Impact of interpersonal counseling on the blood sugar and lipid profile of type 2 diabetes mellitus subjects (nutrition health education and diabetes mellitus)

Uma Iyer, Arti Joshi, Swati Dhruv

Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat, India

Aim: To determine the impact of interpersonal counseling (IPC) on the physiologic indicators (blood glucose, Glycated haemoglobin (HbA1c) and lipid profile) of T2DM subjects. **Setting and Design:** This was a case control intervention study wherein stable type 2 diabetes mellitus (T2DM) subjects were enrolled from biochemistry laboratories. **Materials and Methods:** Stable T2DM subjects who were willing to participate in the study (N = 60) were enrolled. The T2DM subjects in the experimental group were imparted nutrition health education (NHE) through IPC at home with the help of flash cards and a booklet. The IPC was given every month over a period of 4 months. The T2DM control group did not receive any intervention. The main outcome measures were blood glucose, HbA1c, and lipid profile. **Statistical Analysis:** Student's 't' test and paired 't' test were done. **Results:** Four months of NHE led to a significant reduction in the fasting blood glucose (FBG; 14.2%) and HbA1c levels indicating a physiologic fall with good metabolic control. NHE also resulted in a significant reduction in total cholesterol (TC; $P < 0.001$), low density lipoprotein cholesterol (LDL-C; $P < 0.001$), and non high density lipoprotein cholesterol (non–HDL-C; $P < 0.001$), thereby reducing the risk of cardiovascular disease. **Conclusions:** Advocacy measures need to be developed and adopted to sensitize and build the capacities of diabetic subjects.

KEY WORDS: Glycemic control, interpersonal counseling, nutrition health education, serum lipids, type 2 diabetes mellitus

DOI: 10.4103/0973-3930.66506

Correspondence to: **Uma M. Iyer**, Department of Foods and Nutrition, Faculty of Family and Community Sciences, The Maharaja Sayajirao University of Baroda, Vadodara-390 002, Gujarat, India.
E-mail: umamsufn@hotmail.com

Manuscript received: 01.04.2009; Revision accepted: 27.04.2010

Introduction

The number of people with diabetes is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity. Type 2 diabetes mellitus (T2DM) is a major cause of morbidity and mortality and has become an important public health issue worldwide.[1] The cost of diabetes care is high and is escalating worldwide.[2] The majority of health care costs for diabetes are spent in the developed countries, whereas majority of disability adjusted life years (DALYs) are lost in developing countries due to limited health care budgets.[3] Health resources in India and other developing countries are very limited with only 5% of gross domestic product (GDP) being spent on health care.[4] Thus, the rising prevalence of T2DM poses a major clinical, economic, and societal burden in India. Unless effective prevention strategies are put into place, the incidence of diabetes will continue to rise adding to the already strained health budgets of the nation and the individual.

Lifestyle programs provide a ray of hope for reducing the risk of developing diabetes and for achieving optimal management in those who have already developed the condition.[5,6] Education continues to be a key component in the prevention and treatment of diabetes. Low-cost education materials like pamphlets, posters, booklets, flash cards, and CDs on diabetes can be very effective in imparting education to the diabetics. Diabetes education empowers people with diabetes by encouraging them to take responsibility for their health and enabling them to manage their conditions themselves by attaining the desirable goals to improve their glycemic control. Thus, an attempt was made to study the impact of interpersonal nutrition health education (NHE) counseling on the metabolic control of T2DM subjects.

Materials and Methods

Selection and description of participants

Sixty stable non-insulin dependent diabetes mellitus (T2DM) subjects who gave oral consent and were willing to participate in the study were enrolled from the biochemistry laboratories of the city. The subjects were divided randomly into two groups: control group (n = 30) and experimental group (n = 30). The baseline data collected were on general information, background information, clinical information, anthropometry, and 24-hour dietary recall along with fasting blood glucose (FBG), lipid profile, and HbA1c. The parameters were monitored at baseline, 2 months and 4 months. The study was approved by the departmental medical ethics committee (approval number: FND/FHS 21/7/2006).

