthly. The HLE course was designed by the diabetic team led by the family medicine specialist at Simpang Health Clinic based on the SIQ knowledge components for patients with diabetes. The course is conducted by six different healthcare providers (doctor, pharmacist, medical assistant, nutritionist, occupational therapist and physiotherapist); with 30-minute allocation for each topic. Doctor gives lecture on the understanding of diabetes mellitus and hypertension, including the pathophysiology, complications, control of the diseases. Pharmacist explains the pharmacological therapy of DM, including correct timing of medications intake and possible adverse effects. Medical assistant explains about screening of diabetic retinopathy via fundus-camera. Nutritionist teaches on healthy diet including carbohydrate exchange, low salt, low fat and high fiber diet. Occupational therapist demonstrates proper foot care to prevent diabetic foot ulcer. Physiotherapist conducts exercise for patients with diabetes. The materials used are PowerPoint slide presentations, demonstration of healthy quantity of salt and sugar intake per day, pamphlets on DM, hypertension and obesity. All patients with diabetes are invited to only attend HLE once out of the monthly similar HLE courses in addition to the usual medical care at the discretion of their primary care doctors.

Study population

Total patients with diabetes at our clinic were 1000 in year 2018. The sample size was calculated based on the systematic review that demonstrated 14.2% patients with type 2 DM in primary care had adequate health literacy skills (11). Using the Epi info version 3 with a probability (power) 0.8 and drop-out rate of 20%, the estimated minimum sample needed was 190. The inclusion criterion for HLE invitation included patients aged 18 years and above diagnosed with type 2 DM and following up for at least six months in the primary care clinic were invited to attend HLE course from April 2018 to September 2018 (12). The exclusion criteria included intellectual disability, mental health problems, cognitive impairment or activities of daily living dependence (13). We employed convenient sampling to invite 200 patients with diabetes to attend the HLE course during the 6-month period. There were 135 attendees of the HLE course; making the response rate 67.5%. We had recruited 106 attendees and 114 non-attendees who had HbA1c at baseline and four to six months post HLE done. Finally, total 220 samples were analyzed.

Data Collection

The data was retrieved from the medical records retrospectively and then recorded in the data collection forms. The data collection form consists of demographic data, medications and biomedical measures such as weight, height, blood pressure, fasting blood sugar (FBS), glycosylated haemoglobin (HbA1c), and lipid profile. The gaps between pre and post data collection with the date of the attending program (for attended group) or date of the invitation for the program (for not attended group) was ranged from four to six months because HbA1c takes about three months to have changes.

Data Analysis

Statistical Package for the Social Sciences (SPSS) Version 25 was used for statistical analysis. The significant value for the biomedical measures; weight, blood pressure, HbA1c, fasting blood sugar (FBS), total cholesterol, triglyceride (TG), low-density liproprotein (LDL) and total daily dose of insulin under Kolmogorov-smirnov test were less than 0.05, indicated that the variables were not normally distributed. Thus, Wilcoxon signed-ranks test, non-parametric test was used to compare differences of the biomedical measures between pre and post-HLE intervention for among patients who attended or who were unable to attend HLE course (14). Pearson chi-square test was employed to determine the associated factors of HbA1c reduction. Fisher's exact test was used instead of Pearson chi-square test when the expected frequency of less than five is more than 20% of the cells. All variables with a p value < 0.25 in the univariate analysis, were entered into the Binary logistic regression to determine the independent factors of HbA1c reduction among the HLE attendance (15).

Statistical significance was set at $p \leq 0.05$ (16).

Ethical Approval

This study was registered under National Medical Research Registry (NMRR-19-1131-48355), and was conducted after approved by the Medical Research and Ethic Committee (MREC) of Ministry of Health (MOH) Malaysia and District Health Office of Larut, Matang and Selama, Taiping Perak.

RESULTS

A total of 220 medical records of patients with diabetes were included for review and data extraction. Among all, 106 (48.2%) had attended "Healthy Lifestyle Education" (HLE) course, while 114 (51.8%) were non-attendees. Mean ages of attendees and non-attendees were 57.5±11.9 years and 60.8±9.9 years respectively. More than 50% of the participants were female and Malay in both groups. Those attendees had DM diagnosed for about 5.4 years, while the non-attendees had DM for about 7.1 years. More than 85% had hypertension and dyslipidaemia among all subjects. Chronic kidney disease sufferers were more among the non-attendees (11.4%). Only 1.9% of attendees had ischaemic heart disease and 0.9% of non-attendees had stroke (Table I).

