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A brief structured education programme enhances self-care practices and improves glycaemic control in Malaysians with poorly controlled diabetes

M. Y. Tan[1]*, J. M. Magarey[2], S. S. Chee[3], L. F. Lee[4] and M. H. Tan[5]

[1]Department of Nursing, Damai Medical and Heart Clinic, Melaka 75300, Malaysia, [2]School of Nursing, University of Adelaide, Adelaide 5005, Australia, [3]Department of Nutrition and Dietetics, International Medical University126, Jalan 19/155B, Bukit Jalil, Kuala Lumpur 57000, Malaysia, [4]Department of Nutrition and Dietetics, University Malaya Medical Centre, Lembah Pantai, Kuala Lumpur 59100, Malaysia and [5]Division of Metabolism, Endocrinology and Diabetes, University of Michigan, Ann Arbor, MI 48104, USA

*Correspondence to: M. Y. Tan. E-mail: mytan53@hotmail.com

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Abstract

We assessed the effectiveness of a brief structured diabetes education programme based on the concept of self-efficacy on self-care and glycaemic control using single-blind study design. One hundred and sixty-four participants with poorly controlled diabetes from two settings were randomized using computer-generated list into control ($n = 82$) and intervention ($n = 82$) groups, of which 151 completed the study. Monthly interventions over 12 weeks addressed the self-care practices of diet, physical activity, medication adherence and self-monitoring of blood glucose (SMBG). These self-care practices were assessed at Weeks 0 and 12 using pre- and post-questionnaires in both groups together with glycated haemoglobin A1c (HbA1c) and diabetes knowledge. In the intention-to-treat analysis ($n = 164$), the intervention group improved their SMBG ($P = <0.001$), physical activity ($P = 0.001$), HbA1c ($P = 0.03$), diabetes knowledge ($P = <0.001$) and medication adherence. At Week 12, HbA1c difference adjusted for SMBG frequency, medication adherence and weight change remained significant ($P = 0.03$) compared with control group. For within group comparisons, diabetes knowledge ($P = <0.001$), HbA1c level ($P = <0.001$), SMBG ($P = <0.001$) and medication adherence ($P = 0.008$) improved from baseline in the intervention group. In the control group, only diabetes knowledge improved ($P = <0.001$). These findings can contribute to the development of self-management diabetes education in Malaysia.

Introduction

Improving glycaemic control can prevent the onset or delay the progression of micro- and macrovascular complications in diabetes [1, 2]. One requirement for improving glycaemic control is learning through diabetes education and participating in active self-care behaviours essential in day-to-day management to maintain long-term clinical outcomes [3, 4]. Structured diabetes education programmes have been shown to enhance self-management and clinical outcomes [3, 5]. Effective programmes have a clear theoretical approach and are delivered face-to-face with higher intensity. They should also incorporate cognitive restructuring, involve patient–educator interaction and be facilitated by trained educators [3, 6, 7]. One theoretical education approach is based on the theory of self-efficacy. Self-efficacy, a key construct in social cognitive theory, is an individual's perception of his/her ability to perform specific tasks to successful

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completion [8]. Studies of adults with Type 2 diabetes found that greater self-efficacy predicted better dietary and medication management, more frequent self-monitoring of blood glucose (SMBG) and enhanced physical activity [9–11]. Recent randomized trials have found that educational interventions for participants with diabetes also enhance self-efficacy [12, 13]. However, the resources required to implement such educational programmes in real-life may limit their application. Hence, there is a need to explore the effectiveness of a brief education programme in countries with limited resources available for diabetes education.

The prevalence of diabetes in Malaysia has increased from 1 to 2% in the 1960s to 14.6% in 2006 [14]. Malaysia has less than 600 trained diabetes educators/dieticians to meet the health and education needs of almost 1.6 million people with diabetes. Added to this, surveys of Malaysians with diabetes have reported significant knowledge deficit [15–17]. Another study in Malaysia demonstrated that people with diabetes have problems translating the 'advice' received [18]. Many Malaysians with diabetes have poor glycaemic control and vascular complications [19, 20]. The triad of high prevalence of poor glycaemic control in Malaysia, the limited number of diabetes educators and patients' limited knowledge and ability to translate theory into practice underlines an urgent need to find a practical solution in this setting. This study in Malaysia aimed to assess the effectiveness of a brief (approximately 90 min) structured diabetes education programme based on self-efficacy to enhance self-care practices.

