Impact of nutrition education on diabetes knowledge and attitudes of adults with type 2 diabetes living in a resource-limited setting in South Africa: a randomised controlled trial

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Objective: To evaluate the effect of a nutrition education (NE) programme on diabetes knowledge and attitudes of adults with type 2 diabetes mellitus (T2DM).

Methods: Eighty-two adults (40–70 years) with poorly controlled T2DM (HbA$_{1c}$ ≥ 8%) and attending two community health centres in Moretele, North West Province (South Africa) participated in a one-year randomised controlled trial. Participants were randomised to the intervention group (*n* = 41; 8 weekly group education (2–2.5 hours); follow-up meetings and education materials) or control group (education materials only). Diabetes Knowledge Form B assessed knowledge about diabetes. Diabetes Attitudes Scale-III assessed the attitudes towards diabetes and treatment. Assessments were done at 6 and 12 months. Analysis of co-variance compared the groups (baseline, age, gender and clinic adjustments). An intention-to-treat analysis was employed.

Results: The intervention group had higher mean diabetes knowledge scores + 0.95 (*p* = 0.033) and + 2.05 (*p* < 0.001) at 6 and 12 months respectively. However, the scores were below 50%. Patient autonomy for diabetes attitudes was the only score significantly higher in the intervention group + 0.27 (*p* = 0.028) at 12 months.

Conclusion: NE significantly improved diabetes knowledge in the intervention group, though not satisfactorily, but had limited effects on the attitudes towards diabetes.

Keywords: attitudes, diabetes knowledge, nutrition education, South Africa, type 2 diabetes

Introduction

Trial registration: ClinicalTrials.gov NCT01095965

South Africa, along with the rest of the world, is experiencing the challenge of a diabetes epidemic. A national prevalence of 9.27% was reported in the 6th International Diabetes Federation atlas (2013).[1] South Africa was also ranked fifth in the African region for the prevalence of diabetes.[1] Diabetes significantly contributes to the burden of non-communicable diseases in South Africa.[2]

Patient education is an essential component of diabetes care. Diabetes self-management education (DSME) aims to empower the person with diabetes with knowledge, skills and the motivation necessary for performing appropriate self-care.[3] The effectiveness of DSME in terms of knowledge, self-care behaviours, glycaemic control and other health outcomes is well documented in the literature.[4] Nutrition therapy, an integral component of DSME,[3] has also been shown to improve dietary behaviours and health outcomes in people living with diabetes.[5]

From the patients' perspective, participating in diabetes education programmes is beneficial. The benefits indicated include improved understanding of their disease and its management[6] and the gain in knowledge that empowers them to take charge of their condition including the ability to make healthier food choices.[7] Yet, very few patients receive structured education,[8] even though structured self-management education is recommended for all people with T2DM.[9] In South Africa and many African countries there is a paucity of data on structured diabetes education programmes, including those focusing on diet. Also, despite the evidence on the value of DSME, lack of knowledge is ranked high among the barriers to self-management in people with diabetes.[10] Furthermore, poor diabetes knowledge has been implicated as a factor contributing to poor dietary adherence and diabetes control in people with T2DM in a resource-limited area of South Africa.[11]

Beliefs and attitudes are considered important determinants of behaviour and behaviour change in people with diabetes.[12] The attitudes towards diabetes and the treatment thereof are associated with the degree of self-care, including compliance with meal plans[13] and glycaemic control.[14] There is evidence that patients with positive attitudes towards managing their diabetes are more likely to change their behaviour in order to keep their condition under control compared with those with negative attitudes.[15] Although there is ample evidence on the importance of positive attitudes to appropriate diabetes self-management, previous studies have reported poor attitudes with regard to patient autonomy and the psychosocial impact of diabetes.[16] Also a lack of strong belief regarding the need for tight glucose control in both patients and health professionals has been reported.[16]

Knowledge and attitudes are important potential mediators of dietary and related behaviour change[17] and should be addressed in any diabetes diet-focused intervention. Additionally, such interventions should apply behaviour change theories as

indicated for DSME interventions.[18] However, to date, there are limited data on diabetes dietary interventions that concurrently apply theory and address knowledge and attitudes in people with T2DM.