Technical information

Dietary profile of the subjects was taken by a detailed 24-hour dietary recall method. Accordingly, calorie, fat, protein, fiber, carotenoids, iron and vitamin C intake were calculated using the nutritive value of Indian foods.[7]

Analytical procedure

After an overnight fast, venous blood sample was collected in a serum tube and then the serum was separated for further analysis. All the biochemical estimations such as blood glucose, total cholesterol (TC), high density lipoprotein cholesterol (HDL-C) and triglycerides (TG) were done using diagnostic reagents of ERBA autoanalyzer (TransAsia, Mumbai). Enzymatic kits procured from Chema Italy, marketed by Glaxo, were used for direct HDL-C estimation. Very low density lipoprotein cholesterol (VLDL-C) and low density lipoprotein cholesterol (LDL-C) values were calculated using the formula. HbA1c was estimated using ion exchange resin method (Accurex Biomedical Research Pvt Ltd, Thane, Maharashtra, India).

Counseling strategy

The control group did not receive counseling whereas the experimental group received one to one counseling on the knowledge and lifestyle-related risk factors and its management on a monthly basis (three times) for a period of 4 months [Table 1]. The investigator carried out the counseling at the subjects' residence. The counseling was supported by means of flash cards and a booklet. The booklet was given to the subject on the first visit. On an average, it took from 1 hour to 1 hour 15 minutes to counsel the subject. Due to ethical reasons, diabetics in the control group were counseled after the study period.

Table 1: Key components of the nutrition health education material

Key component	Details
About diabetes	Definition of diabetes, signs and symptoms, causes, complications
Risk factors	Nonmodifiable risk factors, modifiable risk factors
Normal values	Anthropometric values, blood glucose, HbA1c, lipid levels, blood pressure measurements
Therapeutic lifestyle changes	Dietary guidelines, dietary tips, physical activity tips, tips on improving lifestyle

Statistical analysis

Paired 't' test and Student's 't' test were done to find the significant differences between the two means. All tests were considered significant at $P < 0.05$ level. All the statistical tests were performed using Microsoft excel package.

Results

Background information – Anthropometric profile, risk factors, and medical history

In both the groups, there were 19 male and 11 female diabetic subjects [Table 2]. The lifestyle factors such as tobacco, smoking, and alcohol were seen in relatively few subjects and were comparable between the groups. When the medical history was looked into, it was seen that 40 and 60% of the diabetic patients had hypertension in the control and experimental groups, respectively. However, based on body mass index (BMI) using Asia Pacific classification it was observed that 66% of the control group and 70% of the experimental group were

Table 2: Clinical profile of T2DM subjects (mean ± SD)

		Control (n = 30)	Experimental (n = 30)
Sex	Male	19	19
	Female	11	11
Age (years)	Male	54.1 ± 9.0	57.9 ± 9.0
	Female	55.5 ± 13.6	58.1 ± 6.3
Height (m)	Male	1.62 ± 7.9	1.63 ± 5.51
	Female	1.53 ± 4.0	1.54 ± 2.5
Weight (kg)	Male	73.5 ± 12.3	67.6 ± 6.9
	Female	60.8 ± 13.4	61.7 ± 10.1
BMI*	Male	27.8 ± 4.3	25.5 ± 2.0
	Female	25.7 ± 5.5	25.8 ± 3.7
Waist circumference (cm)	Male	101.3 ± 28.0	89.1 ± 9.5
	Female	87.1 ± 19.7	85.0 ± 12.3
Waist/hip	Male	1.0 ± 0.1	0.9 ± 0.04
	Female	0.9 ± 0.1	0.8 ± 0.05

*BMI, body mass index = weight/height^2 (kg/m^2)

obese. Thus, the two groups were comparable regarding these parameters.