Methods

The Research Ethics Committee of the University of Adelaide and the Malaysian Medical Research and Ethics Committee approved the study. All participants signed informed consent.

This 12-week single-blind randomized study compared the effect of a brief structured face-to-face education intervention with usual care in adult Malaysians with poorly controlled diabetes. The primary end point was the comparison between groups of the self-care practices at 12th week follow-up. The secondary end points included comparison between group's (i) glycated haemoglobin A1c (HbA1c) at Week 12; (ii) diabetes knowledge score at Week 12; (iii) and comparison within groups of the change from Week 0 to 12 in self-care practices (iv) in HbA1c and (v) in diabetes knowledge scores.

Sample size

The required sample size was calculated with self-care practices as the primary outcome. The power was set at 0.8 with an alpha of 0.05. As there is no published literature on effect size combining these four self-care practices, the convention developed by Cohen was used to calculate this sample size [21]. Based on this, the value of effect size in a two-group test of mean difference was estimated at 0.20–0.49 for small effect, 0.50–0.79 for medium effect and 0.80 for large effect. To test for a significant difference between the two groups, a medium effect size of gamma 0.5 was arbitrarily adopted, requiring a sample size of 126. Since this was a longitudinal study, a 25% attrition rate was included which required a sample size of 164.

Using a computer-generated list with odd number for control participant and even number for intervention participant, 164 participants were randomized to either intervention or control group, with 82 participants in each group. The participants were recruited during their routine clinic visits at a government state hospital that offers tertiary care in an urban area and a government clinic that provides primary care in the rural area. Participants with either Type 1 or Type 2 diabetes were included if they:

1. were non-pregnant adults >18 years of age regardless of gender or ethnicity;
2. spoke and understood Bahasa Malaysia, English, Mandarin or Chinese dialects and
3. had a medical record showing HbA1c >7%.

Participants were excluded if they were unable to answer the questionnaire independently or had hearing or vision impairment. The participants were not informed of their groups. After the initial assessment at baseline, the control group returned to usual care. The interventional group was provided with the intervention.

Research tools

Three research instruments were used: an education programme, an assessment tool and measurement of HbA1c using a Bayer DCA 2000 analyser.

The education intervention

The brief structured education programme consisted of monthly sessions for 12 weeks (3 months)—two were face-to-face individual education sessions and one was a telephone follow-up. The first education session addressed the self-care practices of healthy eating, being active, medication adherence and SMBG. Using the participant's SMBG results, the second and third educational sessions explored problem-solving skills related to hyperglyceamia, hypoglyceamia, sick day and emotional episodes. The education approach was based on the concept of self-efficacy using the four sources of information: performance accomplishments, vicarious experience, verbal persuasion and physiological information. Performance accomplishment refers to the individual's performance of the behaviour as an indicator of the ability to do it. Successful accomplishment of a task increases the expectation of mastery. Vicarious experience refers to individual's learning through observing others as models and comparing themselves with the observed experience. Verbal persuasion refers to the process of giving praise and coaching. Physiological state can alter the level of self-efficacy [8].

The control group was not exposed to the structured education intervention but continued with their usual care of brief medical follow-up at 3-month intervals. During each session, the physician may check glycaemic and metabolic control, medications and general well-beings. With limited resources, the usual care participants are referred for diabetes education if there are problems in their diabetes management. The Malaysian government heavily subsidizes medications but not the cost of SMBG supplies. Hence, SMBG is often not done by patients receiving usual care. In this study, the control participants were not taught SMBG as SMBG is one of the four self-care practices in the intervention. Both groups were provided with the same printed educational materials.

