Articles

Effect of Nutrition Education Intervention and Lifestyle Behaviors on Management of Type 2 Diabetes Mellitus in Mwanza city, Tanzania

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Abstract

Type 2 diabetes mellitus (T2DM) is a chronic disease associated with impaired glucose metabolism. This study aimed at assessing the effect of nutrition education intervention on the lifestyle behaviors and management of T2DMamong adult diabetic patients who attended a clinic at Bugando hospital, Mwanza city for a period of one year during 2013.A cross-sectional study design was used to identify the population at risk of T2DM, from which random blood testing for glucose testing was conducted. Thereafter, a fasting blood glucose test was performed for the study sample with elevated blood sugar (≥200 mg/dl) to confirm the cases (individuals suffering from T2DM).The cases were subjected to nutrition and lifestyle education intervention programme for one year. Findings showed that baseline mean fasting blood glucose was 285.15±86.08mg/dl. Mean age was 55.8525 ± 9.36 years while the mean Body Mass Index (BMI) was 28.18 kg/m^2, falling within the overweight category(24.9-29.9kg/m^2); and there was a significant ($p\leq0.05$) difference in fasting blood glucose between males and females. After the intervention, results revealed that fasting blood glucose levels were observed to decrease gradually from the baseline period up to 12 months. The difference in blood glucose levels between clinical visits (three months) was found to be significant ($p\leq0.05$). There was about 34% average decrease in blood glucose levels from the baseline survey to the post-intervention measure. Fasting blood glucose during baseline was significantly higher ($p\leq0.05$) than at the 3months after intervention. There was 7.3% mean decrease in average body weight from the baseline to the post intervention measurement. Mean BMI also decreased gradually with time. This study revealed that nutrition and modification of lifestyle behavior such as participation in exercises and reducing the amount of starch had delayed the effects of T2DMby one year. It is therefore, possible to delay or prevent the development of complications of diabetes by adherence to clinical recommendation on nutrition and lifestyle modification.

Keywords: *Nutrition, education, lifestyle, management of T2DM.*

Introduction

Type 2 diabetes mellitus(T2DM) is a chronic disease associated with impaired glucose metabolism (ADA, 2009). It may be caused by inadequate insulin produced by beta cells of the pancreas or inability of body cells to respond to insulin produced. This condition can lead to accumulation of glucose in blood due to defects in insulin secretion and insulin action on targeted cells (Erickson, 2007). The effects of this condition include long term damage, dysfunction and failure of various body organs (ADA, 2012).

Long term accumulation of blood glucose can lead to different body disabilities such as nephropathy that may lead to renal failure or a risk of foot ulcers, amputation, sexual dysfunction, risk of cardiovascular diseases and specific complications of retinopathy (Cade, 2008). The short-term management of T2DM aims at lowering and stabilizing mean blood sugar levels, while long-term management aims at avoiding hyperglycemia and ketoacidosis as well as later complications (Teuscher, 2007).Lifestyle modification and nutrition education in particular, recommends that people should follow an appropriate dietary pattern and exercises, which has generally been accepted as the cornerstone of treatment for people with T2DM. An appropriate intake of energy and nutrients will improve glycemic control and reduce the risk of complications (Mann*et al.*, 2004).However, changes that require adherence to a healthy lifestyle are difficult for many people to follow(Coppell *et al.*, 2010).

Management of glucose levels calls for strict adherence to a medical regimen, which may include simple lifestyle measures that have been shown to be effective in preventing or delaying the onset of type 2 diabetes (Joy, 2011). These measures include maintaining a healthy body weight through physical activities or exercises at least 30 minutes of regular, moderate-intensity activity or exercise on most days; eating a healthy diet of between three and five servings of fruit and vegetables per day and reducing sugar and saturated fats intake (Department of Health and Human Services, 2010). Additionally, diabetic patients are advised to avoid tobacco use, because tobacco increases the risk of cardiovascular diseases (Ford, 2006). In many cases, such initial efforts can substantially restore insulin sensitivity. In some cases strict diet and physical activity can adequately control the glycemic levels. In many cases, oral anti-diabetic drugs are required, and in about 30% of the cases insulin injection may be necessary (Rodbard, 2008).

This study aimed at assessing the effect of nutrition education intervention on the lifestyle behaviors and management of T2DMamong adult's diabetic patients who attended clinic at Bugando hospital, Mwanza region for a period of one year.

