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Nutrition education improves knowledge scores on dietary management, physical activity and index among Type 2 diabetes mellitus patients in a Randomized control trial

Ann Thuita[*]

Department of Human Nutrition Sciences, Jomo Kenyatta University of Agriculture and Technology, Kenya

Abstract

Type 2 diabetes mellitus (T2DM) is on the increase hence the need for preventive strategies to curb this upward trajectory. Diabetes education is one of the preventive strategies that can be adapted and employed with the aim of increasing knowledge and awareness of overall management of T2DM Therefore, the aim of this study was to determine the effect nutrition education on knowledge level in Type 2 diabetes mellitus patients. The study was a randomized control trial with two intervention groups; nutrition education peer to peer support (NEP) group and nutrition education (NE) group, and a control (C) group. One of the intervention group received nutrition education programme. The NEP group received nutrition education programme with additional peer to peer support component while NE group received only nutrition education. The nutrition education classes run for eight weeks 2 hrs. each. Standard care was given to the control group. A pre-test questionnaire testing knowledge on diabetes management (5 questions), diet management (10 questions), glycemic index (10 questions) and physical activity (5 questions) was administered to all the groups before the intervention and the same questionnaire was administered after the intervention, at month one, month three and month six. Mean percentage knowledge score was determined and compared between groups using Analysis of co-variance (ANCOVA). The results showed that there were no statistically significant differences in the knowledge score of the participants at baseline in all the groups. However knowledge scores improved significantly ($p<0.01$) post intervention in the NEP; +42.45% after intervention, +40.00% at month one, +34.53% at month three and +36.68% at month six post intervention after intervention, , and. The knowledge score also improved in NE; +38.34% after intervention, +35.37% at month one, +31.12% at month three and +33.10% at month six post intervention. The greatest improvement was seen one month after the intervention in the two intervention groups. When we compared the knowledge score differences between the groups, there was a statistically significant ($p<0.05$) difference between NEP and NE at month one (4.33%,) and at month six (3.59%,) post intervention and between NEP and C (37.99%, 35.13%, 29.04% and 32.57%; $p<0.01$) and NE and C (34.16%, 30.80%, 25.91% and 28.98%; $p<0.01$) after intervention and at month one, month three and month six post intervention, respectively. In conclusion, our findings show that the application of nutrition education programme in Type 2 diabetes mellitus patient improved the knowledge score in diabetes management, diet management, physical activity and knowledge on glycemic index. Furthermore, the inclusion of peer to peer support improved the outcome; hence we recommend that nutrition education programme with peer to peer support can be adapted as a preventive strategy for type diabetes mellitus patients.

Keywords: Nutrition education, Type 2 diabetes, Physical activity, Glycemic index

Introduction

Type 2 diabetes mellitus is a global health problem and is becoming a serious challenge due to its associated complications and increased cost of care [1]. This epidemic is on the increase with a prevalence of 425 billion adults aged 20 years -79 years having T2DM [2]. To combat this burden, different preventive and management approaches that aims at promoting good glycemic control and reducing complication need to be adapted [2,3,1]. These include among others early diagnosis and continuous monitoring of glucose level, screening for complications as well as lifestyle modification (healthy diet and physical activity) [3]. These management and preventive strategy need to be communicated to the patient as well as the stakeholders. This can be achieved through diabetes education.

In fact, diabetes education when employed in a well-structured manner has been shown to enhance knowledge in the management of T2DM as well as improve skills in diabetes self-care [4]. Moreover, studies have shown that application of diabetes education in management of T2DM has led to improved behavior to lifestyle change, compliance to diabetes

treatment (medication, diet and exercise), better glycemic control as well improved metabolic outcome [5]. Diabetes education aims at enabling and empowering the patient in active self-management through knowledge acquisition. Different strategies that include individual counseling, group education, peer to peer support and telecommunication using different health model have been used to implement diabetes education [6].Persons with T2DM have reported potential benefits from diabetes education which includes improved understating of diabetes as well as its management, ability to make healthy food choices as well as participat-

ing in physical activities through improved lifestyle behavior. All these benefits have been linked to improved quality of life [7].

Nutrition education is a main component in diabetes education and has been shown to improve dietary behavior and clinical outcomes in person with T2DM [8]. This has been applied using different strategies that include peer to peer support, text message, group education session, individual counseling among others [9]. Peer to peer support nutrition education strategy applied on T2DM patient has shown improved metabolic outcome, hence, can be adapted in management of T2DM in addition to other strategies [10]. Despite the importance of structured diabetes education, using different strategies being effective, very few patients receive it. Therefore, this study aims to fill this gap by providing a structured nutrition education programme to T2DM and assess its effectiveness on knowledge retention.