The assessment tool

The effect of this intervention was assessed using two sets of Revised Diabetes Self-care Activities (RDSA) Questionnaires modified from the Diabetes Self-care Activities Questionnaire used previously in Malaysia [16]. The pre-questionnaire (77 items) was administered at Week 0 (baseline) to assess the glycaemic control, diabetes knowledge and the preceding week's self-care practices namely dietary intake, physical activity, medication adherence rate and SMBG practices. For dietary self-care, two 24-hour dietary recalls and a Food Frequency Questionnaire with 100 commonly consumed Malaysian food list were used to assess the total caloric, carbohydrate, protein, fat and sugar intake at baseline and Week 12. There were four 24-hour dietary recalls in total. For physical activity, a sample item is 'Last week, how many days did you exercise?' The responses were recorded from 0 to 7 days. Medication adherence (Last week, how many times did you miss your morning/noon/evening medications?) and SMBG (Last week, how many times did you measure your blood glucose?) assessments were determined by the information provided by the participants. The post-questionnaire (59 items) was the RDSA pre-questionnaire minus the 18 demographic questions. It was administered at Week 12 (end of study) to assess any difference in diabetes knowledge and the four self-care practices between groups and within groups. Both questionnaires were administered by the investigator (M.Y.T.) using a one-to-one interviewing approach.

The content validity of the RDSA Questionnaire was independently reviewed by nine health care diabetes consultants and two individuals with diabetes. The Cronbach's alpha of the RDSA Questionnaire was 0.8. The criterion-related validity of the instrument was assessed and three self-care practices

(SMBG, total physical activity and medication adherence) correlated with HbA1c (Table I).

At Week 0, the participants' height and weight were measured using a Seca 807 electronic scale with participants wearing light clothing without footwear. Baseline HbA1c was measured. Then the participants were interviewed in the language/dialect of his/her choice to assess their baseline knowledge and self-care practices using the RDSA pre-questionnaire. Participants prescribed insulin treatment were requested to demonstrate their insulin injection technique. The first 24-hour dietary recall which was the previous day's dietary intake was collected at the baseline face-to-face visit. To enhance dietary accuracy, common Malaysian household cutleries and photographs of food and fruit were used. The second baseline 24-hour dietary recall was done randomly by telephone within 7 days to avoid bias in reporting of dietary intake due to the expectation of a call. To assess the accuracy of self-reported food record, a ratio of reported energy intake to basal metabolic rate (EI: EMR) based on a previous study with Malaysian people was used as guide [22].

In the intervention group, at Week 0 face-to-face session, areas of self-care deficit were identified based on the findings of the RDSA pre-questionnaire. The investigator and the participants then explored approaches to overcome self-care deficits using the participant's past experience (verbal persuasion). To further enhance self-care, evidence-based studies were discussed (vicarious experience). The participants were then given time to practice SMBG (performance accomplishment). Due to limited free blood glucose test strips, SMBG testing was limited to fasting, pre- and post-prandial blood glucose (meal related) six times a week. The education process took approximately 45 min. Printed educational materials and one bottle of 25 blood glucose test strips were provided. Two realistic and achievable short-term goals were set by the participants.

Table I. *Self-care predictors of HbA1c in criterion-related validity*

Self-care	Beta	*P*-value
Medication adherence	−0.036	0.001**
Dietary intake	0.500	0.22
Total physical activity	0.612	0.02*
SMBG	0.561	0.007**

*$P < 0.05$, **$P < 0.01$.

The second face-to-face education session was scheduled a month later. The investigator praised the participant's achievement (vicarious experience). Then the participants were encouraged to identify their barriers and solutions for problems encountered in their self-care practices (verbal persuasion) and any emotional problems (emotional arousal). The intervention took about 30 min. Two bottles of 25 blood glucose test strips were supplied and the participants were requested to return their SMBG diaries via a self-addressed envelope. The third intervention session was a telephone follow-up provided after the investigator received the participant's SMBG results at the end of the second month to reinforce the above education. This session took about 15 min.

No medication dosage was adjusted by the investigator during the educational process.

At Week 12, all participants had their body weight and HbA1c measured. Diabetes knowledge and self-care practices were assessed using the RDSA post-questionnaire. The final two 24-hour diet recalls were recorded a week before the final follow-up and during the final follow-up.

Statistical analysis

Differences between groups at baseline were analysed using *t*-test and chi-square test. An intention-to-treat analysis, including all participants, was undertaken. Changes from baseline measurement were analysed using analysis of variance repeated measures procedure to assess the differences of self-care practices and HbA1c in the intervention and control groups, controlled for medication adherence, frequency of SMBG and weight change. To examine relationships between data, Pearson's or Spearman rho correlations were used. Multiple regressions were used to identify the predictors for glycaemic control. The 24-hour dietary intake was analysed using Nutritionsist Pro 2.0 software based on the Malaysian food composition data.