Methodology

This study was conducted for one year at the diabetic unit of Bugando referral hospital in Mwanza city, which is located in the northern part of Tanzania. The city lies between latitude 20^0 15' and 20^0 45' South of Equator and longitudes 320^0 45' and 33^0 00' East of Greenwich (URT, 2012).The study involved one year of educational intervention from December 2012 to December 2013 for modifying the nutritional and lifestyle behavior of the selected sample for this study.

Subjects

A cross-sectional study design was used to identify the population at risk of T2DM. Random blood glucose testing was conducted. Thereafter, a fasting blood glucose test was performed for the sample from subjects with elevated blood sugar (≥200 mg/dl) to confirm the cases. The cases were subjected to a nutrition and lifestyle behavior education intervention programme for one year. The sample for the follow-up study comprised of only diabetic patients who attended a clinic at Bugando referral hospital for diabetes management. These comprised of adults (males and females) aged 30 years old and above who had resided in Mwanza city for at least a year by the commencement of the clinical study on management of T2DM. Seventy six participants were recruited for the study, but at the end of the study only 61participants remained. Dropping out from the study was caused by various reasons including schedule conflict (n=3), lost track of the follow-up dates (n=5) and unforeseeable circumstances (n=4).

Interventions

Identified cases of diabetes were trained on how to manage the disease through lifestyle behavior modification such as physical exercises, medical and dietary methods, minimizing alcohol intake and abstaining from smoking. Adherence to the treatment regimen was assessed quarterly (every three months) on the basis of structured interviews and measurements. Measurements of Body Mass Index (BMI), blood glucose level, systolic pressure, blood diastolic pressure and Waist Hip Ratio (WHR) were performed to monitor if the participants were improving. Standard lifestyle behavior recommendations were provided in the form of written information and in an individual session for 20-to-30-minutes, performed

annually, where the importance of a healthy lifestyle was emphasized. Participants were required to attend the clinic once after three months for nutrition, lifestyle behavior modification and foot care education. While attending those education session participants were encouraged to follow the Food Guide Pyramid (Cellabert, 2009) and to increase their physical activities in order to reduce body weight. The goal of each participant under the intensive lifestyle intervention was to achieve and maintain weight reduction through a healthy low calorie, low-fat diet and to engage in physical activities of moderate intensity, such as brisk walking, for at least 150 minutes per week.

A training programme covering diet, exercise, and behavior modification was designed to help the participants achieve these goals. The programme was taught by nurses at the Diabetic clinic, providing one-to-one sessions during the first 24 weeks after enrollment. The programme was flexible, culturally sensitive, and individualized. Subsequent individual sessions (usually 3 months) and group sessions, under the supervision of diabetic nurses were designed to reinforce the behavioral changes. The sessions were designed to increase participants' knowledge of healthy eating and physical activity. They also provided practical suggestions for safe weight loss and positive lifestyle changes. The primary diet-related goal was to reduce the amount of carbohydrate and fats intake. In addition, participants had weekly training on physical activity with their health diabetic clinical nurses during the weight loss phase. A physical activity session usually followed an educational session. The exercises was developed and each given to participants. Each participant had a weekly physical activity goal, depending on their physical abilities and fitness level. Also, they were asked to record the number of minutes spent in all physical activities performed per day. The goal here was to engage participants in regular physical activity of moderate intensity for at least 150 minutes per week.

Data Collection

Fasting plasma glucose of the subjects was measured to see if they were attaining normal levels of this indicator after the intervention. Using a standardized Glucometer (Glucometer Type 25 KB JPG), fasting blood glucose was determined once after three months for a period of 12 months. Anthropometric measurements such as height, weight, waist and hip circumferences were measured during the baseline and at every clinical visit. Smoking behavior was self reported and classified as yes/no at the baseline. Alcohol consumption was determined by inquiring about the number of alcoholic drinks consumed per day and categorized as abstainers

(0 units/day), moderate drinkers (1-4 drinks /day), or heavy drinkers (>4 drinks/per day) (International Drinking Guidelines, 2010). The presence of first degree relative who had diabetes (heritage) was self-reported and classified as yes or no during the baseline survey. Information about fruits, vegetable, fats, proteins and carbohydrate intake were assessed by using the food frequency questionnaire and 24hr dietary recall. Examples of bowls representing amounts of food consumed were shown to respondents and used to establish the grams that were eaten per day. Physical activities were assessed by using a question on the frequency and duration of participation in moderate or vigorous physical exercises. The questionnaire included questions on the frequency and duration of participation in different physical activities that were used to calculate hours per week at each intensity level.