The purpose of this study was to implement a nutrition education programme (NEP) and to evaluate the effect on diabetes knowledge and the attitudes towards diabetes and the treatment thereof in adults with T2DM in a resource-limited setting. This was a part of a larger study that assessed clinical and dietary outcomes of the participants.[19]

Methods

Study design and setting

This randomised controlled study was conducted between April 2010 and November 2011 at two community health centres (CHCs) in the Moretele sub-district, North West Province, South Africa. The CHCs are primary health care clinics, located in a rural area and managed by nursing professionals. General physicians consult with referred patients three times a week. People with diabetes make monthly visits to the clinics for routine blood-glucose monitoring and collection of medication. Health education at the CHCs (including education on nutrition) is primarily performed by nursing professionals, since one dietitian serves the entire sub-district. No structured diabetes education is offered at the CHCs. Moretele sub-district is characterised by high unemployment rates (45%), low literacy levels and low-incomes (annual average household income R35 467 (~ US\$3 346).[20] The region has limited infrastructure (facilities and services) and lacks a highly skilled labour force including health professional specialists, therefore it fits our definition of 'a resource limited setting'.

Participants

Participants were men and women with T2DM, aged 40 to70 years. Participants attended either of the two CHCs. All consecutive eligible patients were recruited face to face over a period of eight months. Eligibility criteria included at least one year of living with diabetes; regular attendance at the CHCs; blood sugar levels of $\geq$ 10 mmol/L on two occasions in the previous six months and consequent HbA_{1c} levels $\geq$ 8% after blood analysis; non-pregnant and not on insulin therapy.

The study received ethical approval from the Research Ethics Committee, Faculty of Health Sciences, University of Pretoria (number 215/2009). Participants gave informed written consent or verbal consent.

Sample computation was based on HbA_{1c}, which was the primary outcome of the larger study.[19] Eighty participants were needed to detect a difference of 1% in HbA_{1c} (at 6 months) with 80% power at the 5% level of significance, assuming a 1.5% SD and 10% attrition rate. Based on a study quite similar to the current one, this sample was more than adequate to detect a difference of 2.5 points in the knowledge scores at 6 months with 80% power at the 5% level of significance, assuming a 3.0 point SD and 10% attrition rate.[21]

Participants were randomised to their groups with the use of random permuted blocks and sealed sequentially numbered opaque envelopes. Stratified randomisation on the basis of sex and age was used to ensure balance in important characteristics. It was not possible to blind the participants, the investigators and the appointed field worker, because of the nature of the study.

Intervention

The control group participants received education materials (pamphlet and wall/fridge poster) and continued with their usual medical care. The intervention group received the same education materials and participated in the NEP, which consisted of 8 weekly sessions (2 to 2.5 hours each) to cover the curriculum, follow-up sessions (4 monthly meetings and 2 bi-monthly meetings each lasting 1.5 hours), and vegetable gardening (demonstration of sowing/transplantation of vegetables). Five groups of 6–10 participants attended the sessions. The groups were formed on the basis of recruitment time, resulting in staggered education sessions during the study period. The total NE contact time was 26.5 hours per group for the combined weekly and monthly meetings.

The NEP was developed on the basis of assessed needs and preferences for NE in the target group, which was done in 2009.[22] Briefly, the needs assessment study used qualitative methods and involved patients and the health professionals serving them at the two CHCs. Prominent knowledge deficits and misconceptions regarding diabetes and diabetes treatment were reported. We attempted to address these knowledge gaps during the development of the NEP Additionally, suggestions that were provided by participants such as the involvement of family members and the provision of education materials were incorporated.

The details of the entire NEP are given elsewhere.[19] This part of the study was underpinned by constructs from the Knowledge Attitude Behaviour (KAB) model and the Health Belief Model (HBM).[23] We hypothesised that through the NEP participants would acquire and accumulate knowledge that would lead to positive attitudes which could eventually precipitate appropriate changes in dietary and other diabetes self-care areas. The belief that T2DM is a serious disease was also expected to act as a trigger to positive dietary and related behaviour changes.