Results

One hundred and sixty-four participants were randomized to either control (n = 82) or intervention group (n = 82). At Week 12, 151 participants completed the study (Fig. 1). Analysis was based on all participants (n = 164). At baseline, there was no significant difference between the groups in demographic and clinical characteristics (Table II). No separate analysis was done based on types of diabetes as there were only seven participants (4%) with Type 1 diabetes mellitus.

Self-care practices

Dietary Intake

At Week 0, the participants in both groups had similar total daily calorie, carbohydrate, protein, fat, sugar intake and body weight. Likewise at Week 12, there was no significant difference between control and intervention groups. However in the intervention group, there was a significant reduction in daily total calorie, protein and fat intake from baseline to Week 12, whereas participants in the control group did not change their dietary intake throughout the study (Table III).

Total physical activity

Total physical activity was defined as combined non-leisure and leisure activities with a possible score of 7–44. At baseline, there was no difference between the groups. At Week 12, total physical activity was significantly higher in the intervention group. In within-group analysis, neither group showed a change in total activity.

Medication adherence rate

Percentage of medication adherence was based on participant's report of total medication intake (dosage and frequency) over the total prescribed dosage by their physicians during the preceding 7 days [23]. Those on oral glucose-lowering medications and injectable glucose-lowering medications were evaluated on their adherence, respectively. Medication adherence rate was defined as consuming $\geqslant$ 90% of the prescribed medications in the preceding week. At Weeks 0 and 12, there was no difference in medication adherence between the groups. However, in the intervention group, 14% of participants reported lowering their insulin dosage to avoid hypoglycaemia episodes that were confirmed by SMBG results. By doing so, these participants had lower medication adherence rate [82.45; 95% confidence interval (CI): 79.62–85.28] compared with participants with no hypoglycaemia episodes (91.10; 95% CI: 88.70–93.50). If these participants were considered to be medication adherent, the difference between groups was significant (P = 0.008; 91.42, 95% CI: 89.12–93.72 versus 84.4, 95% CI: 81.76–87.20). In within-group comparison, those participants in the intervention group had a significant increase in medication adherence rate from Week 0 to Week 12. There was no difference within the control group. The effect of prescribed medication by the attending doctors on HbA1c level was analysed with intention to treat. It was not significant.

Self-monitoring of blood glucose

At Week 0, there was no difference in the SMBG practices between the groups. At Week 12, the intervention group practiced SMBG more often than the control group (P = <0.001). In the intervention group, there was an increase in SMBG practice between Week 0 and Week 12 (P = <0.001; 0.56, 95% CI: 0.32–0.80 versus 2.88, 95% CI: 2.53–3.23). In the control group, there was no change in the SMBG practices.

HbA1c

At Week 0, participants in both groups had similar poor glycaemic control. At Week 12, the intervention group had lower HbA1c than the control group (P = <0.001; 8.75 ± 1.75, 95% CI: 8.45–9.02 versus 9.67 ± 2.01, 95% CI: 9.36–9.98) (Fig. 2). This significant difference between groups was still present after adjusting for medication adherence, SMBG frequency and body weight (P = 0.03). Of note, the HbA1c levels of 20% of the intervention participants deteriorated by 0.6–2.6%. Medication adherence