Materials and Methods

Development of nutrition education curriculum for type 2 diabetes mellitus

The nutrition education curriculum was developed after review of studies and reports on T2DM patients employing a nutrition education model [11]. The curriculum aimed at imparting knowledge to participants on diabetes management and lifestyle modification. The education material included a component on importance of nutrition in management of Type 2 diabetes as well as an introduction to diabetes management. The goal of the education material was to provide a basic understanding of the relationship between Type 2 diabetes mellitus and nutrition, to help patient improve recognition of the food groups and increase awareness of the importance of combining foods for improved glycemic control and to improve diabetic meal planning skills. Recommendations from medical nutrition therapy in management of T2DM were adapted in order to achieve this goal [1].

Study setting

The study was conducted at Thika Level 5 Hospital (TL5H), which is in Thika Sub County, Kiambu County, Kenya. Thika Level 5 Hospital (TL5H) is a referral hospital as well as a treatment site for the entire population of Thika, its environment and neighboring counties. The hospital was purposively selected as it operates an outpatient diabetes clinic daily and has a diabetes comprehensive care Centre (DCC) that was established in 2011 due to demand of a comprehensive care for Type 2 diabetes mellitus patients. This demand arose due to increased prevalence of Type 2 diabetes in the region as well as related complications. Type 2 diabetes mellitus (T2DM) patients who attend this clinic are either self or clinician refereed from the county and the nearby counties. The clinic provides a comprehensive care in a single setting hence a preference for most T2DM patients. However as reported by Mwavua et al. [12], the level of care is sub optimal with nutrition education getting little emphasis during health talk. This therefore, calls for a detailed nutrition education programme aimed at improving knowledge and self-care for the participants.

Study design

This was a randomized control trial with two intervention groups and one control group. The first intervention group received nutrition education with peer to peer support, while the second intervention group received nutrition education and control group received standard care. Nutrition knowledge was assessed before start of the intervention, after the intervention, one month after the intervention, three months and six month after the intervention.

Study participants

The study participants were Type 2 diabetes mellitus (T2DM) patients aged between 20 years-79 years attending diabetes care at TL5H. Participants with T2DM aged 20-79 years, willing to attend meeting on appointment days for the six months were included in the study. The participants included in the study also signed an informed consent. Participant with T2DM aged 20 years-79 years and had complications, like renal failure, congestive heart failure (CCF), and stroke were excluded from the study during recruitment.

Sample size

The sample size was determined using a formula by [6]. A sample size of 46 participants was found adequate for each group. An attrition of 10% was given hence each group had a 51 participant. Recruitment of the participants was done for 2 months between the months of August to October 2016. The recruited participants gave their contacts and this was used for contacting the participants and reminding them of their appointment days.

Randomization

The study participants were randomized into three groups; Nutrition education peer support group, nutrition education group and control group using lottery method. After randomization, the groups were given delivery of the nutrition education content. The study employed the social cognitive theory [12] and expected that the nutrition education could lead to knowledge acquisition on nutrition management of Type 2 diabetes. Those participants who consented to participate in the study, were given appointment days. Each group had a separate day. The participants were called and invited for the study in their respective days. The nutrition education content was delivered to the two intervention groups for a period of eight weeks and each session lasted 2 hours. The nutrition education was presented in the form of group enabled sessions. Different methods were used for delivery that included lectures, role play, demonstration, group assignment among others. These delivery methods aimed at giving direct, interactive and experimental approach to delivery of information. The language of communication used in the study was Kiswahili and English as the participants were a combination of different tribes. This is because Thika is a Cosmo-political town. Local language Kikuyu was also used as a third language for patients of Kikuyu origin who could not understand using Kiswahili and English.

Demonstration of food groups was done using the locally available foods. Lessons on different serving sizes using local foods, was done and participants were requested to demonstrate servings of different sizes to their group members. Household utensils that included different plate sizes, cups, glasses, serving spoons of different sizes were used during the demonstrations. Ready to eat food was also used for demonstrations. The foods used were sourced from the TL5H hospital kitchen. Emphasis on colour selection using the signal system was given and demonstrated during serving. Different serving sizes as per the food groups guide using cooked food and row food was given. Different portion size methods that included the plate mode l and Zimbabwe hand jive were used during demonstrations. Participants performed role plays by putting emphasis on the importance of nutrition in diabetes management. Lessons on menu planning using samples of different menus and label reading were also given. Participants shared their local recipes and the PI and the research assistants assisted them to improve into healthy menu plans. Portion control was emphasized during menu planning.