The NEP topics were diabetes pathophysiology, including insulin action, risk factors, symptoms, complications, treatment goals and modalities. Nutrition topics comprised the majority of the sessions (six out of eight weekly sessions) and the content covered included: food groups; healthy eating with a focus on meal balance and variety; food portion control; planning meals on a limited budget; improving vegetable supply through gardening and a cooking session. Pictorial flip charts that included the Zakhe diabetes education tool[24] (adapted with modification) and the South African Food Based Dietary Guidelines were used to teach diabetes and diet-related content respectively.[19] The modified Zakhe education tool was pretested on 10 people with similar characteristics to the participants in this study, and was found suitable. Four persons were involved in programme facilitation, namely the sub-district dietitian (25% of weekly sessions); a final-year nutrition and food science university student from the study site (appointed field worker) (65% weekly and 90% follow-up sessions); the principal investigator (PI), who was a qualified dietitian (10% weekly and

follow-up sessions); and the sub-district horticulture officer (one vegetable-gardening demonstration). The local language (Setswana) was used in most of the sessions (90%); the rest were offered in English by the PI with local language translations carried out by nursing professionals serving the clinics. The dietitian and the field worker were trained to deliver the sessions. A training manual was used to ensure uniform information and delivery.

Measurements

The outcomes of this study were changes in diabetes knowledge and the attitudes towards diabetes and its treatment. This research formed part of a larger study that assessed clinical and dietary outcomes of the participants.[19] Outcomes were measured at 6 and 12 months. Socio-demographic data were obtained at baseline using a researcher-administered questionnaire.

The diabetes Knowledge Form B scale (DKNB)[25] measured diabetes knowledge. The revised Diabetes Attitudes Scale-III (DAS-III)[26] assessed the participant's attitudes towards diabetes and related treatment. These questionnaires have been used in South Africa.[27] The DKNB is a standardised questionnaire comprising 15 questions that sample knowledge in five broad areas: basic physiology, hypoglycaemia, food groups, sick-day management and general diabetes care. Each item was assigned a score of one (1) for a correct response or zero (0) for an incorrect response. For items 13 to 15, with more than one correct answer, a score of one was assigned if all the answers were correct.

The DAS-III scale has five sub-scales and 33 Likert items with scores ranging from 5 (strongly agree) to 1 (strongly disagree). It is a standardised questionnaire measuring attitudes pertaining to the need for special training for professionals, seriousness of T2DM, the value of tight glucose control, psychosocial impact of diabetes and patient autonomy.

The two questionnaires were originally designed in English. The questionnaires were scrutinised for appropriateness by dietitians working in the field of diabetes and by dietitians with experience relevant to resource-limited settings. Questionnaires were translated into the local language (Setswana) by a professional bilingual translator. The questionnaires were then back-translated by the appointed field worker and confirmed by a Setswana-speaking qualified dietitian. The differences between the English version and the Setswana version were verified and resolved. The translated questionnaires were pilot tested with the same patients used for testing the diabetes education tool. A few questions had to be rephrased to improve their comprehension and some unfamiliar terms replaced and/or suitable descriptions used.

The questionnaires were face-to-face interviewer administered in the local language at baseline. At 6 and 12 months these questionnaires were self-administered in a group setting by participants deemed to have adequate reading capabilities (30%; ≥ 9 years of schooling), and interviewer administered for the rest of the participants.

Data analysis

All statistical analyses were done using Stata® software version 11.1 (Stata Corp, College Station, TX, USA). An intention-to-treat analysis using the last-observation-carried-forward approach was used. Groups were compared at baseline using a t-test for continuous variables and chi-square test or Fisher's exact test for categorical data. Post-intervention outcomes were compared between groups using an analysis of co-variance (ANCOVA). Adjustments were done for the baseline values, age, gender and clinic. The level of significance for all tests was set at $\alpha < 0.05$ for a two-tailed test.