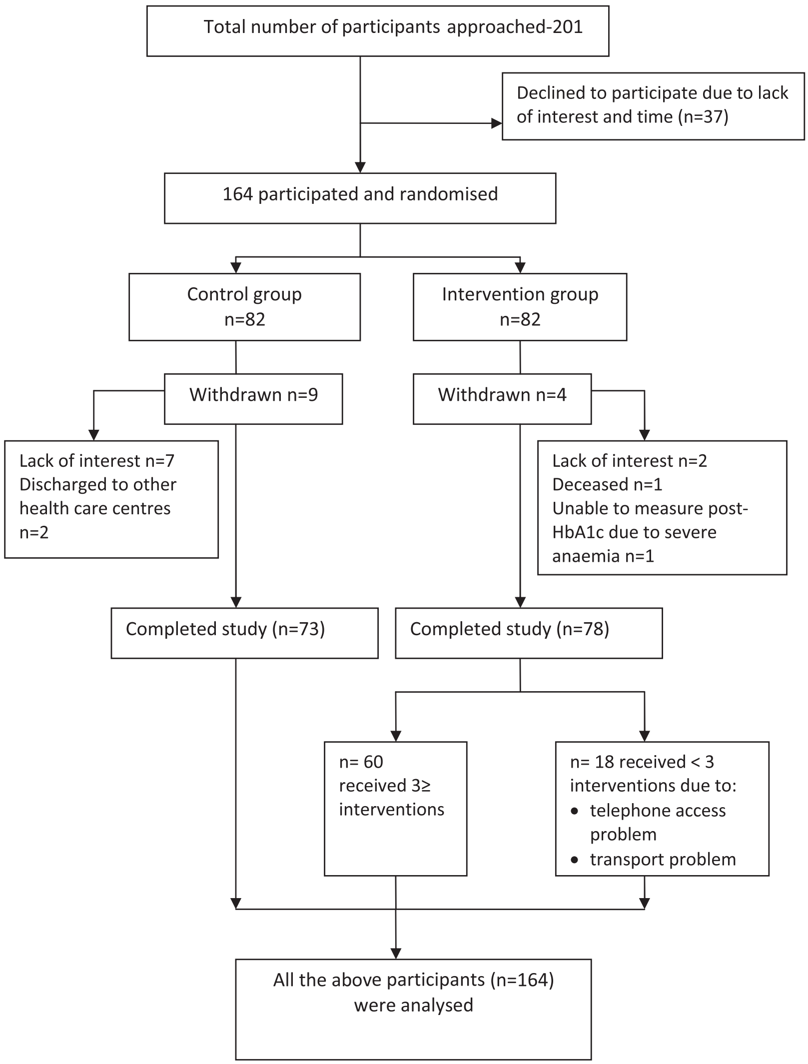

Fig. 1. Flow chart of the phases of randomization.

(B = −0.23, P = 0.009) and SMBG practices (B = −0.21, P = 0.007) accounted for 10.7% of the total variance in HbA1c levels at Week 12.

Diabetes knowledge score

The possible maximum knowledge score was 20. At Week 0, there was no difference in the knowledge score between the groups. At Week 12, participants in the intervention group had higher knowledge scores compared with the control group. Although both the groups increased their knowledge, the intervention group had greater improvement (2.78, 95% CI: 2.39–3.17 versus 1.47, 95% CI: 1.11–1.83).

Correlations

At Week 12, there was significant correlation between HbA1c and medication adherence (r = −0.27;

Table II. *Comparison of the demographic and clinical characteristics of intervention and control groups at baseline*

Variables	Intervention (n = 82), mean (SD)/(%)	Control (n = 82), mean (SD)/(%)	P-value
Age (years)	54 (9.94)	54 (10.74)	n.s.[a]
Gender			n.s.[b]
Male	32 (39%)	31 (38%)	
Female	50 (61%)	51 (62%)	
Race			n.s.[b]
Malay	48 (58%)	52 (64%)	
Chinese	18 (22%)	20 (24%)	
India	14 (17%)	10 (12%)	
Others	2 (3%)	0 (0%)	
Education			n.s.[b]
Never	4 (5%)	5 (6%)	
Primary	42 (51%)	49 (60%)	
Secondary	29 (35%)	23 (28%)	
College	4 (5%)	4 (5%)	
Tertiary	3 (4%)	1 (1%)	
Marital status			n.s.[b]
Single	5 (6%)	3 (4%)	
Married	77 (94%)	79 (96%)	
Occupation			n.s.[b]
Office	6 (7%)	5 (6%)	
Factory	18 (22%)	14 (17%)	
Fieldwork	3 (4%)	7 (9%)	
Housewife	37 (45%)	35 (42%)	
Professional	1 (1%)	4 (5%)	
Retired	17 (21%)	17 (21%)	
Types of diabetes			n.s.[b]
Type 1	2 (2%)	5 (6%)	
Type 2	80 (98%)	77 (94%)	
Duration of diabetes (years)	12.10 (8.60)	10.49 (8.93)	n.s.[a]
Treatment mode			n.s.[b]
Oral drug	36 (44%)	43 (52%)	
Insulin	18 (22%)	13 (16%)	
Combined treatment	28 (34%)	26 (32%)	
Body weight (kg)	69.62 (13.61)	70.06 (14.97)	n.s.[a]
Body mass index (kg/m^2)	27.81 (5.22)	28.48 (5.96)	n.s.[a]

[a]Analysis by t-test.
[b]Analysis by chi-square.
n.s., $P > 0.05$.