Anthropometric and Blood Pressure Measurements

Height and weight were measured by following standard procedures (WHO, 2005). Body mass index was then calculated and categorized in four groups (underweight BMI ≤18.5; normal BMI 18.5-24.9; overweight BMI, 25-29.9; obese BMI, ≥30) according WHO (2004) classification. Waist circumference was measured by using a non –stretchable tape and the readings were taken at the mid –point between the costal margin and iliac crest, with the subject standing erect in a relaxed position and feet placed 25-30 cm apart and all measurements were recorded to the nearest 0.1 cm. Hip circumference was measured at the level of the greater trochanters (widest portion of the hip) using a non-stretchable tape while the subject was standing with arms on the side and feet together. The hip circumference was thereafter recorded to the nearest 0.1cm. Waist and hip circumferences were used to determine the waist hip ratio, where normal hip ratio for women is <0.8, overweight was 0.80-0.84 and obesity ≥ 0.85. For men < 0.9 was the normal weight, 0.9-0.99 was overweight and ≥ 1 was obese. Blood pressure was measured using standard protocol (Pickering *et al.*, 2005). Three serial measurements of blood pressure were taken one minute apart, using a digital blood pressure monitor sphygmomanometer (CH-432B, Citizen Systems Japan Co Ltd) with subjects in the sitting position. The blood pressure was measured after the subject had rested for at least 5 minutes.

Ethical Consideration

Ethical clearance to conduct this study was obtained from the Medical Research Coordinating Committee (MRCC) hosted by National Medical Research (NIMR). Permission to conduct the survey was obtained from

Mwanza region and from Ilemela and Nyamagana district health authorities and also from Bugando referral hospital. After the objectives and benefits of the study were explained to the subjects, they were requested to sign an informed consent form to affirm their willingness to participate in the study. Confidentiality of the collected data was assured.

Statistical Analysis

Data were analyzed by using the Statistical Package for Social Sciences (SPSS) software version 16 where descriptive statistics such as frequency, percentage, means and standard deviations were computed for demographic, biomedical and anthropometric variables. Inferential statistics such as chi-square statistics and student t test were computed at 95% confidence interval to find the relationship between stated variables.

Results

Table 1 indicates demographic, biomedical and anthropometric characteristics of diabetic respondents. About 36.1% (n=22) of respondents had primary school education while 31.1% (n=19) had college level education. Majority of the respondents (62.3%; n=38) were married and 39.3% (n=24) were between 50- 60years old with a mean age of 55.85 ± 9.36 years. The income level of the respondents was 400 000-700 000 Tsh whereby 26.2% were earning that amount per month. Biomedical results showed that diabetic respondents had a waist hip ratio of 0.90± 0.13 indicating high waist-hip ratio, above normal for both males and females. Mean fasting blood glucose was 285.15±86.08and there was a significant difference ($p \leq 0.05$) in fasting blood glucose between male and female respondents. The mean BMI was 28.18kg/m^{2}falling under the overweight category (24.9-29.9).

Effects of the Intervention on Biomedical and Anthropometric for Study Participants

Table 2 shows biomedical and anthropometric differences after intervention. Results revealed that, fasting blood glucose levels decreased gradually from the baseline period up to 12 months and there was a significant difference ($p \leq 0.05$) in blood glucose levels among several clinical visits. There was 34% decrease in blood sugar levels from the baseline survey up to12 months. Fasting blood glucose after 3 months was significantly higher ($p \leq 0.05$) than after 6 months and after 12 months. There was 7.3% (4.2kg) mean decrease in weight from the baseline up to 12 months post intervention. The mean BMI also decreased gradually from the time of intervention. The mean BMI in the first visit was significantly

higher ($p \leq 0.05$) than in during subsequent visits, where there was an average 8.8% decrease in the BMI from the baseline to post intervention results.