Mean nutrient intake

The mean nutrient intake of the T2DM subjects is given in Table 3. The impact of intervention on dietary intake revealed that in the control group the nutrient intake was almost similar before and after intervention. However, in the experimental group, slight improvements were seen with regard to protein and fat intake. All other nutrient values were comparable before and after intervention. The percent energy coming from carbohydrate, protein, and fats were 56, 12, and 32%, and 57, 15, and 28% before and after intervention, respectively. There was a 4% decrease in fat intake after intervention which was primarily due to the decrease in the saturated fat intake (27 g/day vs. 23.5 g/day) and polyunsaturated fatty acid (PUFA) intake (25.6 g/day vs. 21.2 g/day). With unaltered calorie intake, a 4% reduction in fat is an important observation. Thus, interpersonal counseling (IPC) had an impact on the reduction of fat intake in the diet.

Glycemic status of type 2 diabetes mellitus subjects

Table 4 depicts the impact of NHE on the FBG and HbA1c levels of the subjects before, after 2 months, and after 4 months of IPC. After an intervention period of 2 and 4 months, a 6.4 and 14.2% decrease in the FBG was noted in the experimental group, which was accompanied by a significant fall in the HbA1c levels. Such trends were not seen in the control group. The fall in the FBG and HbA1c levels was higher at 4 months of intervention than after 2 months of intervention indicating that long-term lifestyle management is necessary to bring about the desired changes.

When the data were segregated based on the initial FBG values, it was seen that after 2 months of counseling there was a significant decrease in the FBG levels (193 mg/dl vs. 158 mg/dl, $P < 0.05$) and a nonsignificant decrease in the HbA1c levels (12.5%) in subjects who

Table 3: Mean nutrient intake of the T2DM subjects (mean ± SD)

Diet composition	Control (n = 30)		Experimental (n = 30)	
	Baseline	4 months	Baseline	4 months
Calories (kcal)	1796 ± 445	1862 ± 449	1854 ± 708	1934 ± 632
Protein (g)	51.9 ± 16.1	52.8 ± 14.8	49.1 ± 15.9	56.4 ± 16.2
Carbohydrate (g)	228.0 ± 69.6	248.9 ± 64.5	227.6 ± 100	235.0 ± 78.0
Fat (g)	66.6 ± 28.8	65.6 ± 25.5	61.6 ± 33.5	53.4 ± 26.5
Invisible	10.5 ± 3.7 (15.7%)	10.3 ± 3.9 (15.7%)	8.83 ± 3.4 (14.3%)	8.8 ± 3.9 (16.4%)
Saturated Fatty Acid (SFA)	25.0 ± 17.3 (37.5%)	24.2 ± 16.9 (37%)	27.0 ± 17.6 (43.8%)	23.5 ± 18.1 (44%)
PUFA	30.5 ± 16.8 (45.7%)	31.1 ± 17.4 (47.4%)	25.6 ± 19.1 (41.5%)	21.2 ± 16.7 (39.7%)
Fiber (g)	7.3 ± 6.0	7.6 ± 6.1	6.8 ± 6.2	6.5 ± 4.8
Fiber/1000 kcal	4.2 ± 3.6	4.5 ± 3.6	3.9 ± 3.6	3.1 ± 1.8
Iron (mg)	16.0 ± 8.0	15.5 ± 4.4	15.6 ± 7.2	14.7 ± 4.6
Iron/1000 kcal	9.0 ± 3.1	8.6 ± 2.4	8.6 ± 2.8	8.7 ± 4.9
Vitamin C (mg)	80.0 ± 89.0	74.1 ± 94.1	82.0 ± 104	98.2 ± 91.4
β-carotene (µg) (range)	315–5899	577–5564	307–10,794	325–7073

Table 4: Impact of nutrition health education on the glycemic and lipemic status of T2DM subjects (mean ± SD, mg/dl)