Results

Figure 1 shows the flow of participants through the study. Table 1 shows the participants' profile for the intervention and control groups at baseline. Eighty-two patients (11 males) were enrolled, of whom 76 (92.7%; 11 males) completed the study. The mean age of participants at baseline was 58.8 years (SD 7.7 years). All participants were black Africans. Participants were mostly unemployed (> 80%) and nearly half were pensioners (45%). The highest proportion in each group, 43.9% and 39% for the intervention and control groups respectively, had 7–9 years of schooling. All participants were on oral hypoglycaemic agents, with the majority in both groups (> 70%) being on a combination of biguanides and sulphonylureas.

Thirty-three (80%) intervention-group participants attended 6 or more of the 8 weekly meetings and 16 (39%) of these attended all the meetings. The average attendance at monthly and bi-monthly follow-up meetings was 83.3% and 87.7% respectively.

Table 2 shows the baseline and adjusted post-intervention mean knowledge-of-diabetes scores for the two groups. There were no significant group differences in the scores at baseline. Post-intervention the control group had significantly lower mean scores at 6 months (–0.96; $p = 0.028$, 95% CI –1.82 to –0.11) and 12 months (–2.05; $p < 0.0001$, 95% CI –3.0 to –1.10). Table 3 shows the correct responses per item in the five knowledge categories. At baseline there were no significant group differences. Post-intervention, the intervention group had a significantly higher proportion of correct responses to some items compared with the control group. Both groups performed very poorly on the items related to the cause of hypoglycaemia, free foods and empty-calorie foods, insulin adjustments during hyperglycaemia and insulin adjustments during illness throughout the study.

Table 4 shows the mean baseline and adjusted post-intervention scores for the diabetes- related attitudes for each sub-scale and the Cronbach's alpha (baseline). The sub-scale scores, which were out of a maximum of 5, were similar in both groups at baseline. Post-intervention, only scores for patient autonomy at 12 months were significantly higher in the intervention group (+0.27, $p = 0.026$). The scores for the need for special training were the highest among all the subscales and remained above four over the study period in both groups, indicating a positive attitude. The scores for the seriousness of T2DM and the value of tight glucose control were around 3 in both groups, placing participants in the neutral attitude position throughout the study.
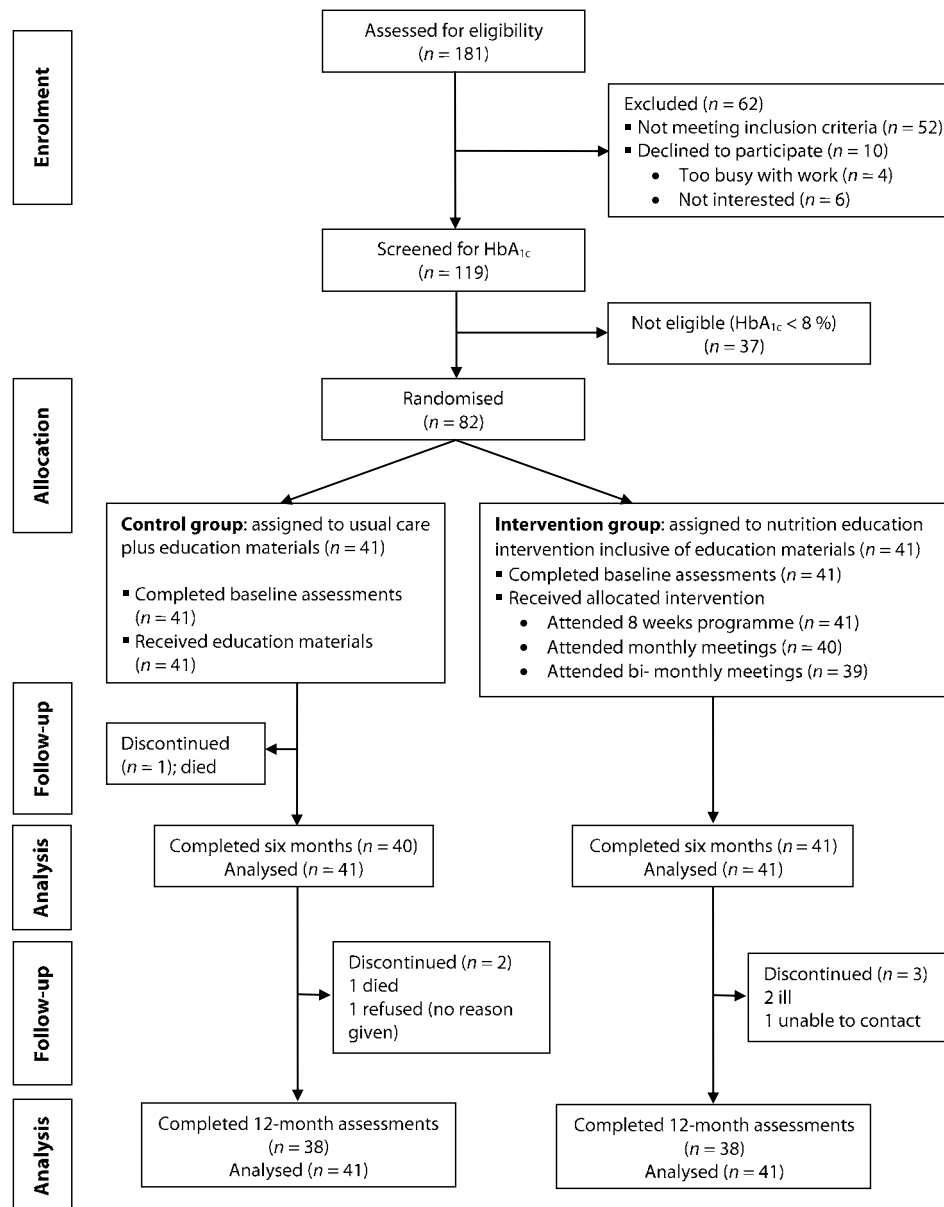
Figure 1: Participants' flow through the study.