Table1. Baseline demographic, biomedical and anthropometric characteristics of diabetic respondents (N=61)

Characteristics	Value/response	Males (%)	Females (%)	Total No. (%)
Education level	Informal	2 (3.3)	3(4.9)	5(8.2)
	Primary	11(18.0)	11(18.0)	22(36.1)
	Secondary	5(8.2)	10(16.4)	15(24.6)
	College	10(16.4)	9(14.8)	19(31.1)
Marital status	Unmarried	1(1.6)	3(4.9)	4(6.6)*
	Married	23(37.7)	15(24.6)	38(62.3)
	Divorced	3(4.9)	7(11.5)	10(16.4)
	Widowed	1(1.6)	8(13.1)	9(14.8)
Income	0-70000	9(14.8)	9(14.8)	18(29.5)
	70000-100000	4(6.6)	8(13.1)	12(19.7)
	100000-300000	6(9.8)	5(8.2)	11(18.0)
	400000-700000	8(13.1)	8(13.1)	16(26.2)
	>700000Tsh	1(1.6)	3(4.9)	4 (6.6)
Age group(years)	30-40 Years	2(3.3)	0(0)	2(3.3)
	40-50 Years	7(11.5)	10(16.4)	17(27.9)
	50-60 years	8(13.1)	16(26.2)	24(39.3)
	>60 years	11(18)	7(11.5)	18(29.5)
Biomedical/Anthropometrical	Waist hip ratio	0.8802±0.13449	0.9099±.13534	0.8963±0.13465
	BMI (Kg/m^2)	26.6207±3.08168	29.4993±6.85909	28.1780*
	Fasting glucose(mg/dl)	296.31±96.58	275.68±76.30	285.15±86.08
	Pulse (mmhg)	81.2857±12.12	79.6515±9.66	80.4016±10.79
	Diastolic(mmg)	131.43±15.95	139±30.81	135.89±25.26*
	Sytolic(mmhg)	80.9286±10.06	86.0909±12.10	83.7213±11.42
Energy intake	Kilocalories	2376±441.14	2359±483.40	2367±462. 27
	Age in years	56.1429±10.60	55.6061±8.33	55.8525±9.36

No differences ($p>0.05$) in systolic blood pressure was observed among subjects though there was a decrease in the mean levels from the baseline up to 12 months. In the case of diastolic blood pressure there was significant variation ($p \leq 0.05$) among subjects in the baseline and 3 months, 6 months and 12 months post intervention results. Mean diastolic blood pressure decreased by 6.3% over the entire intervention period. The waist-hip ratios among subjects decreased from the baseline up to 12 months after the intervention commenced, but this decrease was not significantly different from zero ($p>0.05$).

Table 2.Changes on anthropometric and biomedical characteristics over time

Characteristics	Baseline	3 Months	6 Months	12 Months
Weight (Kg)	78.7±14.3[a]	78.7±14.7[a]	77.1±13.3[b]	72. 9±13.1[b]
BMI (Kg/m^2)	28.4±5.1[a]	28. 6±5.6[a]	27.5±5. 1[b]	25.9±4. 6[b]
Waist circumference (cm)	92. 1±13. 6[a]	91.3±9.7[a]	90.4±9.9[a]	89.6±9.3[a]
Hip circumference (cm)	1.0±12. 6[a]	1.0±9.9[a]	1.0±10.5[a]	1.0±10.2[a]
W-H (cm)	0. 91±0.10[a]	0.91±0.1[a]	0.89±0.1[a]	0.89±0.13[a]
Fasting glucose (mg/dl)	285.5±86. 1[a]	247.2±95.4[b]	217.9±95.9[c]	188.4±100. 4[c]
Systolic BP(mmHg)	86. 1±15.7[a]	87.0±11.6[a]	86.5±10. 2[a]	83.7±11.4[a]
Diastolic BP (mmHg)	135.5±20.9[a]	135.9±25. 3[a]	134.5±20.1[a]	126.9±15.3[b]
Pulse rate (beats per minute)	83. 5±31.4[a]	80.4±10. 8[a]	80. 2±11.5[a]	80.1±13. 3[a]

Mean ± sd, Different superscript along the row means significant difference at $p \leq 0.05$