Additionally, the principle investigator (PI) gave participants foods with different labels and gave them time to study them and communicate to

their group members what was contained in the labels. This aimed at assisting participants to make informed decisions before purchasing any food products. Glycemic index of different food were also given. Locally available foods were used while communicating the glycemic indices of different foods. The participants were encouraged to form groups and classify food samples given to high, low or medium glycemic index using the signal system. Moreover, differences between glycemic load and glycemic index was given and demonstrations done. Participants were also given a chance to practice. A one-day lesson on physical activity was given that included importance of exercise in type 2 diabetes, types of exercise recommended, and time for exercises. The physical activity pyramid was used to demonstrate different physical activity levels. Demonstrations of different exercises were given by the PI together with a physiotherapy trained on diabetes management. During these sessions, participants were requested to dress ready for exercise. They were also encouraged to achieve at least 30 minutes of moderate activity daily for at least five days a week.

Data collection

Data was collected using a pretest and posttest questionnaire to test knowledge delivery as well as examining whether delivery method used was adequate. Before implementation of the curriculum, a pretest questionnaire was given to all participants in all the groups. The PI took participants through the question before they started answering to ensure they understand what was being asked. The questionnaire had questions on general management of diabetes (5), health diet (10), physical activity (5) and glycemic index (5). The same questionnaire was given after the intervention, at one month, 3 month at six months. The average score of the questions was used to compute the total pretest and posttest score.

The posttest evaluation was done at month1, month 3 at month 6. Finally, grading of the education session delivery was done only for the intervention groups; hence a sample size of 102 participants was used for the analysis.

Data analysis

Data was analyzed using statistical package for social science (SPSS) version 20. Nutrition education delivery assessment was presented as frequency and statistical significance using chi square test was set at $p<0.05$. Pre and post test data between the groups was analyzed using analysis of co-variance (ANCOVA) while controlling for baseline characteristic (age, gender, and marital status, education level, years lived with diabetes and family history of diabetes). The data was presented as mean (Standard error; SE or standard error of difference; SED) and statistical significance set at $p<0.05$.

Results

Baseline characteristics

As shown in Table 1, the mean age of the participants was 56 years with more than half having attained primary education in all the groups;54.9% in NEP group, 52.9% in NE group and 56.9% in C group. Majority (85%) of the participants had received information about including vegetables in their meals, while only 45.8% had been told to take plenty of water. Other information given to the participant before the start of the study included information of including vegetables in their meals, avoiding alcohol, eating a low fat diet, eating non refined carbohydrates as well as use of the plate method in portion control as shown in **Table 1**.

Table 1: Baseline characteristic of the participants data presented as proportion (n) and percentages (%) or mean (standard deviation; SD)

Parameters		Total	NEP	NE	C
		Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)	Mean±SD or n (%)
Age		56 ±11.67	57±10.88	55 ±12.34	56±11.97
Education level	No education	0(0)	0(0)	1(2)	1(0.7)
	Primary	28(54.9)	27(52.9)	29(56.9)	84(54.9)
	Secondary	20(39.2)	18(35.3)	16(31.4)	54(35.3)
	Tertiary	3(5.9)	6(11.8)	5(9.8)	14(9.2)
Nutrition information	Include vegetable in meals	42(82.4)	42(82.4)	46(90.2)	130(85)
	Take plenty of water	22(43.1)	20(39.2)	28(54.9)	70(45.8)
	Include protein in meal	27(52.9)	19(37.3)	19(37.3)	65(45.2)
	Eat non refined carbohydrates	5(9.8)	4(7.8)	1(2.0)	10(6.5)
	Avoid alcohol	3(2.0)	1(2.0)	5(9.8)	9(5.9)
	Use plate model in portion control	5(9.8)	2(3.9)	5(9.8)	12(7.8)
	Consume low fat diet	11(21.6)	9(17.6)	8(15.7)	28(18.3)
Place where information was received	Hospital	45(88.2)	43(84.3)	40(78.4)	125(82.4)
	Media	3(5.9)	4(7.8)	3(5.9)	10(635)
	church	1(2.0)	3(5.9)	4(7.8)	8(5.2)
	Others(from friends and group gatherings)	2(3.9)	1(2.0)	4(7.8)	7(4.6)