Table I: Socio-demography of Diabetic Patients (N=220)

Domains	Attendees (n=106)	Non-attendees (n=114)
Age in years (mean±SD)	57.5±11.9	60.8±9.9
Gender		
Male	43 (40.6)	50 (43.9)
Female	63 (59.4)	64 (56.1)
Ethnic		
Malay	62 (58.5)	58 (50.9)
Chinese	18 (17.0)	24 (21.1)
Indian	26 (24.5)	32 (28.0)
Years of DM (mean±SD)	5.4±4.2	7.1±5.4
Comorbids		
Hypertension	92 (86.8)	103 (90.4)
Dyslipidaemia	99 (93.4)	105 (92.1)
CKD	5 (4.7)	13 (11.4)
IHD	2 (1.9)	0 (0)
Stroke	0 (0)	1 (0.9)
Medications Use		
Metformin	95 (89.6)	99 (86.8)
Gliclazide	47 (44.3)	64 (56.1)
Acarbose	1 (0.9)	4 (3.5)
Intermediate-acting Insulin	34 (32.1)	28 (24.6)
Rapid-acting Insulin	29 (27.4)	15 (13.2)
Premixed Human Insulin	8 (7.5)	8 (7.0)
Long-acting Analogue Insulin	1 (0.9)	1 (0.9)
Calcium Channel Blocker	59 (55.7)	66 (57.9)
ACEi / ARB	68 (64.2)	82 (71.9)
Diuretic	23 (21.7)	30 (26.3)
Beta-blocker	23 (21.7)	26 (22.8)
Aldosterone Antagonist	2 (1.9)	0 (0)
Alpha-blocker	1 (0.9)	2 (1.8)
Statin	95 (89.6)	99 (86.8)
Aspirin	7 (6.6)	8 (7.0)

SD: Standard Deviation DM: Diabetes Mellitus CKD: Chronic Kidney Disease
IHD: Ischaemic Heart Disease ACEi: Angiotensin-converting Enzyme Inhibitor
ARB: Angiotensin Receptor Blocker

The usage of anti-hypertensive agents, oral hypoglycaemic agents (OHA), aspirin and statin between these two groups were almost similarly distributed. The commonest prescribed OHA was Metformin (86.8-89.6%), followed by Gliclazide (44.3-56.1%). Among insulin injections, the highest use was intermediate-acting (24.6-32.1%), followed by short-acting (13.2-27.4%), premixed human (7.0-7.5%) and long-acting analogue (0.9%). For the anti-hypertensive agents, the commonest prescribed was angiotensine-converting enzyme inhibitor (ACEi) or angiotensine receptor blocker (ARB) (64.2-71.9%), followed by calcium channel blocker (CCB) (55.7-57.9%), diuretic (21.7-26.3%) and beta-blocker (21.7-22.8%) (Table I).

The median of total daily insulin dose was two times higher among the attendees (55units) compared to non-attendees (28units). Prior to the program invitation or attendance, the attendees had higher median in systolic blood pressure (SBP) (134mmHg) and LDL (2.71mmol/L) than those non-attendees. However after attended the program, they achieved lower median in SBP (134.5mmHg) and LDL (2.6mmol/L) compared to those non-attendees. After the HLE course, the attendees achieved significant improvement in the median of HbA1c from 8.60% to 8.55% (p=0.007) and FBS from 8.1mmol/L to 7.4mmol/L (p=0.003). Besides, there was significant reduction in total cholesterol among the attendees from 4.9mmol/L to 4.5mmol/L (p<0.001) (Table II).

Among the non-attendees, they had median HbA1c worsening from 7.6% to 7.9% (p<0.001). The median of insulin's total daily dose was increased from 28 units to 38 units (p<0.001). There is also increment in median SBP from 132mmHg to 138.5mmHg (p=0001). The median LDL level worsened from 2.7mmol/L to 3.0mmol/L (p=0.015). There was significant reduction in weight from 69.8kg to 68kg (p<0.001) (Table II).

After the HLE attendance, 61 (57.5%) patients with diabetes had HbA1c reduction. Thirty-nine (69.6%) of those attendees with FBS reduction had achieved improvement in HbA1c (p=0.008). Fifteen (93.8%) of those with increased Metformin dose achieved HbA1c reduction (p=0.002). However, the HbA1c improvement was not associated with the increased dose of insulin or sulphonylurea, age group, gender, ethnic, years of diagnosed with diabetes, blood pressure and lipid reduction (Table III).

Following adjustment for the other confounding factors, multivariate analysis showed that reduction in FBS among the patients with diabetes who attended the HLE course increased the odds of decreased HbA1c by 3.8 times, a lower 95% confidence level of 1.3 and upper 95% confidence level of 11.3 (p=0.015) (Table IV).