Self-care Practices of Diabetic Respondents for the Management of T2DM

Self-care practices of respondents in the management of T2DMare indicated in Table 3 below. About 39% (n=24) of the male respondents and 47% (n=29) females claimed to follow a healthy diet. The mean calorie intake was 2376 ± 441.14 Kcal and 2359 ± 483.40 Kcal for males and females, respectively. About32.8% (n=20) of females respondents used only 20 minutes for vigorous exercises per day while 26.2% (n=16) of males used an average of half an hour for vigorous exercises per day. Moreover, majority of respondents were monitoring blood glucose levels once every 3 months. Generally, most of the respondents were used to inspecting their feet to prevent injuries which could cause amputation. About 32.8% (n=20) males and 39.3% (n=24) females reported that oral medication was the common method used in the treatment of T2DM disease. About 21.3% (n=13) of the respondents reported to be taking pills to reduce blood pressure. Furthermore 26.2% (n=16) of males and 36.1% (n=22) of females used to take fruits twice per day while very few took fruits more than 3 times per day. Only 14.8% (n=9) of males used to smoke before they were diagnosed to be diabetic and only very few 3.3% (n=2) were still smoking at the time of the study. In relation to alcohol, about 24.6% (n 15) of males and 45.9% (n=28) females ($p<0.05$) had abstained from alcohol intake following the intervention.

Table3. Care practices of diabetic respondents for the management of T2DM

Self-care practices	Response	Males(%)	Females (%)	χ^2	p-value
Following a healthy diet	Yes	24(39. 3)	29(47. 5)	0. 06	0. 80
	No	4(6.6)	4(6.6)		
Physical exercises	Half an hour	16(26. 2)	11(18)	7. 15	0. 06
	Only 20 minutes	8(13. 1)	20(32. 8)		
	Not exercising	4(6.6)	2(3. 3)		
Monitoring blood glucose	Every 3 months	17(27. 9)	19(31. 1)	0. 13	0. 80
	Not often	11(18)	14(23)		
Inspecting feet	Yes	24(39. 3)	29(47. 5	0. 46	0. 80
	No	4(6.6)	4(6.6		
Management style	Oral medication and diet	20(32. 8)	24(39. 3)	1. 20	0. 03*
	Insulin	8(13. 1)	8(13. 1)		
	Exercise and diet	0(0)	1(1.6)		
Using blood pressure pills	Yes	13(21. 3)	24(39. 3)	4. 02	0. 02*
	No	15(24. 5)	9(14. 75)		
Diseases apart from DM	Hypertension	10(16. 4)	8(13. 1)		
	Diabetic Foot ulcer	2(3. 3)	4(6. 6)		
	Hypertension. Numbness. foot aching	3 (4. 9)	9 (14.17)		
	No	9(14. 8)	5(8. 2)	3.42	0. 03*
	Pulmonary tuberculosis. hypertension	0(0)	5(8. 2)		
	Diabetic foot and hypertension	1(1. 6)	3(4. 9		
	HIV/AIDS	3(4. 9)	0(0)		
Frequency of intake of fruits	Once per day	3(4.9	2(3.3)	0.74	0.92
	Twice per day	16(26.2	22(36.1		
	Tree times per day	6(9.8	6(9.8		
	More than 3 times a day	3(4.9	3(4.9		
Smoking behavior	Previous smoked	9(14.8	1(1.6		
	Current smoked	2(3.3	0(0	12.6	0.00*
	Never smoked	17(27.9	32(52.5		
Alcohol intake	Abstainers	15(24.6	28(45.9		
	Moderate drinkers	12(19.7	5(8.2	7.45	0.01*
	Heavy drinkers	1(1.6	0(0		

Means significant different at $p \leq 0.05$

Discussion

A one year follow up of the nutrition education and lifestyle modification intervention showed improvements in metabolic, anthropometric and cardiovascular outcomes. The most notable improvement among the findings was the glycemic control. Other studies have similarly found significant improvements in glycemic control to emerge including after

longer intervals - 18 months and beyond - following the intervention (Dunning, 2005; Ruchirawanitchathep, 2008). For example, in a study of diabetes involving education group visits, the blood glucose level was significantly lowered at 2-year follow-up but not at 1-year post-intervention (Ruchirawanitchathep, 2008).

The mean BMI of the respondents at the baseline period fell in the overweight category throughout the study but tended to decrease gradually with significant decrease in the mean BMI from the baseline, 3 months, up to 12 months of the intervention follow-ups period. Also, at 12 months after the intervention, the respondents' weight decreased by 4.2kg (7%). The participants showed weight fluctuations during the entire study; however most of them continued to lose weight after the 6 months assessment. As a group, participants achieved an average 1.6kg weight reduction at 6 months and they continued to lose weight up to 4.2 kg by the end of the study. These results were similar to another study by Matvienko *et al.* (2009) who suggested that at 6 months, participants had achieved 7% weight loss goal. This was a very intensive controlled study compared to the current study. During the final assessment of the current study at 12 months, some participants maintained a weight loss of 7%.

