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Impact of teaching module on the dietary intake of type 2 diabetic patients

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Abstract
Diabetes is a single leading cause of regeneration of multiple degenerative diseases. The number of diabetic population is increasing day by day due to wrong food choices, faulty eating habits, sedentary life style and lack of nutritional knowledge. Nutritional knowledge plays a vital role in diabetes management. Right choices of food can improve the blood glucose level and helps in preventing the diabetes mellitus. In the present pilot work, efficacy of nutrition counseling was assessed on the diabetic patients (Control=60, experimental =60) in terms of improvement in their blood glucose level, food intake, nutrient intake, nutritional knowledge etc. The findings ($p>0.05$, 0.01) revealed that nutrition counseling for a period of three months helps in improving the conditions of diabetic patients.

Keywords: Diabetes, food, nutrient, counseling, fasting blood glucose

Introduction
The word diabetes has originated from the Greek word *diabanein*, which means to pass through because excessive urine is produced as a symptom of this disease (Sharma and Arya 2011). And the term *diabetes* is commonly referred to diabetes mellitus, which means excessive sweet urine (known as "glycosuria"). The three main types of diabetes are, Type 1 diabetes or IDDM (Insulin-dependent diabetes mellitus), Type 2 diabetes or NIDDM (Non-insulin-dependent diabetes mellitus) or adult-onset diabetes mellitus and gestational diabetes. Screening of patients with diabetes can help in reducing the burden of diabetes on a community as well as on nation. **(**Shivashankar and Dhandayuthapani 2011) [8].

Diabetes is a disorder where glucose levels remain high in blood and there is impairment of protein, fat and carbohydrate metabolism. Based on the causes of the diabetes mellitus, the factors which contribute to hyperglycaemia are, reduction in insulin secretion, decrease in glucose utilization and an increase in the production of glucose (Alberti *et al.*1998) [1]. IDF Diabetes atlas Ninth edition 2019 has reported that globally the prevalence of the disease in 2019 was 463 million (adults of age 20-79 years) is predicted to rise to 700 million in 2045. (IDF Diabetes Atlas Ninth edition 2019). WHO has reported that there is a noticeable increase in the number of individuals affected with diabetes mellitus and the trend is scheduled to grow in geometric proportions in the next couple of decades. WHO also predicts that the developing nations will suffer from this epidemic in the 21st century. A noticeable increase has been seen in the prevalence of diabetes in both rural as well as urban Indians. Diet and lifestyle-related conditions which cause obesity will clearly influence the risk of an individual and populations, developing Diabetes, who are susceptible to this condition. Now a days, diabetes mellitus has become an important public health challenge. It is the major cause of death and disability across the world. There is an uncertain future in front of India in relation to the potential burden that diabetes may impose upon the country. According to the International Diabetes Federation diabetes atlas 9th edition (IDF), India is one of the members of the seven countries of the IDF SEA (South East Asia) region. Globally 463 million people have diabetes and in the SEA region 88 million people have the disease; it could rise to 153 million by 2045. India is at the second position after China with 77 million cases of Type 2 diabetes mellitus (T2DM).

Factors responsible for diabetes mellitus may be the sedentary lifestyle, decrease in physical activity, increase in calorie and fat intake, history of gestational diabetes and stress. The shift in the age of onset of the diabetes is also observed, it has shifted to younger age population. As young Individuals with diabetes face the complications of diabetes, the economic productivity of this section of society may decline and this will affect the national economic productivity significantly (Yesudian *et al.* 2014 and Sharma *et al.* 2016) [9, 6].

It could have long-lasting adverse effects on a nation's health. As studies have indicated that nutrition intervention provided by dietician have better healthoutcomes. (Siopis *et al*. 2020) [10]. The positive health benefits of nutrition interventions and nutrition couseling are expanding. (Kahan S and Manson J E, 2017). Keeping the above discussion in mind the current study was carried out to provide nutrition counseling and assess the efficacy of teaching module on the nutritional status of type 2 diabetic patients.

Material and Methods

Location of the study

The study was conducted in the rural and urban areas of Ludhiana district (Punjab).

Selection of subjects

A statistically adequate sample of 60 diabetic men (experimental:30, control:30) in the age group of 40-60 years were randomly selected from the rural area and also 60 diabetic men (experimental:30, control:30) in the age group of 40-60 years were randomly selected from the urban area of Ludhiana district.

Development of Interview schedule

An interview schedule was developed to obtain the desired information on various aspects of data collection. The reliability of the schedule was worked out by pre testing on 10 respondents selected randomly on non-samples subject. Based on the response received during pre-testing certain necessary changes were incorporated in the schedule. Hence, the pre-tested and restructured schedules were used to collect the pre and post intervention data.

Collection of Data

Information was collected through personal interview schedule using the especially structured schedule. The data were collected in month of July to Oct 2018. The data pertaining to dietary intake and blood glucose level were recorded before and after the intervention.

Nutrition counselling

The efficacy of teaching module was evaluated in terms of improvement in dietary intake and blood glucose level by pre (before nutritional education) and post test technique (after nutritional education). Nutrition counselling of selected subjects was done at an interval of fifteen days for a period of three months through a teaching module and interactive sessions. After pre-testing, the subjects were imparted nutrition education supplemented with printed material about the causes, risk factors, symptoms and complications of Diabetes and its management by diet and exercise.

The impact of nutritional education was evaluated after comparing the pre and post test scores in knowledge, attitude and practices (KAP scores) related to management of diabetes.

Gain in score= score of post test - score of pre test

$$\text{Quantum of improvement} = \frac{\text{Post test score}}{\text{Pre test score}}$$

The following parameters were recorded at the initial and final stage of the study.