Discussion

This study showed that an NEP implemented among a population of mostly black African women in their late fifties, with low levels of education, significantly improved knowledge of diabetes, but not attitudes towards diabetes as measured at 6 months and 12 months post-intervention.

The results are in agreement with NE studies done in China[28] and Iran[29] in people with T2DM. These results add to the evidence that DSME does improve patients' knowledge regarding diabetes and the treatment thereof.[4]

Although the intervention improved the knowledge of diabetes significantly from baseline to post-intervention, the overall knowledge scores remained poor (< 7.5/15; < 50% correct), possibly indicating that the population did not comprehend the disease and the management thereof. In contrast, the majority (78%) of participants who attended a diabetes education course in Brazil obtained scores higher than 8 out of a maximum possible of 15.[30]

The low baseline diabetes knowledge scores (pre-education) are comparable with those reported from studies done in Nigeria[31] and Australia.[32] The low knowledge scores could be related to the low education level and a lack of prior exposure to diabetes education programmes.[32] The low knowledge scores post-intervention could be due to low literacy levels, including health literacy, that are associated with low education attainment.[33] Low literacy could affect the ability to process and understand information. The effects of low literacy could be exacerbated by the lack of previous participation in structured diabetes education programmes and the fact that not all NE sessions were offered in the local language. Poor knowledge of diabetes even after attending diabetes education has been reported in people with low health literacy compared with those who have adequate literacy.[33]

Poor performance in both groups was observed in the basic physiology knowledge category, which included insulin action and causes of hypoglycaemia, as well as items on empty-calorie foods and free foods from baseline to post-intervention. The finding of poor knowledge on the causes of hypoglycaemia after

Table 1: Participants' characteristics at baseline: comparisons between the intervention and control groups