Table II: Comparison in Biomedical Parameters between Attendees and Non-attendees (N=220)

Variables	Median (Interquartile range)		*Z statistic*	*p* value
	Pre-program	Post-program/ Post-invitation		
Weight (kg)				
Attendees	71.00 (65.00, 80.00)	71.50 (65.00, 80.00)	-0.254	0.800
Non-attendees	69.75 (62.00, 80.00)	68.00 (60.00, 80.00)	-3.570	<0.001
SBP (mmHg)				
Attendees	134.00 (120.00, 146.00)	134.50 (126.75, 146.00)	-0.941	0.347
Non-attendees	132.00 (121.75, 143.00)	138.50 (126.75, 150.00)	-3.240	0.001
DBP (mmHg)				
Attendees	79.00 (70.00, 86.00)	78.00 (71.00, 85.25)	-0.015	0.988
Non-attendees	78.00 (71.00, 84.00)	77.00 (71.00, 84.00)	-0.045	0.964
HbA1c (%)				
Attendees	8.60 (7.40, 11.13)	8.55 (7.00, 10.23)	-2.692	0.007
Non-attendees	7.55 (6.70, 8.50)	7.90 (7.00, 9.00)	-5.084	<0.001
FBS (mmol/L)				
Attendees	8.10 (6.90, 10.80)	7.35 (6.20, 8.70)	-2.982	0.003
Non-attendees	6.85 (5.70, 8.10)	7.15 (5.80, 8.58)	-1.432	0.152
Total Cholesterol (mmol/L)				
Attendees	4.85 (3.93, 5.90)	4.50 (3.88, 5.20)	-4.252	<0.001
Non-attendees	4.40 (3.90, 5.30)	4.40 (3.90, 5.20)	-0.107	0.915
Triglyceride (mmol/L)				
Attendees	1.75 (1.20, 2.40)	1.60 (1.20, 2.40)	-1.842	0.065
Non-attendees	1.45 (0.90, 1.88)	1.40 (1.00, 1.90)	-0.110	0.912
LDL (mmol/L)				
Attendees	2.71 (1.90, 3.75)	2.60 (2.08, 3.41)	-1.027	0.305
Non-attendees	2.70 (2.04, 3.34)	2.95 (2.20, 3.73)	-2.444	0.015
Insulin's total daily dose (unit)				
Attendees	55.00 (36.50, 77.00)	62.00 (49.00, 75.50)	-1.865	0.062
Non-attendees	28.00 (8.00, 52.00)	38.00 (12.00, 56.00)	-3.576	<0.001

Wilcoxon signed-ranks test SBP: systolic blood pressure
DBP: diastolic blood pressure FBS: fasting blood sugar
LDL: low density lipoprotein

Table III: Associated Factors of HbA1c Reduction Post-HLE Attendance (N=106)

Variables	Total (n=106)	HbA1c Reduction, n (%)		p value
		No (n=45)	Yes (n=61)	
Age ≥ 60 years	51	26 (51.0)	25 (49.0)	0.087
Gender: Women	63	28 (44.4)	35 (55.6)	0.616
Ethnic: Malay	62	25 (40.3)	37 (59.7)	0.665
Chinese	18	7 (38.9)	11 (61.1)	
Indian	26	13 (50.0)	13 (50.0)	
DM ≥ 5 years	37	17 (45.9)	20 (54.1)	0.189
Weight reduction	41	20 (48.8)	21 (51.2)	0.297
FBS reduction	56	17 (30.4)	39 (69.6)	0.008
SBP reduction	44	17 (38.6)	27 (61.4)	0.503
DBP reduction	46	17 (37.0)	29 (63.0)	0.316
TC reduction	61	28 (45.9)	33 (54.1)	0.358
TG reduction	39	17 (43.6)	22 (56.4)	0.650
LDL reduction	33	15 (45.5)	18 (54.5)	0.835
Insulin dose increment	29	12 (41.4)	17 (58.6)	0.737
Metformin dose increment	16	1 (6.2)	15 (93.8)	0.002*
Sulphonylurea dose increment	11	4 (36.4)	7 (63.6)	0.756*

Pearson chi-square test * Fisher's Exact Test
DM: Diabetes Mellitus FBS: Fasting Blood Sugar
SBP: Systolic Blood Pressure DBP: Diastolic Blood Pressure
TC: Total Cholesterol LDL: Low Density Lipoprotein

DISCUSSION

Healthy lifestyle comprises balanced diet and adequate physical activity, is essential for all patients with DM to achieve good glycaemic control and reduce risk of getting cardiovascular disease (17). Diabetic education can minimize the chances to develop complications of diabetes and thus reduce morbidity and mortality in diabetics (18).