Dietary intake

The dietary intake were recorded by using 24 hour recall method for three consecutive days. The daily food and nutrient intake was assessed by using Diet Cal software (Kaur 2018). The food and nutrient intake were compared with the suggested dietary intake for balanced diet (ICMR 2011) and recommended dietary allowances (ICMR 2010). The percent nutrient adequacy ratio (NAR) was calculated using the following formula

NAR%= (Intake of nutrient/Recommended intake of nutrient) ×100

Nutrient Adequacy Ratio (NAR)

To estimate the nutrient adequacy of the diet, a Nutrient Adequacy Ratio (NAR) was calculated for the energy, protein, fat intake and nine micronutrients (vitamin A, vitamin C, folic acid, thiamine, riboflavin, niacin, calcium, iron and zinc and dietary fiber). The percent NAR was calculated using the following formulae

NAR% = (Intake of nutrient/Recommended intake of nutrient) * 100

Categorization of Nutrient adequacy ratio (NAR%) using a classification given by Jood *et al.* (1999)

Adequate	-100% and above
Marginally adequate	-75% and above
Marginally inadequate	-50 to 74.9%
Inadequate	-Below 50%

Measurement of fasting blood glucose

In order to check the blood glucose measurements, participants were requested to attend the survey early in the morning, after an overnight fast of 8- 12 hours. Fasting capillary blood glucose was measured using a glucose meter (ACCU-CHECK® Active). Diabetes was defined on fulfilment of criteria laid down by the WHO consultation group report and international diabetes federation IDF (WHO, 2006), Diabetes was diagnosed on plasma fasting blood glucose ≥126mg/dl and known cases of type 2 diabetes mellitus. Prediabetes was diagnosed on plasma fasting blood glucose 100mg/dL (5.6mmol/L) to 125mg/dL (6.9mmol/L) (impaired fasting glucose).

Statistical Analysis

Mean and standard error for variables were calculated. t- test was used for analysing the efficacy of teaching module in terms of improvement in dietary intake, anthropometric measurements and blood glucose level before and after nutritional education among the selected subjects. Wilcoxon signed rank test was used to determine the improvement in knowledge scores.

Results and Discussion

Food intake

The mean food intake before and after three months of nutrition intervention to the rural and urban diabetic men and its percentage adequacy is given in Tables 1 and 2.

Table 1: Impact of nutrition counselling on the daily food intake of selected diabetic men

Food Groups	Rural (n=60)						Urban (n=60)					
	Control Group (n=30)			Experimental Group (n=30)			Control Group (n=30)			Experimental Group (n=30)		
	Before	After	t-test	Before	After	t-test	Before	After	t-test	Before	After	t-test
Cereals	209.19± 6.50	212.69± 6.50	1.03^{NS}	211.19± 6.44	208.94± 9.69	1.04^{NS}	192.84± 7.39	194.94± 7.49	0.94^{NS}	191.77± 7.56	188.47± 9.89	1.05^{NS}
Pulses	47.48± 1.58	49.91± 1.98	0.72^{NS}	48.18± 1.68	53.72± 1.76	1.99^{**}	42.56± 2.55	45.46± 2.49	1.03^{NS}	43.44± 2.65	51.94± 3.22	1.83^{*}
Green leafy vegetables	35.43± 2.45	31.03± 2.85	1.46^{NS}	36.83± 2.55	41.13± 2.47	1.74^{*}	34.41± 3.64	31.81± 3.61	1.48^{NS}	35.51± 3.82	40.62± 3.92	0.95^{NS}
Roots and tubers	147.04± 5.37	149.14± 5.57	0.78^{NS}	159.15± 5.37	144.04± 5.48	3.89^{***}	162.11± 8.78	165.54± 8.99	0.63^{NS}	178.28± 8.87	163.88± 10.27	3.41^{***}
Other vegetables	129.85± 5.88	125.15± 5.56	1.49^{NS}	126.85± 6.18	139.95± 7.12	2.93^{***}	145.61± 9.32	147.21± 9.33	0.85^{NS}	146.82± 9.88	158.12± 11.42	3.52^{***}
Fruits	61.77± 6.18	59.97± 6.08	0.92^{NS}	69.17± 4.18	73.41± 5.18	1.42^{NS}	65.22± 7.24	67.39± 7.24	0.92^{NS}	68.42± 8.72	75.81± 7.92	1.75^{*}
Milk and milk products	435.78± 23.85	438.18± 23.90	0.86^{NS}	445.78± 24.25	456.14± 25.90	3.51^{***}	324.45± 18.33	326.56± 17.99	0.90^{NS}	329.47± 16.85	327.44± 16.84	0.78^{NS}
Sugar and jaggery	16.55± 0.85	18.58± 0.85	0.98^{NS}	16.25± 0.84	12.36± 0.75	1.52^{NS}	13.19± 0.88	15.11± 0.92	1.21^{NS}	14.29± 0.88	11.11± 0.89	1.23^{NS}
Fats/Oils	13.67± 0.48	14.69± 0.49	0.54^{NS}	13.87± 0.44	11.59± 0.41	0.96^{NS}	19.25± 0.92	16.38± 0.88	1.03^{NS}	19.3± 0.91	15.4± 0.94	1.58^{NS}

#Values are represented as Mean±SE
##Nutrition Intervention: Control group (No Nutritional Counseling) and Experimental group (Nutritional Counseling)
*Significant at 10%; **Significant at 5%; *** Significant at 1% NS-Non Significant

Table 2: Impact of nutrition counselling on the per cent adequacy of food intake of selected diabetic men

Food Groups	Rural (n=60)					Urban (n=60)				
	SDI	Control Group (n=30)		Experimental Group (n=30)		SID	Control Group (n=30)		Experimental Group (n=30)	
		Before (%)	After (%)	Before (%)	After (%)		Before (%)	After (%)	Before (%)	After (%)
Cereals	375	55.78	56.71	56.31	55.71	375	51.42	51.98	51.13	50.25
Pulses	75	63.30	66.54	64.24	71.62	75	56.74	60.61	57.92	69.25
Green leafy vegetables	100	35.43	31.03	36.83	41.13	100	34.41	31.81	35.51	40.62
Roots and tubers	200	73.52	74.57	79.57	72.02	200	81.05	82.77	89.14	81.94
Other vegetables	200	64.92	62.57	63.42	69.97	200	72.80	73.60	73.41	79.06
Fruits	100	61.77	59.97	69.17	73.41	100	65.22	67.39	68.42	75.81
Milk and milk products	300	145.26	146.06	148.59	152.04	300	108.15	108.85	109.82	109.14
Sugar and jaggery	20	82.75	92.90	81.25	61.80	20	65.95	75.55	71.45	55.55
Fats/Oils	25	54.68	58.76	55.48	46.36	25	77.00	65.52	77.20	61.60

#Suggested Dietary Intake (SDI) by ICMR, 2010
##Nutrition Intervention: Control group (No Nutritional Counseling) and Experimental group (Nutritional Counseling)

Cereals

Cereals are the main components of the diet among rural as well as urban subjects. Among the cereals, wheat is the principal choice of all the subjects. The most commonly consumed cereals among the diabetic subjects were wheat and wheat products (refined wheat flour, semolina), rice and maize. The data showed that the initial and final mean daily intake of the cereals in control group of rural men was 209.19 and 212.69 g/day with percent adequacy of 55.78 and 56.71% respectively. After nutrition intervention the corresponding figures in experimental group were 211.19 and 208.94 g/day with percent adequacy of 56.31 and 55.71%, respectively. There was non-significant difference in the cereal intake of both the groups.