Characteristic	Intervention (n = 41)	Control (n = 41)	p-value
Age (years) mean (SD)	59.4 (6.9)	58.2 (8.0)	0.66
Diabetes duration (years)	5 (3–9)[a]	7 (4–10)[a]	0.37
	n (%)	n (%)	
Ethnicity			
Black Africans	41 (100)	41 (100)	-
Gender			
Male	5 (12.2)	6 (14.6)	0.75[b]
Female	36 (87.8)	35 (85.4)	
Gender/age			
Males: 40–60 years	2 (4.9)	3 (7.3)	1.0
Males 61–70 years	3 (7.3)	3 (7.3)	
Females 40–60 years	20 (48.8)	19 (46.4)	
Females 61–70 years	16 (39)	16 (39)	
Marital status			
Single	6 (14.6)	6 (14.6)	0.69
Married	25 (61)	28 (68.3)	
Widowed	6 (14.6)	6 (14.6)	
Separated/divorced	4 (9.8)	1 (2.5)	
Living situation			
Live with family	37 (90.2)	39 (95.1)	0.54
Live alone	3 (7.3)	2 (4.9)	
Other	1 (2.5)	0	
Education level			
No formal education	2 (4.9)	5 (12.2)	0.69
Grade 1–6	11 (26.8)	11 (26.8)	
Grade 7–9	18 (43.9)	16 (39.0)	
Grade 10–12	7 (17.1)	8 (19.5)	
Post grade 12	3 (7.3)	1 (2.5)	
Employment status			
Employed	2 (4.9)	6 (14.6)	0.26
Not employed	39 (95.1)	35 (84.4)	
Oral hypoglycaemics	8 (19.5)	7 (17.1)	0.92
Biguanides			
Sulphoynlureas + biguanides	29 (70.7)	29 (70.7)	
Sulphonylureas	4 (9.8)	5 (12.2)	

[a]Median and interquartile range in parentheses.
[b]Based on chi-square or Fisher's exact test if n < 5.

diabetes education has previously been reported in both type 1 and T2DM patients attending diabetes education programmes in Sydney.[34] The poor knowledge on basic physiology and insulin action was reported among black women with T2DM in South Africa.[27] Poor knowledge scores may reflect inadequate comprehension of the underlying principles of diabetes self-management in many patients in this setting, which could impact negatively on self-care activities.

Despite the poor performance in the knowledge section, the knowledge gained motivated the intervention group to engage in

Table 2: Diabetes knowledge scores: differences between the intervention and control groups from baseline to post-intervention

	Baseline			6 months				12 months			
	Intervention	Control	Difference in means (95% CI)	p-value[a]	Intervention	Control	Difference in adjusted means (95% CI)	p-value[b]	Intervention	Control	Difference in adjusted means (95% CI)	p-value[b]
	5.30 (0.30)	5.60 (0.33)	−0.29 (−1.20–0.62)	0.52	5.98 (0.30)	5.02 (0.30)	−0.96 (−1.82–−1.11)	0.028	6.98 (0.34)	04.92 (0.34)	−2.05 (−3.00–−1.11)	0.000

Note: Data are presented as means and standard error of the means.
[a]Based on Student's t-test.
[b]Adjusted for baseline values, age, clinic and gender.

Table 3: Correct responses for diabetes knowledge per knowledge category by group from baseline to post-intervention

Category of knowledge	Baseline			6 months			12 months		
	Interv. (n = 41)	Control (n = 41)	p-value[a]	Interv. (n = 41)	Control (n = 41)	p-value[a]	Interv. (n = 41)	Control (i = 41)	p-value[a]
Basic physiology of diabetes including insulin action, n (%)									
When glucose is detected in urine	26 (63.41)	22 (53.70)	0.37	15 (36.59)	11 (29.27)	0.48	25 (61.00)	20 (48.78)	0.27
Best food before prolonged exercise	23 (56.10)	22 (53.66)	0.82	16 (39.02)	18 (43.90)	0.65	23 (56.10)	18 (43.90)	0.40
High blood or urine sugar level and insulin adjustment	9 (21.95)	15 (36.59)	0.15	18 (43.9)	13 (31.70)	0.26	19 (46.34)	10 (24.39)	0.038
Normal glycaemia and hypoglycaemia, n (%)									
Normal range of blood glucose	19 (46.34)	23 (56.01)	0.40	26 (63.41)	21 (51.22)	0.26	35 (85.34)	16 (39.02)	0.000
Cause of hypoglycaemia	10 (24.39)	10 (24.39)	1	9 (21.95)	11 (26.83)	0.61	7 (11.07)	6 (14.63)	0.76
When hypoglycaemia is likely to occur	1 (2.44)	0	0.50	2 (4.90)	3 (7.31)	0.50	2 (4.90)	1 (2.44)	0.50
Food group and food substitutions, n (%)									
Fat food (margarine)	23 (56.10)	23 (56.1)	1	25 (61.00)	23 (56.10)	0.65	27 (65.85)	25 (60.98)	0.65
Carbohydrate food (rice)	11 (26.83)	13 (31.70)	0.63	24 (58.54)	16 (39.02)	0.08	24 (58.54)	21 (51.22)	0.51
Egg substitution	13 (31.70)	10 (24.40)	0.46	18 (43.90)	17 (41.46)	0.82	25 (61.00)	16 (39.02)	0.047
Free foods	0	0	1	2 (4.90)	0	0.25	2 (4.90)	2 (4.90)	0.69
Empty-calorie foods	2.0 (4.90)	3.0 (7.31)	0.50	6.0 (14.64)	2.0 (4.90)	0.13	5.0 (12.20)	2.0 (4.90)	0.22
Sick day management, n (%)									
Insulin adjustment during illness	17 (41.46)	18 (43.90)	0.82	27 (65.68)	16 (39.02)	0.015	20 (48.78)	12 (29.27)	0.07
Illness, poor dietary intake and use of insulin	12 (29.27)	13 (31.70)	0.81	8 (19.5)	5 (12.20)	0.36	15 (36.59)	10 (24.39)	0.23
General diabetes management, n (%)									
Key to control of diabetes	37 (90.2)	37 (90.2)	1	36 (87.80)	31 (75.61)	0.15	37 (90.2)	29 (70.73)	0.026
Reason for attention to foot care	15 (35.59)	16 (39.02)	0.82	27 (65.68)	16 (39.02)	0.015	17 (41.46)	15 (36.59)	0.65