	Control (n = 30)			Experimental (n = 30)		
	Baseline	2 months	4 months	Baseline	2 months	4 months
FBG	147 ± 57	143 ± 35	144 ± 58	155 ± 48	145 ± 53	133 ± 32**##
HbA1c (%)	6.7 ± 1.3	6.7 ± 1.2	6.7 ± 1.2	7.2 ± 0.9	7.1 ± 1.0	7.0 ± 0.7#
TC	190 ± 6	193 ± 7	190 ± 22	229 ± 65	191 ± 41***	193 ± 5***
TG	145 ± 44	154 ± 44	161 ± 37**	150 ± 01	143 ± 75	132 ± 50
HDL-C	34 ± 6	35 ± 5	35 ± 5	41 ± 5	44 ± 5	44 ± 5**
VLDL-C	29 ± 9	31 ± 9	32 ± 7	30 ± 20	29 ± 15	26 ± 10
LDL-C	82 ± 35	127 ± 25***	123 ± 25***	157 ± 53	119 ± 42***	123 ± 34***

**Significantly different from baseline at $P < 0.01$; ***significantly different from baseline at $P < 0.001$; #significantly different from 2 months at $P < 0.05$; ##significantly different from 2 months at $P < 0.01$

had initial FBG > 150 mg/dl. At the end of 4 months of counseling, there was a 20.9% (193 mg/dl vs. 146 mg/dl, $P < 0.05$) reduction in the FBG levels, which was accompanied by a significant reduction in the HbA1c levels (7.6 vs. 6.9, $P < 0.01$). Favorable reductions ($P < 0.05$) were also observed in the FBG and HbA1c values when the values were compared between 2 and 4 months of intervention.

Lipids and lipoprotein levels

At the end of 2 months of IPC, desired alterations were observed in the lipid profile of the experimental group subjects [Table 4]. A highly significant lowering of TC (229 mg/dl vs. 191 mg/dl, $P < 0.001$), LDL-C (157 mg/dl vs. 119 mg/dl, $P < 0.001$) and non–HDL-C (187 mg/dl vs. 147 mg/dl) was noted in the experimental group. There was a 4.6% reduction in the TG levels as a result of which a 3.3% reduction in VLDL-C was observed. The intervention also brought a 7.3% increase in the HDL-C levels. Long-term intervention for 4 months also brought a significant reduction in the TC (229 mg/dl vs. 193 mg/dl, $P < 0.001$), LDL-C (157 mg/dl vs. 123 mg/dl, $P < 0.001$), and non–HDL-C (187 mg/dl vs. 149 mg/dl, $P < 0.001$) levels. This was accompanied by a significant rise in the HDL-C levels (41 mg/dl vs. 44 mg/dl, $P < 0.01$). In the control group at the end of the intervention, a rise in the levels of TG, LDL-C, and non–HDL-C was seen.

Regarding the positive impact of NHE on the lipid parameters, we looked at the data based on the initial TC and TG values which have been given in Tables 5 and 6, respectively. The fall in TC and atherogenic lipoprotein (LDL-C, VLDL-C, and non–HDL-C) was significant in diabetics having TC > 200 mg/dl than those diabetics having TC < 200 mg/dl. In diabetics with TC values <200 mg/dl, the mean values remained unaltered over a period of 4 months. In the control group, irrespective of TC levels, an increase in LDL-C and non–HDL-C was observed.

Table 5: Impact of nutrition health education on the lipid profile of T2DM subjects based on their initial TC levels (mean ± SD, mg/dl)