Source of nutrition information	Doctor	2(3.9)	7(13.7)	4(7.8)	13(8.5)
	Nutritionist	44(86.3)	38(74.5)	41(80.4)	123(80.4)
	media	3(5.9)	4(7.8)	3(5.9)	10(6.5)
	Relative/friend/group gathering	2(3.9)	2(3.9)	3(5.1)	7(4.6)

Knowledge score of the participants

As shown in Table 2 there was no statistical significant difference in knowledge score of the participants at baseline in all the groups. However, knowledge score improved significantly post intervention in the NEP group; +42.45% after intervention, +40.00% at month one, +34.53% at month three and +36.68%, at month six post intervention (Table 2). There was also improvement of overall knowledge in NE group; +38.34% after intervention, +35.37% at month one, +31.12% at month three and +33.10% at month six post intervention (Table 2). The greatest improvement has seen one month after the intervention in both intervention groups (Table 2). Comparison of knowledge score differences between the groups was statistically significant ($p < 0.05$) between NEP and NE (4.33 %,) and at month six (3.59 %,) post intervention. Statistical significant difference was also seen between NEP and C after intervention (37.99%, at month one (35.13%), at month three 29.04% and 32.57%; at month six post intervention. Additionally statistical significant difference was also sees between $p < 0.01$) and NE and C after intervention 34.16%, at month one 30.80%, at month three 25.91% and at month six post intervention 28.98%; $p < 0.01$) after intervention, and at month one, month three and month six post intervention, respectively (**Table 2**).

Table 2: General Diabetes Knowledge Score of the Participants Before the intervention, After the Intervention, at Month 1, at Month3 and at Month 6 Post Intervention

Months	NEP Mean(SE)	NE Mean(SE)	C Mean(SE)	P value	NEP-NE Mean(SED)	NEP-C Mean(SED)	NE-C Mean(SED)
Pretest	45.38(1.18)	45.22(1.17)	44.41(1.16)	0.82	-0.29(1.51)	0.66(1.50)	0.94(1.49)
Posttest (After intervention)	86.61(1.13)	82.78(1.12)	48.62(1.11)	0	3.38(1.60)	37.99(1.59)**	34..16(1.57)**
Posttest after Month1 post intervention	84.15(1.15)	79.82(1.15)	49.02(1.14)	0	4.33(1.64)*	35.13(1.63)**	30.80(1.61)**
Posttest after Month3 post intervention	78.61(1.20)	75.61(1.20)	49.70(1.19)	0	3.13(1.71)	29.04(1.70)**	25.91(1.68)**
Posttest after Month6 post intervention	80.98(1.04)	77.38(1.02)	48.40(1.06)	0	3.59(1.17)*	32.57(1.16)**	28.98(1.15)**
Knowledge change of the participants							
Change post intervention	42.45(1.51)	38.34(1.50)	5.12(1.49)	0	4.12(2.14)	38.34(2.14)**	33.22(2.12)**
Change at month 1	40.00(1.52)	35.37(1.53)	5.52(1.51)	0	4.63(2.17)*	34.47(2.16)**	29.84(2.14)**
Change at month 3	34.53(1.64)	31.12(1.65)	6.20(1.66)	0	3.41(2.34)	28.33(2.35)**	24.92(2.33)**
Change at month 6	36.68(1.30)	33.10(1.28)	5.07(1.32)	0	3.58(1.84)	31.61(1.87)	28.03(1.84)

The study reported an average knowledge score of less than a 50% general diabetes management; 42.78% in NEP group , 43.38% in NE group and 42.95% in C group, and dietary management;44.33% in NEP group , 45.01% in NE group and 43.34% in C group . Additionally knowledge on glycemic index and physical activity was also below 50% for all the groups at baseline . Nevertheless, the Knowledge score percentage for general management of diabetes improved significantly ($p < 0.01$) after the intervention 88.08% at month one (85.02%), at month three (79.07%) and at month post intervention (82.05%) in the NEP group. Additionally there was also improvement in knowledge score percentage in diet management knowledge; 8 after the intervention (88.37%), at month one (85.28%), at month three (79.07%) and at month six (82.05%) post intervention. Glycemic index knowledge (84.25%, 82.44%, 78.58% and 78.69%) and physical activity knowledge score (85.75%, 83.84%, 79.68% and 81.68%) also showed significant improvement ($p < 0.01$, p=0.000) after intervention, at month one, at month three and at month six post intervention . The NE group also reported significant improvement ($p < 0.01$, =0.000) for general diabetes management knowledge score(84.27%, 80.96%, 75.34%, 77.75%); for diet management knowledge (84.24%, 80.95%, 76.35% and 78.41%) for glycemic index knowledge (80.59%, 78.01%, 74.51% and 76.31%)and physical activity knowledge (82.02%, 79.36%, 76.25% and 77.06%) after the intervention, at month one, at month three and at month six post intervention . Notably, the greatest improvement of above 80% in all parameters studied was seen at month one post intervention for both NEP and NE group . Additionally, the NEP group showed the greatest improvement in all parameters studied in all the months .