Note: Interv. = intervention.
[a]Based on chi-square test or Fisher's exact test if n < 5.

appropriate dietary behaviours related to reducing starchy food portions and energy intake.[19] Starchy food portions (at 6 and 12 months) and energy intake (only at 12 months) were found to be significantly lower in the intervention group. A process evaluation of the NEP revealed that the intervention group participants perceived themselves to have gained new knowledge and responded by making positive dietary and related behavioural changes. They were also very satisfied with the programme.[35]

Table 4: Attitudes toward diabetes and its treatment: differences between intervention and control groups from baseline to post-intervention

Sub-scale	Scale characteristics		Baseline				6 months				12 months			
	Number of items	Cronbach's alpha	Interv. group (n = 41)	Control group (n = 41)	Difference in means (95% CI)	p-value[a]	Interv. group (n = 41)	Control group (n = 41)	Difference in adjusted means (95% CI)	p-value[b]	Interv. group (n = 41)	Control group (n = 41)	Difference in adjusted means (95% CI)	p-value[b]
Need for special training	5	0.72	4.69 (0.10)	4.65 (0.10)	0.04 (−0.15–0.23)	0.69	4.57 (0.1)[c]	4.61 (0.10)	0.06 (−0.23–0.18)	0.64	4.59 (0.10)	4.46 (0.10)	0.13 (−0.32–0.06)	0.18
Seriousness of type 2 diabetes	7	0.46	3.07 (0.09)	3.16 (0.08)	0.08 (−0.32–0.15)	0.49	3.20 (0.09)	3.00 (0.09)	0.16 (−0.43–0.10)	0.22	3.15 (0.09)	3.26 (0.09)	0.10 (−0.14–−0.34)	0.40
Value of tight control	5	0.43	3.00 (0.10)	3.14 (0.09)	0.14 (−0.40–0.13)	0.30	3.09 (0.08)	3.03 (0.08)	0.06 (−0.29–0.17)	0.60	3.05 (0.09)	3.02 (0.09)	0.03 (−0.52–0.17)	0.82
Psychosocial impact of diabetes	4	0.46	4.03 (0.07)	3.92 (0.08)	0.11 (−0.10–0.33)	0.29	3.91 (0.08)	3.93 (0.08)	0.02 (−0.21–0.26)	0.83	3.89 (0.07)	3.93 (0.07)	0.03 (−0.15–0.22)	0.71
Patient autonomy	6	0.50	3.97 (0.08)	3.90 (0.07)	0.07 (−0.15–0.29)	0.54	3.76 (0.07)	3.92 (0.07)	0.14 (−0.05–0.36)	0.11	3.92 (0.09)	3.67 (0.09)	0.27 (−0.49–−0.07)	0.028

Note: Data are presented as means and standard error of the means.
Interv. = intervention.
[a]Based on Student's t-test.
[b]Adjusted for baseline values, age, clinic and gender.