	Control			Experimental		
	Baseline	2 months	4 months	Baseline	2 months	4 months
TC < 200		(n = 11)			(n = 11)	
TC	175 ± 14	194 ± 29*	190 ± 22*	177 ± 21	167 ± 30	169 ± 34
TG	144 ± 47	151 ± 46	157 ± 40	126 ± 62	128 ± 93	122 ± 57
HDL-C	35 ± 6	35 ± 6	35 ± 5	41 ± 3	41 ± 4	42 ± 3
LDL-C	74 ± 46	128 ± 26***	123 ± 26***	111 ± 26	100 ± 39	102 ± 39
VLDL-C	35 ± 3	30 ± 9*	31 ± 8	25 ± 12	26 ± 19	24 ± 11
Non–HDL-C	109 ± 47	158 ± 28***	154 ± 23***	136 ± 22	126 ± 29	127 ± 32
TC > 200		(n = 10)			(n = 19)	
TC	221 ± 13	191 ± 23*	191 ± 24*	259 ± 63	205 ± 41**	208 ± 27***
TG	149 ± 39	159 ± 41	168 ± 29	143 ± 61	151 ± 64	138 ± 46#
HDL-C	33 ± 5	35 ± 4	34 ± 4	41 ± 7	45 ± 6*	46 ± 5**
LDL-C	71 ± 39	124 ± 23***	123 ± 24***	189 ± 52	130 ± 40***	135 ± 35***
VLDL-C	44 ± 3	32 ± 8*	34 ± 6	29 ± 12	30 ± 13	28 ± 9#
Non–HDL-C	115 ± 37	156 ± 24***	157 ± 24***	217 ± 60	160 ± 38***	162 ± 26***

*Significantly different from baseline at $P < 0.05$; **significantly different from baseline at $P < 0.01$; ***significantly different from baseline at $P < 0.001$; #significantly different from 2 months at $P < 0.05$

Table 6: Impact of nutrition health education on the lipid profile of T2DM subjects based on their initial TG levels (mean ± SD, mg/dl)

	Control			Experimental		
	Baseline	2 months	4 months	Baseline	2 months	4 months
TG < 150		(n = 17)			(n = 19)	
TG	112 ± 20	137 ± 46	143 ± 37***	98 ± 24	112 ± 51	108 ± 29
TG/HDL	3.4 ± 0.8	4.0 ± 1.7	4.1 ± 1.1**	2.4 ± 0.8	2.5 ± 1.0	2.4 ± 0.6
TG > 150		(n = 13)			(n = 11)	
TG	188 ± 23	175 ± 29	185 ± 18	203 ± 44	195 ± 82	173 ± 52
TG/HDL	5.5 ± 1.1	5.1 ± 0.9	5.4 ± 0.8	5.0 ± 1.3	4.5 ± 2.0	± 1.2*

*Significantly different from baseline at $P < 0.05$, **Significantly different from baseline at $P < 0.01$; ***significantly different from baseline at $P < 0.001$

The data based on initial TG levels showed a rise in TG in control subjects having TG < 150 mg/dl, whereas those with TG > 150 mg/dl maintained their levels after 2 and 4 months. In the experimental group, the response was better in hypertriglyceridemic diabetic subjects but it was not significant. However, the important observation was the reduction in the small dense lipoprotein represented by TG/HDL at the end of 4 months reducing the risk of atherogenicity (5.0 vs. 4.0).

Discussion

The risk and burden of diabetes is now increasing very rapidly. To effectively manage diabetes in this era of the diabetes epidemic requires a systematic and concerted approach by targeting all the risk factors effectively. Health care providers, diabetic educators, clinicians, and patients share the common goal of preventing or minimizing the secondary complications of diabetes mellitus.

The main components of the NHE imparted were the quality of diet, physical activity, adverse effects of smoking and alcohol as many studies have demonstrated the beneficial effects of these components on the disease status of the diabetics. In the present study, the favorable changes in these parameters could be attributed to a combination of these factors. Primarily, the emphasis was on diet and physical activity as there were very few diabetics who were smokers or had the habit of consuming tobacco or alcohol. The positive changes in the physiologic indicators (carbohydrate and lipid parameters) after a period of 4 months highlight the significance of multicomponents in the management of T2DM. It is important to note that any single or multibehavioral change may bring about positive long-term effects.

Reduction in fat intake, especially saturated fat, and regular walk and other dietary modifications (avoiding sweets/processed foods) may have helped in normalizing the health of diabetics. An emerging point from this study is that changes in lifestyle can reduce the level of cardiovascular risk factors. In the present study, modification in lifestyle could not influence BMI and fat distribution. Marked visible changes in BMI and Waist circumference (WC) can be seen with intervention trials of longer duration.