In our study, patients who attended the "Healthy Lifestyle Education" (HLE) course exhibited significant improvement in HbA1c and FBS than those non-attendees. This could be regard to regular self-check of blood sugar, dietary regimen, exercise, and lifestyle behavior modification after the diabetic educational course as demonstrated by a study by Mokabel et al. (19). Educating patients with diabetes will help to empower them for foot care and increase health consciousness in DM (20). The diabetic education program also significantly improved awareness in relation to diabetic

Table IV: Independent Factor of HbA1c Reduction Post-HLE Attendance (N=106)

Independent variables	Coefficient	S.E.	Wald statistic	Odd ratio (OR)	95% C.I for OR		*p* value
					Lower	Upper	
Age ≥ 60 years	-0.708	0.525	1.821	0.493	0.176	1.378	0.177
DM ≥ 5 years	-0.452	0.532	0.722	0.636	0.224	1.806	0.396
FBS reduction	1.344	0.550	5.964	3.833	1.304	11.271	0.015
Metformin dose increment	-0.101	0.918	0.012	0.904	0.150	5.468	0.913

Binary logistic regression model, Enter mode was applied. Hosmer-Lemeshow test, (p=0.546), Pearson Chi-Square & sig, (p=0.036) and Classification table (overall correctly classified percentage = 63.5) was applied to check the model fitness.

retinopathy (DR), thus we included DR screening and foot care in our course as part of the motivation for glycaemic control (21).

One of the strategies of DM control is "Fix the Fasting First". Our study revealed that those attendees with fasting blood sugar (FBS) reduction were almost four times more likely to have HbA1c reduction. This could be explained by a Korean study by Hong et al. that indicated close association between HbA1c and FBS; every increment of 1.0 mmol/L in FBS increases 0.45% of the HbA1c level (22).

Increased dose of Insulin and oral hypoglycaemic agents were not independently associated with HbA1c reduction in this study. The masked pharmacological effect in DM control could be due to high prevalent of low medical adherence among patients with diabetes prior to attending educational course (23). In this study, we did not assess the change of understanding of medications and adherence after the HLE course. However, studies have shown that patient education improves understanding of medications and adherence (24).

Despite pharmacological treatment for years in our participants, providing HLE is still beneficial in HbA1c lowering. This result is consistent with a Turin study among people with established diabetes by Trento et al. (25) where group education improved their HbA1c better than the control groups. On the other hand, our study population is different from the DESMOND study; in which only newly diagnosed patients with diabetes were recruited because shortly after diagnosis, when aggressive medical treatment is imposed, it may be masked the extra benefits of the diabetic education (13).

The HLE attendees achieved significant mean reduction in HbA1c, FBS and total cholesterol but insignificant increased in weight. A minute weight increment in our attendees was possibly due to increased insulin adherence. However, the adherence to insulin pre and post-HLE course was not explored in this study. A study done by Norris et al. showed that weight loss was difficult and subtle despite dietary, exercise or behavioral interventions (26). A group-based 8-hour education program which delivered by a diabetic nurse educator in 4 sessions, for 4 weeks in a tertiary care university hospital demonstrated decrement in HbA1c among the non-insulin-using type 2 DM patients; but similarly significant improvement in both groups' weight, blood pressure and total cholesterol (27). Their outcome is better than ours probably because of longer duration and more sessions in their program, enhancing the impact of education.

Since DM is a progressive disease, the non-attendee/ control group represents the usual clinical course of the disease. Therefore the significant worsening of FBS and HbA1c levels in control group was not surprising. Besides, the control group had significant increment of systolic blood pressure (SBP) and low-density lipoprotein (LDL), indicating the need of HLE course to curb the poor DM and metabolic control. The weight reduction among those non-attendees could be due to hyperglycaemic-induced diuresis as a result of uncontrolled DM. There was no other program that helped in weight reduction at our health clinic.

Integration of HLE into primary care could enrich patients' experience, improve their understanding, enhance motivation to improve their self-care and enhance primary care doctors in providing a holistic clinical care (28). Since the entire DM team was involved, it might have been motivated to improve patients' outcomes through the supportive environment.

This study has demonstrated the good impact of healthy lifestyle education to the glycaemic and cholesterol level among patients with DM, but there is no concrete evidence to suggest that it helps in weight reduction, possibly caused by better adherence of insulin among the attendees. Those non-attendees had increment of systolic blood pressure, HbA1c, LDL and insulin dosage overtime. In our district health clinics, we do not have professional dietician, so we incorporate the nutritionist to help in the education course. This study was conducted in a single centre, thus the findings could not be generalized.

CONCLUSION

Lifestyle modification by education is a cost-effective strategy to have better glycaemic and lipid control. Hence effort should be made to dictate the continuity of "Healthy Lifestyle Education" (HLE) course to empower patients with diabetes on effective self-care for better glycaemic and metabolic control to reduce the morbidity and mortality from DM. We recommend the equipment with professional services of dietician in primary care level to help in weight reduction. Future study should include the measurement of waist circumference. Besides, further study on long term effects of HLE course towards patients' health behavior, medication adherence and the complications of DM could be executed.

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