The data further showed that initial and final mean daily intake of cereals in urban control group was 192.84 and 194.94 g/day with percent adequacy of 51.42 and 51.98%, respectively. After nutrition intervention, the average intake of cereals in experimental group was 191.77 and 188.47 g/day with percent adequacy of 51.13 and 50.25%, respectively. The mean daily intake of cereals before and after the study was less than the suggested value 375 g by ICMR (2011) in both rural as well as urban groups. The present investigation suggest that for long term effects nutritional counseling should be imparted at regular interval to see significant improvements in the dietary intake.

Pulses

The most commonly consumed pulses were Bengal grams, green grams, lentils and kidney beans among the subjects. The mean daily consumption of pulses among rural control group was 47.48 and 49.91 g/day before and after study with percent adequacy of 63.30 and 66.54%, respectively and the average daily intake of pulses increased significantly ($p \leq 0.05$) after the nutrition counseling in experimental group. It was 48.18 and 53.72 g/day before and after the study with percent adequacy of 64.24 and 71.62%, respectively (Tables 1 and 2).

The average daily intake of pulses among urban control group was 42.56 and 45.46 g/day with percent adequacy of 56.74 and 60.61%, respectively and corresponding pulses intake in experimental group was 43.44 and 51.94 g/day before and after the study with percent adequacy of 57.92 and 69.25%, respectively. It was found that the pulses consumption among both rural urban control and experimental group was marginally inadequate. Significant increase ($p \leq 0.01$) was observed in the pulses intake of rural and urban experimental group. Nutrition counseling was given to experimental group, telling them the importance of whole pulses, roasted chickpea and sprouts etc. However the pulses consumption was less when compared to the suggested intake of 75 g by ICMR (2011). Madhu (2010) [4] has reported higher consumption (75g/day) of pulses among diabetic men.

Green leafy vegetables (GLV's)

The average daily intake of green leafy vegetables before the study was 35.43 and 36.83 g/day, with percent adequacy of 35.43 and 36.83%, respectively, by the subjects of control and experimental group (Tables 1 and 2). After nutrition intervention, the average daily intake was 31.03 and 41.13 g/day with percent adequacy of 31.03 and 41.13% in the subjects of control and experimental group, respectively. The average daily intake of GLV's by the subjects of urban control and experimental group was 34.41 and 35.51 g/day with percent adequacy of 34.41 and 35.51%, respectively. After nutrition intervention, the average daily intake was 31.81 and 40.62 g/day in the subjects of control and experimental group with percent adequacy of 31.81 and 40.62% respectively.

The data further revealed that the GLV's consumption of both rural urban control and experimental group was inadequate when compared with the suggested dietary guidelines (Tables 1 and 2). There was significant increase ($p< 0.01$) in the consumption of GLV's after the study in both the groups. However, the mean daily intake of GLV's was much less in both the groups before and after the study as compared to the suggested intake of 100 g/day by ICMR (2011). Madhu (2014) [4] and Choudhary (2010) has reported 37-50 g/day consumption of GLV's among diabetic men.

Roots and tubers

The major roots and tubers consumed by the subjects were onion, potatoes, radish, garlic and carrots etc.

The data (Tables 1 and 2) further showed that average daily intake of roots and tubers by the rural subjects before the study in control and experimental group was 147.04 and 159.15 g/day with percent adequacy of 73.52 and 79.57% respectively. After nutrition intervention, the corresponding figures observed were 149.14 and 144.04 g/day with percent adequacy of 74.57 and 72.02%, in the subjects of control and experimental group, respectively.

The average daily intake of roots and tubers by the urban subjects before the study in control and experimental group was 162.11 and 178.28 g/day, with percent adequacy of 81.05 and 89.14%, respectively. After nutrition intervention, the corresponding figures observed were 165.54 and 163.88 g/day with percent adequacy of 82.77 and 81.94% in the subjects of control and experimental group, respectively. It was found that the roots and tuber consumption which was marginally inadequate before nutrition counseling came out marginally adequate after counseling. There was significant ($p\leq 0.05$) decrease in the consumption of roots and tubers in the experimental groups of both rural and urban men after the nutrition counseling given to them.

Other vegetables

The mean daily intake of other vegetables like cucurbits, bittergourds, pumpkin, brinjal and ladyfingers etc. by the subjects before the intervention in rural control and experimental group was 129.85 and 126.85 g/day, with percent adequacy of 64.92 and 63.42%, respectively (Tables 1 and 2). After the intervention figures observed were 125.15 and 139.95 g/day with percent adequacy of 62.57 and 69.97% in the subjects of control and experimental group, respectively.

The mean daily intake of other vegetables before the intervention in control and experimental group of urban subjects was 145.61 and 146.82 g/day, with percent adequacy of 72.80 and 73.41% respectively. After the intervention figures observed were 147.21 and 158.12 g/day with percent adequacy of 73.60 and 79.06% in the subjects of control and experimental group, respectively. The data showed that the other vegetable consumption was marginally inadequate among both rural and urban subjects. Significant increase ($p\leq 0.05$) in the intake of other vegetables in the experimental group of rural and urban men could be due to nutrition counseling imparted to the subjects. They were told that other vegetables cooked as well as in salad form are rich in fiber. However the mean daily intake of other vegetables before and after the intervention was less in both the groups than the suggested intake of 200 g /day by ICMR (2011). Madhu (2014) [4] has reported other vegetable intake 126 g/day after nutrition counseling among diabetic males. Chaudhary (2010) has also reported the similar results after nutrition counseling to the diabetic males.