Various studies like Diabetes Prevention Program (DPP) have demonstrated that both medication and lifestyle interventions can delay or prevent progression from impaired glucose tolerance to diabetes.[8] The study also demonstrated that an intensive lifestyle intervention reduces the incidence of diabetes by 58% compared to 31% reduction by metformin intervention. Results from other studies have provided evidence that community-based nutrition and exercise interventions can significantly reduce the risk factors for diabetic complications.[9,10] Studies in Finland[11] and the United States[8] provide evidence that changes in lifestyle, including dietary intake, can be effective in preventing diabetes.

There is apprehension amongst people that it is difficult to motivate T2DM subjects to carry out lifestyle changes, specifically those related to nutrition. However, the present study has found that changing lifestyle habits is achievable for T2DM patients. In conclusion, we strongly feel that lifestyle modification program including nutrition education can be associated with normalization of lipids and glycemia, thereby improving the quality of life.

The study has implications for research and practice. Empowering diabetic subjects is an effective strategy and reinforcement is equally important. The IPC can be strengthened in the existing hospital set up by building the capacities of the dieticians and the other supporting staff. Reinforcements of the key messages by the diabetologists/nutritionists/dieticians in subsequent follow-up visits may help in sustainability. Lastly, diabetes education centers/rehabilitation centers in various clinics could help to facilitate and monitor the progress of diabetic patients by widening the range of strategies. Each diabetic patient should have his/her diabetic index card that should give an overview of various risk factors along with physiologic indicators.

Acknowledgment

Part of the data is from the Ph.D. dissertation of Ms. Arti Joshi, submitted to The M S University of Baroda, Baroda.

References

1. Rana JS, Li TY, Manson JE, Hu FB. Adiposity compared with physical inactivity and risk of type 2 diabetes in women. Diabetes Care 2007;30:53-8.
2. Ramachandran A, Ramachandran S, Snehalatha C, Augustine C, Murugesan N, Vishwanathan V, *et al*. Increasing expenditure on health care incurred by diabetic subjects in a developing country: A study from India. Diabetes Care 2007;30:252-6.
3. Jönsson B. The economic impact of diabetes. Diabetes Care 1998;21: C7–10.
4. Peters DH, Yazbeck AS, Sharma RR, Ramana GN, Pritchett L,

Wagstaff A. Better health systems for India's poor: Findings, analysis, and options. Washington D.C.: The World Bank Report; 2002.
5. Jacobs-van der Bruggen MA, Bos G, Bemelmans WJ, Hoogenveen RT, Vijgen SM, Baan CA. Lifestyle interventions are cost-effective in people with different levels of diabetes risk: Results from a modeling study. Diabetes Care 2007;30:128-34.
6. Murphy E, McAuley KA, Bell D, McLay RT, Chisholm A, Hurley R, *et al*. A new approach to design and implement a lifestyle intervention programme to prevent type 2 diabetes in New Zealand Maori. Asia Pac J Clin Nutr 2003;12:419-22.
7. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive value of Indian foods. 2nd ed.. Revised and updated by Narasinga Rao BS, Deosthale YG, Pant KC, editors. Hyderabad, India: National Institute of Nutrition; 1993.
8. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, *et al*. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med 2002;346:393-403.
9. Pan XR, Li GW, Hu YH, Wang JX, Yang WY, An ZX, *et al*. Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. The Da Qing IGT and Diabetes Study. Diabetes Care 1997;20:537-44.
10. Torjesen PA, Birkeland KI, Anderssen SA, Hjermann I, Holme I, Urdal P. Lifestyle changes may reverse development of the insulin resistance syndrome. The Oslo Diet and Exercise Study: A randomized trial. Diabetes Care 1997;20:26-31.
11. Tuomilehto J, Lindström J, Eriksson JG, Valle TT, Hämäläinen H, Ilanne-Parikka P, *et al*. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N Engl J Med 2001;344:1343-50.

Source of Support: Nil, **Conflict of Interest:** None declared