$P = 0.001$) and SMBG ($r = -0.28$; $P = 0.001$) but not with diet self-care and total physical activity; total education time with SMBG practices ($r = +0.38$ $P = 0.001$), better medication adherence ($r = +0.22$, $P = 0.04$) and knowledge improvement ($r = +0.34$, $P = 0.02$) but not physical activity level, dietary intake and HbA1c levels; SMBG with medication adherence ($r = +0.28$, $P = <0.001$) and carbohydrate intake ($r = -0.24$, $P = 0.04$); diabetes knowledge ($r = +0.28$, $P = 0.001$) but not other self-care.

Discussion and conclusions

The structured education programme of approximately 90 min duration resulted in more frequent

Table III. *Comparison of self-care practices, HbA1c levels and knowledge between and within the intervention and control groups at Weeks 0 and 12*

Variable	Between-groups comparison at baseline week 0 (n = 164)			Between-groups comparison at week 12 (n = 164)			Within-group comparison for intervention group (n = 82)	Within-group comparison for control group (n = 82)
	Intervention, n = 82, Week 0, mean (95% CI)	Control, n = 82, Week 0, mean (95% CI)	P-value, Week 0	Intervention, n = 82, week 12, mean (95% CI)	Control, n = 82, Week 12, mean (95% CI)	P-value, Week 12	P-value, Week 0 versus Week 12	P-value, Week 0 versus Week 12
Body weight	69.62 (67.54–71.70)	70.06 (67.77–72.35)	n.s.[a]	69.55 (67.44–71.66)	70.16 (67.90–72.42)	n.s.[a]	n.s.[a]	n.s.[a]
Self-care measures								
24-h intake								
Total Kcal	1732 (1662–1801)	1731 (1660–1801)	n.s.[a]	1579 (1521–1636)	1663 (1599–1727)	n.s.[a]	0.009[a]	n.s.[a]
CHO (g)	246 (236–256)	259 (248–270)	n.s.[a]	235 (226–244)	251 (241–261)	n.s.[a]	n.s.	n.s.[a]
Protein (g)	67 (63–71)	66 (62–70)	n.s.[a]	59 (56–62)	62 (59–65)	n.s.[a]	0.01[a]	n.s.[a]
Fat (g)	52 (49–55)	47 (44–50)	n.s.[a]	45 (43–47)	47 (44–50)	n.s.[a]	0.01[a]	n.s.[a]
Sugar (g)	24 (22–26)	27 (24–30)	n.s.[a]	23 (20–26)	29 (26–32)	n.s.[a]	n.s.[a]	n.s.[a]
Total physical activity	15.01 (14.02–16.00)	13.40(12.69–14.23)	n.s.[a]	15.50 (14.63–16.37)	12.73 (12.01–13.45)	0.001[a]	n.s.[a]	n.s.[a]
SMBG/week	0.56 (0.32–0.80)	0.74 (0.48–1.00)	n.s.[a]	2.88 (2.53–3.23)	0.62 (0.35–0.89)	<0.001[a]	<0.001[a]	n.s.[a]
Medications adherence	84.48 (81.78–87.18)	85.00 (82.14–87.86)	n.s.[a]	89.21 (86.75–91.67)	84.48 (81.76–87.20)	n.s.[a]	0.008[a]	n.s.[a]
[b]Medication adherence after adjusting for hypoglycaemia	84.48 (81.78–87.18)	85.00 (82.14–87.86)	n.s.[a]	91.42 (89.12–3.72)	84.48 (81.76–87.20)	0.008	0.001	n.s.[a]
Diabetes knowledge	9.27 (8.76–9.78)	8.46 (7.89–8.94)	n.s.[a]	11.9 (11.40–12.40)	9.8 (9.30–10.30)	<0.001[a]	<0.001[a]	<0.001[a]

[a]Analysis of variance repeated measure with intention to treat; P = <0.05; n.s.P > 0.05.
[b]Medication adherence rate was defined as consuming ⩾90% of the prescribed medications in the preceding week. Fourteen per cent of the intervention participants reported lowering their insulin dosage to avoid hypoglycaemia episodes that were confirmed by SMBG results. If these participants were considered to be medication adherent, the difference between groups was significant.