Fruits

Papaya, apple, pear, jamun and sweet lime was the major fruits consumed by the subjects. The data (Tables 1 and 2) further showed that the average daily intake of fruits by the subjects of control and experimental group was 61.77 and 69.17 g/day, with percent adequacy of 61.77 and 69.17% respectively. After nutrition counseling the corresponding figures were 59.97 and 73.41 g/day, with percent adequacy of 59.97 and 73.41% respectively. The mean daily intake was much less in both groups before and after the intervention as compared to the suggested intake of 100g/day by ICMR (2011).

The average daily intake of fruits by the subjects of control and experimental group of urban subjects was 65.22 and 68.42 g/day, with percent adequacy of 65.22 and 68.42% respectively. After the intervention the corresponding figures were 67.39 and 75.81 g/day with percent adequacy of 67.39 and 75.81%, respectively. It was found that the mean intake of fruits was marginally inadequate among both groups. The mean daily intake was much less in both groups before and after the intervention as compared to the suggested intake of 100g/day by NIN ICMR (2011). Chowdhary (2014) and Madhu (2014) [4] has also recorded the similar intake of fruits (60-80 g/day) among male diabetic subjects.

Milk and Milk products

The consumption of milk and milk products was in the form of curd, buttermilk, milk and kheer etc. The data (Tables 1 and 2) of the present study revealed that the mean daily intake of milk and milk products before the study was 435.78 and 445.63 g/day with percent adequacy of 145.26 and 148.59% by the rural subjects in the control and experimental group, respectively. After the intervention, the corresponding figures observed were 438.18 and 456.14 g/day with percent adequacy of 146.06 and 152.04% in the subjects of control and experimental group, respectively. The mean daily intake of milk and milk products by urban subjects before the study was 324.45 and 329.47 g/day with percent adequacy of 108.15 and 109.82% by control and experimental group, respectively. After the intervention, the corresponding figures observed were 325.56 and 327.44 g/day with percent adequacy of 108.85 and 109.14% in the subjects of control and experimental group, respectively.

It was seen that the mean daily intake of milk was more than adequate in both the groups as compared to the suggested intake value of 300 g/day by, ICMR (2011). Chaudhary (2010) [2] and Madhu (2014) [4] has presented 350 g/day milk consumption among diabetic males.

Sugar and jaggery

The mean daily intake of sugar/jaggery among the rural subjects of control and experimental group was 16.55 and 16.25 g/day with percent adequacy of 82.75 and 81.25%, respectively and after three months the corresponding values came out to be 18.58 and 12.36 g/day with percent adequacy of 90.90 and 61.80%, in the subjects of control and experimental groups, respectively (Tables 1 and 2). The mean daily intake of sugar/jaggery among the subjects of urban control and experimental group was 13.19 and 14.29g/day with percent adequacy of 65.95 and 71.45% respectively and after three months the corresponding values came out to be 15.11 and 11.11 g/day with percent adequacy of 75.55 and 55.55% in the subjects of control and experimental groups, respectively.

There was decrease in the mean sugar intake of subjects in the rural and urban experimental group. Reduction in the sugar intake could be due to the nutrition counseling given to the subjects where it was told to them that sugar increases blood glucose levels quickly.

Fats and oils

The mean daily intake of fats/oils by the rural subjects was 13.67 and 13.87 g/day with percent adequacy of 54.68 and 55.48% in control and experimental group, respectively and after nutrition intervention the corresponding values came out to be 14.69 and 11.59 g/day with percent adequacy of 58.76 and 46.36% in control and experimental group, respectively. The mean daily intake of fats/oils by the urban subjects was 19.25 and 19.30 g/day with percent adequacy of 77 and 77.20% in control and experimental group, respectively and after nutrition counseling the corresponding values came out to be 16.38 and 15.40 g/day with percent adequacy of 65.52 and 61.60% in control and experimental group, respectively.

There was decrease in the mean intake of fats and oils after the study in rural and urban control and experimental groups but the difference was non significant. Though the mean intake of fats and oils was within suggested intake value 25 g/day by ICMR (2011).

Nutrient intake

The mean nutrient intake before and after three months of nutrition intervention to the rural and urban diabetic men and its percentage adequacy is given in Tables (3 and 4).

Energy

The data presented in Table 3 & 4 showed that mean energy intake of the rural men before intervention was 1389.14 and 1382.92 kcal with percent adequacy of 59.87 and 59.60% in control and experimental group, respectively which after nutrition intervention was 1385.19 and 1380.14 kcal with percent adequacy of 59.69 and 59.48%, respectively in control and experimental group. The data (Table 3 and 4) further showed that in case of urban subjects mean energy intake before intervention was 1349.48 and 1343.12 kcal with percent adequacy of 58.16 and 57.89% in control and experimental group, respectively. After nutrition intervention the corresponding values were 1352.12 and 1336.57 kcal with percent adequacy of 58.28 and 57.61% in control and experimental group, respectively. The data revealed that the energy intake of both rural and urban, control and experimental groups was marginally inadequate. There was no significant difference in mean energy intake before and after intervention in both rural and urban control and experimental groups. However the mean energy intake of both the groups was less than the suggested values of energy 2320 kcal/day by ICMR (2010).

Table 3: Impact of nutrition counseling on the average daily nutrient intake of selected diabetic men