No significant difference was observed in systolic and diastolic blood pressures, although there was a decrease in the levels from the baseline up to12 months. The waist hip ratio was decreasing from 3 months to 6 months but there was no significant reduction in the BMI from 6 months to 12 months. Generally findings of this study revealed that, improvements in lifestyles and behavior changes achieved during the one-year intervention (e.g. making good dietary choices, spacing out carbohydrates, using insulin as prescribed, exercising and generous fruits intake)showed positive results. Respondents could attain more improvements if the intervention time had been extended. In another study by Aas *et al.* (2005) using a similar group of patients confirmed that an intensive educational programme, including dietary instruction, had the potential to improve blood glycemic levels within a six month duration of the intervention.

Self-care practices of the respondents in the management of T2DM suggested that, majority of the respondents claimed to adhere to intake of healthy diets. The mean intake of Kcal was acceptable as recommended by Cellabert (2009). This was because the respondents were advised to minimize the dietary intake of carbohydrates, fats and proteins because of their rising effects in blood sugar levels. Furthermore, respondents were advised to reduce dietary intake of red meats and increase intake of fish,

chicken and other white meats as sources of proteins. Usually, high iron content of red meat diminishes insulin's effectiveness or damages the cells that produce insulin (Haimoto, 2009).

Dietary education on the management of T2DMgiven by nurses at the diabetic unit focused on intake of generous amount of fruits and vegetables while high consumption of starch was discouraged. The nutrition education provided was based on the fact that vegetables and fruits are rich in antioxidants such as vitamin C and E and beta carotene. These are very important in counteracting the artery clog process which is very common in diabetics. The Low Density Lipoproteins (LDL) in the diabetics are more susceptible to oxidation, which is caused by high blood sugar levels and thus more likely to become toxic in diabetics. In turn such oxidized LDL is more likely to clog arteries. As sugar is metabolized, it releases oxygen free radicals that tend to make cholesterol toxic. This can be counteracted by a steady supply of antioxidants, which are free radical scavenger. These wipe up the destructive reaction caused by free radicals (Cade, 2008).Some of the respondents followed the dietary advices given for the management of T2DM. Other respondents suggested that sometimes they could not afford to buy advised foods such as fruits because they are expensive. John and Zielbland (2003) proposed that among the many influences on diet is availability, cost and time for preparation.

Majority of females used to work and perform other household chores rather than performing physical exercises because they had limited time for exercises and they preferred to work at home as one way of reducing weight. Meanwhile, most men preferred to exercise vigorously for thirty minutes and above every day, which was acceptable for the management of the disease (ODPHP, 2008).

Patients on insulin medication were supposed to check their blood glucose levels more often than those on normal oral medication, in order to prevent hypoglycemia effect of induced insulin. Oral medication was the most commonly used method for managing the T2DM disease. Individual patients with serious conditions were treated with insulin but after recovery they returned to normal oral medication. Moreover, most of the diabetic respondents in this study used to inspect their feet frequently in order to prevent injuries, which could lead to amputation. It was revealed that, blood pressure was the most common condition which affected a number of diabetic patients. It was also found that, most of the respondents were taking blood pressure pills. This was in line with what was reported by Long and Dagogo (2011) who noted that, up to 75% of adults with diabetes

also suffer from hypertension, and patients with hypertension alone often show evidence of insulin resistance.

Conclusions and Recommendations

This study revealed that, education on nutrition and lifestyle modification intervention had positive behavioral changes that produced clinical benefits on diabetic patients. In this intervention study, improvement in both glycemic control and anthropometric measures in patients with type 2 diabetes were revealed. Nutrition and modification of lifestyle education were effective means of delaying and reducing complications associated with T2DM. On the basis of these results, it is recommended that, patients should adhere to clinical recommendation on nutrition and lifestyle modification so as to prevent secondary complications of T2DM. Interventions that are cost effective and feasible in developing countries include, moderate blood glucose control, screening for retinopathy, blood lipid control and screening for early signs of diabetes-related kidney disease. These screenings have to be conducted regularly to reduce complications of the disease.

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