Nutrition content delivery

Majority (66.7% in NEP and NE) of the participants felt that the content delivered during the intervention was very good, with only 18.6% (17.6% in NEP group and 19.6% in NE group) and 14.7% (15.7% in NEP group and 13.7% in NE group) feeling that it was good and moderate, respectively. In terms of time allocation, majority 94.1% (96.1% in NEP group

and 92.2% in NE group respectively) felt that the 2 hours allocated for the education session was adequate. Additionally, majority of the participants; 94.1% and 90.2% in NEP group and 96.1% and 94.1% in NE in group, felt that the intervention was important and that the teaching materials were relevant and can be adapted and used as a reminder . Furthermore, majority of the participants felt the teaching methods used were appropriate and only 2.9% (3.9 in NEP and 2.0% in NE) felt that it needed revision.

Discussion

Studies have shown that lack or insufficient knowledge on diabetes management is associated with, poor dietary choices and poor self-care leading to poor glycemic control and increased metabolic disorders in T2DM patients [13]. Therefore, strategies geared towards improving knowledge levels in diabetes management and support are recommended as one of the preventive measure for T2DM [2, 3]. Such strategies include among others diabetes education. Diabetes education has been shown to be the key in improving knowledge levels and management of T2DM as well as self-care management and glycemic control [10]. Importance of lifestyle modification is components that need to be in cooperated in diabetes education. However, despite the importance of diabetes education there is low knowledge level on general management of T2DM reported in patients [5]. It is no wonder that this study also reported a knowledge level of below 50 % at baseline.

Nutrition education applied alone as a component of diabetes education or with other strategies like peer support and exercise programmes using different health models in T2DM, have been shown to increase nutrition knowledge, self-care as well as good glycemic and metabolic control in some studies [9]. The current study employed a nutrition education programme with peer to peer support using the social cognitive theory and determined its effect on knowledge retention. Our study showed an improved level in knowledge in diabetes management, dietary management of T2DM, glycemic index and physical activity in the intervention groups. The results of this study is supported by findings of a South Africa study that showed improved knowledge, behavior and clinical outcomes after application of a nutrition education programme [8]. Another study in Egypt employing nutrition education is also in support of our study [5].

Conclusions

Peer to peer support in Type 2 diabetes management is reported as one of the preventive strategies in T2DM management. This is especially true when combined with nutrition education and diabetes self-management. A study by that used peer assisted learning (PAL) education in T2DM patients reported an increased knowledge scores as well as better metabolic outcomes. Indeed, inclusion of peer to peer support in our study improved knowledge scores post intervention which was significantly higher than the use of nutrition education programme alone. This therefore indicates that, peer support can be used in nutrition education programmes and diabetes education and hence can be a good intervention strategy for T2DM patients' management. Additionally, the current study showed a higher nutrition score immediately after the intervention with a drop as time progressed in all the components.

For this reason, it is clear that knowledge retention was higher at the onset of the programme and declined as time elapsed after the intervention. Therefore suggest this therefore suggests that for nutrition education to be effective continuous update needs to be given to the patients after initial programme to ensure that they retained the knowledge. Moreover, knowledge scores for diabetes management and diet management recorded higher levels post intervention. However, knowledge on glycemic index was lower compared to others indicating. This gives an indication that the patient had good retention on diabetes management and diet management compared to Glycemic index and Physical activity knowledge. Application of nutrition education programme in Type 2 diabetes mellitus patient improved the knowledge score in diabetes management, diet management, physical activity and knowledge on glycemic index. Consequently, inclusion of peer to peer support improved the outcome further; hence nutrition education programme with peer to peer support can be adapted as a preventive strategy for type diabetes mellitus patients.

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