Nutrients	Rural (n=60)						Urban (n=60)					
	Control Group (n=30)			Experimental Group (n=30)			Control Group (n=30)			Experimental Group (n=30)		
	Before	After	t-test	Before	After	t-test	Before	After	t-test	Before	After	t-test
Energy [Kcal]	1389.14± 42.59	1385.19± 42.01	0.81^{NS}	1382.92± 43.19	1380.14± 46.59	0.34^{NS}	1349.48± 29.85	1352.12± 30.12	0.78^{NS}	1343.12± 30.13	1336.57± 39.12	1.82*
Protein [g]	50.99± 3.22	51.48± 3.18	0.84^{NS}	51.42± 3.25	54.55± 4.12	1.79*	47.85± 1.78	49.12± 1.83	0.85^{NS}	47.15± 1.82	51.99± 2.01	1.74*
Fat [g]	36.88± 1.32	38.24± 1.38	0.70^{NS}	37.18± 1.52	35.92± 1.40	0.72^{NS}	38.28± 1.95	41.29± 1.95	0.74^{NS}	39.11± 1.95	32.29± 1.87	1.98**
Carbohydrates[g]	235.22± 7.89	237.21± 7.90	0.68^{NS}	237.42± 7.92	229.17± 6.54	1.97**	209.85± 4.88	212.11± 4.92	0.71^{NS}	211.62± 5.28	206.38± 4.23	1.81*
Beta-Carotene [µg]	2845.12± 195.44	2681.43± 196.85	0.71^{NS}	2852.11± 19	3092.23± 195.44	7.99***	2802.13± 256.77	2811.57± 258.04	0.64^{NS}	2891.13± 256.7	2942.13± 256.7	4.34***
Thiamine [mg]	1.20± 0.03	1.23± 0.01	0.76^{NS}	1.22± 0.03	1.24± 0.04	1.04^{NS}	1.12± 0.03	1.13± 0.04	0.66^{NS}	1.24± 0.04	1.32± 0.05	1.21^{NS}
Riboflavin[mg]	1.22± 0.05	1.26± 0.09	1.12^{NS}	1.21± 0.05	1.27± 0.06	1.12^{NS}	1.22± 0.04	1.23± 0.05	1.02^{NS}	1.32± 0.05	1.40± 0.06	1.19^{NS}
Niacin [mg]	12.54± 0.49	12.41± 0.38	0.92^{NS}	12.53± 0.39	12.57± 0.41	0.92^{NS}	11.46± 0.03	11.47± 0.05	0.68^{NS}	12.12± 0.6	13.28± 0.7	0.93^{NS}
Vitamin B12[µg]	0.42± 0.03	0.39± 0.02	0.71^{NS}	0.43± 0.02	0.46± 0.03	0.71^{NS}	0.43± 0.01	0.46± 0.01	0.71^{NS}	0.51± 0.02	0.63± 0.02	0.75^{NS}
Vitamin C [mg]	25.56± 2.01	25.87± 2.47	0.73^{NS}	27.08± 2.01	29.60± 2.25	0.74^{NS}	26.83± 2.21	26.84± 2.21	0.76^{NS}	28.46± 2.22	30.93± 2.47	0.34^{NS}
Calcium [mg]	655.52± 14.89	656.58± 15.90	1.09^{NS}	658.61± 16.11	662.91± 17.88	1.92*	669.13± 26.54	667.16± 26.52	0.69^{NS}	661.52± 26.54	689.37± 27.84	3.01***
Iron [mg]	12.85± 0.48	12.49± 0.51	0.69^{NS}	12.91± 0.52	13.03± 0.54	0.63^{NS}	12.87± 0.49	12.81± 0.47	0.69^{NS}	12.91± 0.52	13.34± 0.64	0.96^{NS}
Zinc [mg]	4.18± 0.17	4.34± 0.21	1.17^{NS}	4.22± 0.19	5.11± 0.19	1.17^{NS}	4.83± 0.56	4.85± 0.58	1.19^{NS}	5.18± 0.62	5.52± 0.81	1.19^{NS}
Magnesium [mg]	385.22± 12.10	387.18± 13.27	1.21^{NS}	389.12± 12.44	394.14± 13.01	1.21^{NS}	386.41± 12.55	386.48± 12.57	1.23^{NS}	392.12± 12.44	395.57± 12.67	0.64^{NS}
Total Dietary Fibre [g]	15.15± 0.05	16.56± 0.05	1.19^{NS}	16.05± 0.07	19.95± 0.97	1.92*	15.12± 0.25	15.18± 0.26	0.85^{NS}	15.27± 0.74	21.39± 0.76	2.02**

#Values are represented as Mean±SE

##Nutrition Intervention: Control group (No Nutrition Counseling) and Experimental group (Nutrition Counseling)

*Significant at 10%; **Significant at 5%; *** Significant at 1% NS-Non Significant

Table 4: Impact of nutrition counseling on the Nutrient adequacy ratio (NARs) of selected diabetic men

NAR (%)	Rural (n=60)					Urban (n=60)				
	RDA^	Control Group (n=30)		Experimental Group (n=30)		RDA^	Control Group (n=30)		Experimental Group (n=30)	
		Before (%)	After (%)	Before (%)	After (%)		Before (%)	After (%)	Before (%)	After (%)
Energy [Kcal]	2320	59.87	59.69	59.60	59.48	2320	58.16	58.28	57.89	57.61
Protein [g]	60	84.98	85.80	85.70	90.91	60	79.75	81.86	78.58	86.65
Fat [g]	25	147.52	152.96	148.72	143.68	25	153.12	165.16	156.44	129.16
Carbohydrates[g]	290	81.11	81.79	81.86	79.02	290	72.36	73.14	72.97	71.16
Beta - Carotene [µg]	4800	59.27	55.86	59.41	64.42	4800	58.37	58.57	60.23	61.29
Thiamine [mgs]	1.2	100.00	102.50	101.66	103.33	1.2	93.33	94.16	103.33	110.00
Riboflavin[mgs]	1.4	87.14	90.00	86.42	90.71	1.4	87.14	87.85	94.28	100.00
Niacin [mgs]	16	78.37	77.56	78.31	78.56	16	71.62	71.68	75.75	83.00
Vitamin B12[µg]	1	0.42	0.39	0.43	0.46	1	43.00	46.00	51.00	63.00
Vitamin C [mg]	40	63.90	64.67	67.70	108.32	40	67.07	67.11	71.15	77.32
Calcium [mg]	600	109.25	109.43	109.76	110.48	600	111.52	111,19	110.25	114.89
Iron [mgs]	17	75.58	73.47	75.94	76.64	17	75.70	75.35	75.94	78.47
Zinc [mgs]	12	34.83	36.16	35.16	42.58	12	40.25	40.41	43.16	46.00
Magnesium [mgs]	340	113.30	113.87	114.44	115.92	340	113.65	113.67	115.32	116.34
Total Dietary Fibre [g]	30	50.50	55.20	53.50	66.50	30	50.40	50.60	50.90	71.30

^Recommended Dietary Allowance (RDA) by ICMR, 2010

##Nutrition Intervention: Control group (No Nutritional Counseling) and Experimental group (Nutritional Counseling)

Protein

The mean daily intake of protein was 50.99 and 51.42 g/day with percent adequacy of 84.98 and 85.70% in the rural subjects of control and experimental group, respectively. After nutrition counseling, the corresponding figures were 51.48 and 54.55 g/day with percent adequacy of 85.80 and 90.91% in the subjects of control and experimental group, respectively. The mean daily intake of protein by urban men was 47.85 and 47.15 g/day with percent adequacy of 79.75 and 78.58% in the subjects of control and experimental group, respectively. After nutrition counseling, the corresponding figures were 49.12 and 51.99 g/day with percent adequacy of 81.86 and 86.65% in the subjects of control and experimental group, respectively. The data showed that the protein intake of rural and urban subjects was marginally adequate.