The lack of improvement in attitudes towards diabetes and the treatment thereof are consistent with the findings of a study done in Glasgow.[36] Comparisons for specific attitude sub-scales are difficult to make, since different attitude-measuring instruments are used in different studies. There is also limited literature on NE programmes that have measured attitudes towards diabetes and its treatment.

The lack of improvement in attitudes, especially related to the value of tight glucose control and the seriousness of T2DM diabetes, in the intervention group was not expected since the need for tight glucose control and the consequences of poor control were greatly emphasised during the NE sessions. The apparent perception among the current study participants that T2DM is not a serious disease could be due to the fact that participants were not on insulin therapy. Previous research has indicated a link between patients' beliefs about diabetes severity and the mode of treatment: diabetes that is treated with insulin has been perceived as more serious than that treated by oral hypoglycaemic agents or diet.[37] This situation could also be reinforced by health professionals referring to diabetes not treated with insulin as 'borderline' or 'mild diabetes'.[37] The neutral attitudes towards tight glucose control and the seriousness of T2DM diabetes seen in participants in this study could indicate a lack of strong belief regarding the importance of these aspects. This underestimation of the importance of tight glucose control could negatively influence their reception of information and the commitment towards appropriate self-care activities. Clark et al. reported that intervention participants who viewed diabetes as less serious showed fewer improvements on dietary outcomes.[38] Anderson *et al.*, in a study done in the USA, found that patients who reported high levels of adherence to diabetes care had more positive attitudes toward diabetes and the management thereof.[15]

The lack of improvement in the attitudes towards diabetes and associated treatment does not meet the expectations based on the KAB model, which purports that an accumulation of knowledge leads to a change in attitude.[23] Knowledge acquired by the participants in this study was possibly insufficient to have a positive effect on attitudes. Inadequate acquisition of knowledge could be supported by the post-intervention diabetes knowledge scores being less than 50% correct. However, as the magnitude of knowledge accumulation that would confer a change in attitude is not known, it may not be conclusive that insufficient knowledge was responsible for a lack of improvement in attitudes (this study). Knowledge alone may not necessarily lead to a change in attitude or practices.[39] Participants' exploration of their attitudes seems to play a role in attitudinal changes.[6]

The strengths of this study include the randomised study design, the low attrition rates and the 12-month study period that allowed for observation of changes in the measured outcomes and their sustenance beyond 6 months. The limitations of this study include the administration of the questionnaires by two different methods that was necessitated by the unavailability of one of the trained interviewers. This could have influenced the way participants responded to questions.[40] However, since the methods were equally applied to the intervention and control groups, the effect would cut across the two groups. This issue affected less than a third of the participants. Although piloted and previously used in South African studies, the questionnaires have not been validated with the patient population. This could have contributed to the observed results and the low internal consistency in some of the DAS III sub-scales in comparison with those of the original scale.[26] Notwithstanding, the Cronbach's alpha values in this study are comparable with those reported in a previous South African study done among urban black women with T2DM.[27] The higher proportion of females compared with males could limit the generalisation of the results. However, this scenario seems to be typical of the study setting[22] and for the South African diabetes population in primary care settings.[41]

Conclusions

The NEP significantly improved diabetes knowledge, though not adequately, but had no effect on the attitudes towards diabetes and the treatment thereof. This poor performance is of concern and warrants regular and sustained structured diabetes education and the provision of opportunities for participants to explore their attitudes towards diabetes and the management thereof. The positive attitude portrayed by the patients regarding the need for special training of health professionals is an indication that they value the information they receive from health professionals. An assessment of the attitudes of health professionals with regard to diabetes and the treatment thereof would be beneficial, since their opinions are reported to influence patients' beliefs about disease severity.[36] Future studies could also benefit from assessing the beliefs regarding dietary and related behaviours rather than just beliefs related to diabetes and the treatment thereof.[42]

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