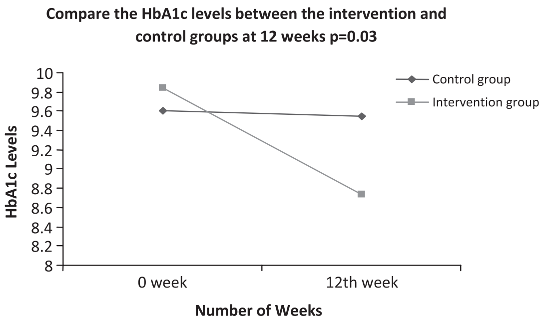

Fig. 2. Comparison of the HbA1c levels between the intervention and the control groups at Week 12 adjusted for changes in medication adherence, SMBG frequency and body weight.

SMBG, increased total physical activity and better medication adherence and was associated with a concomitant decrease in HbA1c and an increase in diabetes knowledge comparing the intervention and control groups. Such a brief structured education programme, incorporating the principles of self-efficacy leading to better self-care and improved glycaemic control, is practical and can be implemented in Malaysia as shown in this study.

There was a significant inverse correlation between SMBG and HbA1c. There are conflicting reports on the efficacy of SMBG and glycaemic outcomes, particularly in non-insulin-treated Type 2 diabetes patients [24–27]. Some studies suggest that SMBG enhances self-management when results are reviewed and acted upon [28, 29]. In this study, the intervention participants were taught on how meal-related SMBG, medication non-adherence and physical inactivity could contribute to hyperglycaemia or hypoglycaemia. The SMBG results were reviewed monthly and were used as an education tool rather than single self-care behaviour to enhance medication, dietary and physical activity self-care practices and this might explain SMBG being a contributing factor to the decreased in HbA1c. Furthermore, the individualized education was provided with the language of the participant's choice. This is important in multiracial society like Malaysia to enhance understanding of the education provided. In addition, a change in SMBG practice from very infrequent (0.56, 95% CI: 0.32–0.80) to frequent (2.88, 95% CI: 2.53–3.23) as occurred in the intervention group may make a bigger difference in outcomes than previous studies from developed nations where SMBG practices changed from frequent to very frequent.

There are conflicting reports on factors related to positive exercise interventions for Type 2 diabetes [30–32]. High intensity, structured and supervised exercise classes and longer intervention duration are reported to produce optimal results [31, 33]. This study used brief verbal self-efficacy approach instead of organized structured, supervised classes and targeted for multiple self-care behaviours may have contributed to <10% of the intervention participants started regular exercise programmes. Participants who were factory/field workers (27%) reported lack of time as a barrier to engage in regular exercise for they work 8–12 hours daily, 6–7 days a week and perceived that they had done enough activity during their working hours. Sixty percent of the intervention group were females. A previous Malaysian study reported that Malay females are socially conditioned to act in groups [34]. The local community exercise facilities are not easily accessible as some form of transportation is often necessary. Females constituted one of the groups that had problems with transportation (P = 0.04) in this study. Previous studies reported similar psychosocial exercise barriers [35, 36].