There was significant ($p \leq 0.01$) increase in the protein intake of subjects of rural and urban experimental group who were given nutrition counseling. It was suggested to them that roasted pulses, sprouts and whole pulses helps in maintaining blood glucose levels. There was also increase in the protein intake in the subjects of urban experimental group. However the mean daily intake of protein of both rural and urban subjects was lower than the suggested intake 60 g/day by ICMR (2010).

Total fat

The average daily intake of fat before nutrition counseling was 36.88 and 37.18 g/day with percent adequacy of 147.52 and 148.72% by the subjects of rural control and experimental group, respectively. After nutrition counseling the corresponding figures were 38.24 and 35.92 g/day with percent adequacy of 152.96 and 143.68% in the subjects of control and experimental group, respectively. The mean daily intake of fat before nutrition counseling was 38.28 and 39.11 g/day with percent adequacy of 153.12 and 156.44% by the subjects of urban control and experimental group. After nutrition counseling the corresponding figures were 41.29 and 32.29 g/day with percent adequacy of 165.16 and 129.16% in the subjects of control and experimental group, respectively. There was significant decrease ($p \leq 0.05$) in the fat intake of both rural and urban groups after nutrition counseling. The fat intake of both control and experimental group was higher than the suggested value of 25 g/day by ICMR (2010).

Carbohydrate

The initial mean carbohydrate intake (Table 3 and 4) was 235.22 and 237.42 g/day with percent adequacy of 81.11 and 81.86% in the subjects of control and experimental group, respectively. After nutrition counseling the corresponding figures were 237.21 and 229.17 g/day with percent adequacy of 81.79 and 79.02% in the subjects of control and experimental group, respectively. The initial mean carbohydrate intake by urban subjects was 209.85 and 211.62 g/day with percent adequacy of 72.36 and 72.97% in control and experimental groups, respectively. After nutrition counseling the corresponding figures were 212.11 and 206.38 g/day with percent adequacy of 73.14 and 71.16% in the subjects of control and experimental group, respectively. The carbohydrate intake of both rural and urban control and experimental groups was marginally adequate. There was significant decrease ($p \leq 0.05$) in the intake of carbohydrates in both rural and urban experimental groups.

Beta carotene

The initial mean intake of ß-carotene by rural subjects was 2845.12 and 2852.11 µg/day with percent adequacy of 59.27 and 59.41% in the subjects of control and experimental group. After nutrition counselling the corresponding figures were 2681.43 and 3092.23 µg/day with percent adequacy of 55.86 and 64.42% in the subjects of control and experimental group. The initial mean intake of ß-carotene by urban subjects was 2802 and 2891.13 µg/day with percent adequacy of 58.37 and 60.23% in the subjects of control and experimental group respectively. After nutrition counseling the corresponding figures were 2811.57 and 2942.13 µg/day with percent adequacy of 58.57 and 61.29% in the subjects of control and experimental group, respectively. The data showed that the ß-carotene intake of both rural and urban subjects was marginally inadequate. There was significant ($p \leq 0.01$) increase in the ß-carotene intake of both rural and urban experimental groups after nutrition couseling. However the mean daily intake of ß-carotene was much less than the suggested intake value of 4800 µg/day by ICMR (2010) in both the groups.

Thiamine

The mean daily intake of thiamine by rural subjects before nutrition counseling was 1.20 and 1.22 mg/day with percent adequacy of 100 and 101.66% in control and experimental group, respectively. After nutrition counseling the corresponding figures were 1.23 and 1.24 mg/day with percent adequacy of 102.50 and 103.33% in control and experimental group, respectively. The average daily intake of thiamine of urban subjects before nutrition counseling was recorded 1.12 and 1.24 mg/day with percent adequacy of 93.33 and 103.33% in control and experimental group respectively. After nutrition counseling the corresponding figures were 1.13 and 1.32 mg/day with percent adequacy of 94.16 and 110.00% in the subjects of control and experimental group, respectively. The data showed that the thiamine intake of the subjects was adequate among both rural and urban subjects. The thiamine intake of both control and experimental group was adequate as suggested value of 1.2 mg/day by ICMR (2010).

Riboflavin

The mean daily intake of riboflavin by rural subjects before (Table 3 and 4) nutrition counseling was 1.22 and 1.32 mg/day with percent adequacy of 87.14 and 86.42% in control and experimental group, respectively. After nutrition counseling the corresponding figures were 1.26 and 1.27 mg/day with percent adequacy of 90.00 and 90.71% in the subjects of control and experimental group, respectively. The mean daily intake of riboflavin in urban subjects of control and experimental groups before nutrition counseling was 1.22 and 1.32 mg/day with percent adequacy 87.14 and 94.28%, respectively. After nutrition counseling the corresponding figures were 1.23 and 1.40 mg/day with percent adequacy of 87.85 and 100% in the subjects of control and experimental group, respectively. The data represented that the riboflavin intake of the rural and urban diabetic subjects was marginally adequate to adequate. The riboflavin intake of both control and experimental group of rural and urban subjects was less than the suggested value of 1.4 mg/day by ICMR (2010)

Niacin

The mean daily intake of niacin before nutrition counseling was 12.54 and 12.53 mg/day (Table 3 and 4) with percent adequacy of 78.37 and 78.31% by the rural subjects of control and experimental group respectively. After nutrition counseling the corresponding figures were 12.41 and 12.57 mg/day with percent adequacy of 77.56 and 78.56% in the subjects of control and experimental group, respectively. The mean daily intake of niacin before nutrition counseling was 11.46 and 12.12 mg/day with percent adequacy of 71.62 and 75.75% by the subjects of urban control and experimental group respectively. After nutrition counseling the corresponding figures were 11.47 and 13.28 mg/day with percent adequacy of 71.68 and 83% in the subjects of control and experimental group, respectively. The data depicted that the niacin intake of both control and experimental groups of rural and urban subjects was marginally adequate. There was no significant change in the niacin intake of both rural and urban control and experimental groups before and after nutrition counseling. Niacin intake of both control and experimental group was less than the suggested value of 16 mg/day by NIN ICMR (2010).

Vitamin B12

The data (Table 3 and 4) further showed that the mean daily intake of vitamin B12 before nutrition counseling was 0.42 and 0.43 µg/day with percent adequacy of 42 and 43% by the subjects of rural control and experimental group respectively. After nutrition counseling the corresponding figures were 0.39 and 0.46 µg/day with percent adequacy of 39 and 46% in the subjects of control and experimental group, respectively. The mean daily intake of vitamin B12 before nutrition counseling was 0.43 and 0.51 µg/day with percent adequacy of 43 and 51% by the subjects of urban control and experimental group. After nutrition counseling the corresponding figures were 0.46 and 0.63 µg/day with percent adequacy of 46 and 63% in the subjects of control and experimental group, respectively. It was found that the vitamin B12 intake of both rural and urban control and experimental groups was inadequate. There was increase in the vitamin B12 intake of both rural and urban experimental groups after nutrition counseling. However the vitamin B12 intake of both control and experimental group was less than the suggested value of 1 µg/day by ICMR (2010).

Vitamin C

The average daily intake of vitamin C before nutrition counseling was (Table 3 and 4) 25.56 and 27.08 mg/day with percent adequacy of 63.90 and 67.70% by the rural subjects of control and experimental group respectively. After nutrition counseling the corresponding figures were 25.87 and 29.60 mg/day with percent adequacy of 64.67 and 74% in the subjects of control and experimental group, respectively. The average daily intake of vitamin C among urban subjects, before nutrition counseling was 26.83 and 28.46 mg/day with percent adequacy of 67.07 and 71.15% by the subjects of control and experimental group, respectively. After nutrition counseling the corresponding figures were 26.84 and 30.93 mg/day with percent adequacy of 67.11 and 77.32% in the subjects of control and experimental group, respectively. It was found that the vitamin C intake of rural and urban diabetic subjects was marignally adequate. Chaudhary 2010 [2] has reported 40-50 mg/day mean intake of vitamin C among diabetic men. There was increase in the intake of vitamin C by the subjects in experimental group but the difference was non significant. Vitamin C intake of both control and experimental group was less than the recommended value of 40 mg/day by ICMR (2010).

Calcium

The average daily calcium intake by the rural subjects before nutrition counseling was 655.52 and 658.61 mg/day with percent adequacy of 109.25 and 109.76% in control and experimental group, respectively. The corresponding intake after nutrition counseling was 656.58 and 662.91 mg/day with percent adequacy of 109.43 and 110.48% in control and experimental group respectively (Table 3 and 4). The average daily calcium intake of urban subjects before nutrition counseling was 669.13 and 661.52 mg/day with percent adequacy of 111.52 and 110.25% in control and experimental group, respectively. The corresponding intake after nutrition counseling was 667.16 and 689.37 mg/day with percent adequacy of 111.19 and 114.89% in control and experimental group respectively. The data revealed that calcium intake of the control and experimental group of rural and urban subjects was more than adequate. Chaudhary (2010) [2] has reported 640-670 mg/day mean intake of calcium among diabetic men.

There was significant ($p \leq 0.05$) increase in the calcium intake of subjects in the experimental group. The increase in calcium intake was due to the nutrition counseling given to the subjects of experimental group and mean daily intake of calcium of both the groups was more than the suggested daily intake value 600 mg/day by ICMR (2010)

Iron

The results revealed (Table 3 and 4) that the average daily intake of iron of rural men before nutrition counseling was 12.85 and 12.91 mg/day with percent adequacy of 75.58 and 75.94% by the subjects of control and experimental group, respectively. After nutrition counseling the corresponding figures were 12.49 and 13.03 mg/day with percent adequacy of 73.47 and 76.64% in the subjects of control and experimental group, respectively. The average daily intake of iron before nutrition counseling was 12.87 and 12.91 mg/day with percent adequacy of 75.70 and 75.94% by the subjects of urban control and experimental group, respectively. After nutrition counseling the corresponding figures were 12.81 and 13.34 mg/day with percent adequacy of 75.35 and 78.47% in the subjects of control and experimental group, respectively. The data depicted that the iron intake of both the groups was marginally adequate. There was no significant change in the iron intake of both the groups before and after nutrition counseling. However iron intake of both rural and urban control and experimental group was less than the suggested value of 17 mg/day by ICMR (2010).

Zinc

The average daily intake of zinc before nutrition counseling was 4.18 and 4.22 mg/day with percent adequacy of 34.83 and 35.16% by the subjects of rural control and experimental group, respectively. After nutrition counseling the corresponding figures were 4.34 and 5.11 mg/day with percent adequacy of 36.16 and 42.58% in the subjects of control and experimental group, respectively. The average daily intake of zinc before nutrition counseling was 4.83 and 5.18 mg/day with percent adequacy of 40.25 and 43.16% by the subjects of urban control and experimental group. After nutrition counseling the corresponding figures were 4.85 and 5.52 mg/day with percent adequacy of 40.41 and 46.00% in the subjects of control and experimental group, respectively. The data showed that the average daily intake of zinc was inadequate among both rural urban control and experimental groups.

There was no significant change in the zinc intake of both the groups before and after nutrition counseling. However zinc intake of both control and experimental group of rural and urban subjects was less than the suggested value of 12 mg/day by ICMR (2010)

Magnesium: The data further elucidated that the average daily intake of magnesium before nutrition counseling was 385.22 and 389.12 mg/day with percent adequacy of 113.30 and 114.44% by the subjects of rural control and experimental group, respectively. After nutrition counseling the corresponding figures were 387.18 and 389.12 mg/day with percent adequacy of 113.87 and 115.92% in the subjects of control and experimental group, respectively. The mean daily intake of magnesium (Table 3 and 4) before nutrition counseling was 386.41 and 392.12 mg/day with percent adequacy of 113.65 and 115.32% by the subjects of urban control and experimental group. After nutrition counseling the corresponding figures were 386.48 and 395.57 mg/day with percent adequacy of 113.67 and 116.34% in the subjects of control and experimental group, respectively. It was found that the average daily intake of magnesium was adequate among the subjects. There was no significant change in the magnesium intake of both the groups before and after nutrition counseling. However magnesium intake of both control and experimental group was higher than the suggested value of 340 mg/day by ICMR (2010)