Two systematic reviews (including 58 trials) assessed dietary interventions within diabetes care [37, 38]. The dietary interventions with positive outcomes usually involved intensive longer duration, group work and included exercise programmes. As discussed in this study, the education intervention was about 90 min to address all four self-care practices. To begin with low dietary knowledge at baseline ($M = 2.19 \pm 1.54$ of maximum 9), it was uncertain whether the intervention participants understood their carbohydrate replacement. Furthermore, psychosocial factors like local dietary habits of preparing family meals in common servings rather than individual servings and family members who prepared the family meals for the married male participants (40%) did not attend the education sessions despite this being encouraged may have contributed to the findings. Previous studies found lack of family support/understanding on the importance of dietary self-care in diabetes management as important barrier to individual dietary change due to family members' dietary preferences and food preparation [39, 40]. The Malay participants (60%) consumed the highest sugar intake as compared with participants of other ethnicity ($P = 0.03$). This might contribute to the insignificant reduction of carbohydrate intake at Week 12 as compared with significant reduction in total calorie, fat and protein in the intervention group. With small increase in physical activity level and small reduction in dietary intake, it was expected with no change of body weight in both groups.

This study facilitated medication adherence and correct timing of intake. Thirty-seven per cent of the intervention participants took their medications that included conventional insulin injections at incorrect timing of more than 1 hour before or after their meals at baseline. With education, 14% of intervention participants lowered their insulin dosage to avoid hypoglycaemic episodes that were confirmed by SMBG results. This study defined medication adherence self-care as taking ⩾90% of the prescribed medication. Hence by doing so, they were considered as non-adherent and had lower medication adherence rate as compared with participants with no hypoglycaemic episodes. If these participants were considered to be medication adherent, the difference between groups would be significant ($P = 0.008$).

Only 77% of the intervention group received all three education interventions due to self-reported problems with telephone access and lack of transportation. The participants self-reported lack of transportation to attend education sessions received less education ($P = 0.006$) had higher HbA1c at Week 12 ($P = 0.03$). Previous studies found that distance from health facilities was positively correlated to poor glycaemic control of participants [41, 42].

This study has limitations and strengths. (i) The study was not blinded. With only one investigator who is fluent in three languages and three dialects to provide the intervention and collect data, it would be difficult to conduct the study blinded. However, having the same person conduct the intervention ensured consistency throughout the study. (ii) The effect of the intervention was assessed in Week 12. This measured the short-term impact but not the moderate-term and long-term impacts to demonstrate sustainable effect. With limited resources, a long-term study was not possible. (iii) This study may be perceived as using traditional health education approaches. But, these approaches were adapted and based on self-efficacy. The intervention programme was also adapted to be implemented in a culturally appropriate multiracial society with limited number of diabetes educators/dieticians in Malaysia. (iv) Individualized education approach was less time efficient as compared with group education. Individualized education was preferred based on previous experience in providing diabetes education in Malaysia because of language problems and poor group attendance. (v) The study participants are not entirely representative of the general population in that those who were unable to answer the questionnaire independently or had hearing or vision impairment were excluded. Nevertheless, the study participants' racial, education, occupation, treatment modality and type of diabetes mirror those in the 'Malaysia Diabetes Registry' which increases its generalization in Malaysian settings [43]. Finally, conducting the study in real-life and using multilingual approach demonstrates what is practical in Malaysia. Future longer duration studies with more resources should use a team approach to compare individual and group education and address psychosocial factors like family support, local dietary habits, transportation problems that possibly hinder self-care to increase its generalization. Furthermore, behaviour theory-based education like self-efficacy should be incorporated in future diabetes educator training curriculum.

The findings of this study have implications for patient education and clinical practice in Malaysia. By providing the required resources (blood glucose strips and knowledge) to the intervention participants, it has enhanced self-care and improved clinical outcomes. Individuals with diabetes should be encouraged to practice SMBG and use it as an educational tool to empower self-care practices and problem-solving skills. In this study, participants who were elderly and with less education did not gain the same benefits from the intervention compared with the younger participants with more education due to psychosocial problems. Specially designed education programme for this elderly group should be developed and tested. With limited dieticians in Malaysia, there is a considerable shortage of dietary services provided by trained dieticians. Diabetes nurse educators who are in the forefront of providing diabetes education are in a unique position to assist the dieticians in enhancing basic dietary knowledge and self-care practices.

Conclusions

This structured education face-to-face intervention programme improved three self-care practices, diabetes knowledge and glycaemic control. Conducted in real-life, this study not only highlights the complexity of the educational process for diabetes self-management in a multi-racial and multicultural nation but also the limited resources of diabetes education in Malaysia. This study's approach may be one of the ways that diabetes care in Malaysia can be improved.

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Conflict of interest statement

None declared.

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