Total dietary fiber

The data (Table 3 and 4) showed that average daily intake of dietary fiber before nutrition counseling was 15.15 and 16.05 g/day with percent adequacy of 50.50 and 53.50% by the subjects of (rural) control and experimental group, respectively. After nutrition counseling the corresponding figures were 16.56 and 19.95 g/day with percent adequacy of 55.20 and 66.50% in the subjects of control and experimental group, respectively. The average daily intake of dietary fiber before nutrition counseling was 15.12 and 15.27 g/day with percent adequacy of 50.40 and 50.90% by the subjects (urban) of control and experimental group. After nutrition counseling the corresponding figures were 15.18 and 21.39 g/day with percent adequacy of 50.60 and 71.30% in the subjects of control and experimental group, respectively. The data revealed that the average daily intake of fiber was marginally adequate among both rural and urban subjects. There was significant ($p \leq 0.05$) increase in the total dietary fibre intake of subjects of both rural and urban experimental groups. The increase in total dietary fibre intake was due to the nutrition counseling given to the subjects of experimental group and mean daily intake of total dietary fibre of both the groups was less than the suggested daily intake value 30 g/day by ICMR (2010).

Impact of counseling on the blood glucose level of selected diabetic subjects

The data (Table 5) showed that in control group the initial mean fasting blood glucose level of the selected rural men was 188.08 mg/dl which was decreased in few points (187.12mg/dl) after a period of three months. In the experimental group, initial mean fasting blood glucose level of the selected rural men before nutrition counseling was 186.22 mg/dl which was decreased significantly due to the impact of nutrition counseling (180.99mg/dl).

Table 5: Impact of nutrition counseling on the mean fasting blood glucose levels of rural and urban men

Blood glucose mg/dl	Control		t-test	Experimental		t-test
	Before (n=30)	After (n=30)		Before (n=30)	After (n=30)	
Rural men						
Mean ±SE	188.08±7.33	187.12±7.31	1.52^{NS}	186.22±7.14	180.99±6.12	2.28^{***}
Urban men						
Mean ±SE	182.90±7.72	181.19±7.71	1.49^{NS}	180.92±6.12	171.24±5.99	3.99^{***}

#Values are represented as Mean±SE

##Nutrition Intervention: Control group (No Nutritional Counseling) and Experimental group (Nutritional Counseling)

*Significant at 10%; **Significant at 5%; *** Significant at 1% NS-Non Significant

Among the urban population, the initial mean fasting blood glucose level of the selected men in control group was observed as 182.90 and final as 181.19 mg/dl where as in the experimental group, initial mean fasting blood glucose level of the selected urban men before nutrition counseling was 180.92 mg/dl which was decreased significantly (p>0.01) due to the impact of nutrition counseling (171.24mg/dl).

Impact of Teaching Module on the KAP scores of selected diabetic subjects

The effect of nutrition counseling on the selected subjects is presented in Table 6. The nutrition counseling of experimental group was done after every fifteen days for a period of three months. The pre and post test scores of both groups (control and experimental) were estimated. The effect of nutrition counseling on the KAP scores of selected rural diabetic men revealed that there was a significant increase in the percentage of nutritional knowledge (21.84 to 84.22%), gain in attitude (31.96 to 85.68%) and improved practices (29.68 to 84.44%) for management of diabetes among the experimental group at p>0.05 as compared to control that remain non-significant. The overall observance of KAP scores increased from 26.33 to 86.64 per cent among the experimental group also found significant at $p \leq 0.05$.

The effect of nutrition counseling on the KAP scores (Table 6) of selected urban diabetic men revealed that there was statistically significant ($p \leq 0.05$) increase in the percentage of nutritional knowledge (23.18 to 87.96%), gain in attitude (33.28 to 91.96%) and improved practices (32.76 to 87.96%) diabetes management among the experimental group. The control group was observed non-significant due to lack of nutritional education that was not imparted to them.

Table 6: Effect of nutrition counseling on the KAP score of selected subjects

Variables	No. of Items	Control (n=30)			Experimental (n=30)		
		Pre-test scores	Post test scores	Z value	Pre-test scores	Post test scores	Z- value
Rural (n=60)							
Knowledge	50	10.11 (20.22)	10.21 (20.42)	1.183^{NS}	10.92 (21.84)	42.11 (84.22)	6.144
Attitude	25	7.89 (31.56)	7.91 (31.64)	0.762^{NS}	7.99 (31.96)	21.42 (85.68)	4.123
Practice	25	7.12 (28.48)	7.13 (28.52)	0.981^{NS}	7.42 (29.68)	21.11 (84.44)	4.122
Total KAP	100	25.12 (25.12)	25.25 (25.25)	1.235^{NS}	26.33 (26.33)	86.64 (86.64)	8.102
Urban (n=60)							
Knowledge	50	11.22 (22.44)	11.32 (20.21)	1.093^{NS}	11.59 (23.18)	43.98 (87.96)	6.154
Attitude	25	8.02 (32.08)	8.03 (32.12)	1.054^{NS}	8.32 (33.28)	22.99 (91.96)	4.372
Practice	25	8.11 (32.44)	8.35 (32.48)	0.191^{NS}	8.19 (32.76)	21.99 (87.96)	4.365
Total KAP	100	27.35 (27.35)	27.70 (27.70)	1.342^{NS}	28.10 (28.10)	88.22 (88.22)	8.681

*Wilcoxon Signed-Ranks Test Significant at 5% level

Figure in the parenthesis represent the percentage

The results further elucidated that in experimental group, the overall observance of KAP scores also increased statistically significant (at $p \leq 0.05$) from 28.10 to 88.22 per cent. While the control group remained non-significant in overall KAP scores (27.35 to 27.47%) due to lack of nutritional counseling. From the present study, we can suggest that nutritional counseling is a sound approach to improve the nutritional knowledge, attitude and healthy dietary practices for the effective management of diabetes mellitus.

Conclusion

Based on the findings of the study, its concluded that, nutrition counseling for three months improved the dietary intake, anthropometric profile and mean fasting blood glucose levels of the subjects. The total KAP score of the subjects increased significantly after nutrition intervention. Hence, it is recommended that. Healthy dietary habits such as reduced refined carbohydrates, increased protein, increased dietary fiber, reduced sugar/jaggery and reduced fat intake, should be followed to prevent and manage diabetes mellitus.

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