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Impact of Nutrition Education on Anthropometric and Knowledge, Attitudes and Practices (KAP) Score on Nutritional Status of Non-Insulin Dependent Diabetics

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ABSTRACT One hundred twenty non-insulin dependent diabetic subjects were selected from Punjab Agricultural University and Civil Hospital of Ludhiana. The selected subjects were divided into four groups, viz. Group I, II, III and IV having thirty subjects each. The nutrition education was given for three months after fifteen days interval to the subjects of Group II, III and IV through individual and group contact and gain in nutrition knowledge was assessed after the study. The anthropometric measurements of the subjects were measured. Significant improvements were seen in weight, BMI, MUAC and TSFT of the subjects in Group II, III and IV after study. There were also a significant increase ($P \leq 0.01$) in the knowledge, attitude and practice score obtained by the subjects in Group II, III and IV and a non-significant increase ($P \leq 0.01$) was seen in knowledge, attitude and practice score of the subjects in Group I. Therefore, it can be reported from the results that nutrition education significantly improved the nutritional status of the diabetic patients. So the objective of the study was planned to assess nutritional status of the non-insulin dependent diabetics.

INTRODUCTION

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces (WHO 2009). Diabetes is fast becoming a leading cause of morbidity, mortality and disability across the world. Diabetes mellitus is a global metabolic epidemic affecting essential biochemical activities in almost every age group (Gupta et al. 2008).

According to International Diabetic Federation (IDF 2011), the estimated diabetes prevalence for 2010 has risen to 285 million, representing 6.4% of the world's adult population, with a prediction that by 2030 the number of people with diabetes will have risen to 438 million corresponding to 7.8% of the adult population (IDF 2011).

India has been declared as the "Diabetic capital of world". By 2030 there would be 366 million diabetics throughout the world and 79.44 million diabetics in India alone (WHO 2007). It is estimated that by the year 2030, diabetes is likely to be the seventh leading cause of death accounting 3.3 per cent of total deaths in the world (WHO 2008).

According to International Diabetic Federation (IDF 2011), 70% of the current cases of diabetes occurs in low- and middle income countries. With an estimated 50.8 million people living with diabetes, India has the world's largest diabetes population, followed by China with 43.2 million. The largest age group currently affected by diabetes is between 40-59 years. By 2030 this "record" is expected to move to the 60-79 age groups with 196 million cases. Diabetes is one of the major causes of premature illness and death worldwide. Non-communicable diseases including diabetes account for 60% of all deaths worldwide. Type 2 diabetes is responsible for 85-95% of all diabetes in high income countries and may account for an even higher percentage in low and middle income countries. 80% of type 2 diabetes is preventable by changing diet, increasing physical activity and improving the living environment. Yet, without effective prevention and control programmes, the incidence of diabetes is likely to continue rising globally (IDF 2011).

Aegle marmelos family Rutaceae is highly reputed medicinal tree commonly known as the *bael*. It is medium sized tree growing throughout the forest of India of altitude 1200 meters. It

is found all over India, in sub-Himalayan forest, Bengal, central and south India. The different parts of this plant contain number of coumarins, alkaloids, sterols and essential oils. Various parts of this plant such as leaves, fruit and seed possess hypoglycaemic, hypolipidemic and blood pressure lowering property (Lmbole et al. 2010). The peel of the fruit which is a very hard shell and green to brown in color depends on ripening stage. The appearance of yellow or orange edible pulp is like a boiled pumpkin, possesses a slightly sweet taste and a characteristic floral, terpene-like aroma, very fragrant and pleasantly flavored. Seeds are surrounded by slimy transparent mucilage (Suvimol and Pranee 2008).

Bael (*Aegle marmelos*) is an important medicinal plant of India. Biochemical compounds of *bael* leaves, fruits and seeds have been used in several diseases like diabetes, cardiovascular and anti-inflammatory (Maity et al. 2009). The most important ingredients present in plants are alkaloids, terpenoids, steriods, phenols glycosides and tannins (Venkatesan et al. 2009). The *bael* leaf contain seven monotorpene hydrocarbons (90.7%), three oxygenated monoterpenes (2.9%), four sesquiterpene hydrocarbons (3.1%) and one phenolic compound (0.2%). Limonene (82.4%) was the main constituent of *bael* (Kaur et al. 2006). *Aegle marmelos* leaf extract (200 mg/dl for 35 days) significantly affect the activity of lipid peroxidase, lipoprotein and antioxidant enzymes in isoproterenol treated rats (Rajadurai and Prince 2005).

Leaf extract of *Aegle marmelos* (Bilva) was effective in restoring blood glucose, body weight to normal values and significantly reversed the altered (histological and ultra structural) parameters in tissues of streptozotocin induced diabetic rats seen by light and electron microscopy to near normal and improved the functional state of pancreatic beta cells. The hypoglycemic effects of this plant drug appear to be mediated through regeneration of damaged pancreas (Dahanukar et al. 2000). *Bael* leaf enhances ability to utilize the external glucose load in the body by stimulation of glucose uptake similar to insulin. *Bael* extract significantly lowers blood urea, reduction in lipid peroxidation and cholesterol and increased levels of super dioxide dismutase, catalase, glutathione peroxidase and glutathione level in serum as well as in liver in experimental diabetic animals (Sharma et al. 2007).

METHODOLOGY

One hundred twenty non-insulin dependent diabetic subjects were selected from Punjab Agricultural University and Civil Hospital of Ludhiana. The selected subjects were divided into four groups viz. Group I, II, III and IV having thirty subjects each. The subjects of Group I was not given any treatment. The subjects of Group II, III and IV were given nutrition education respectively for a period of three month. A multiple choice questionnaire was designed to test the knowledge regarding diabetes. There were three parts of the questionnaire. Part I included questions related to knowledge, Part II consisted of questions related to attitude and Part III was on aspect of practices. The preliminary interview schedule was pre tested on fifteen diabetic subjects so as to test the validity and suitability of the interview schedule. Thereafter, necessary modifications were incorporated. The modified questionnaire was used in the present study. These fifteen subjects were not included in the study. Various anthropometric parameters viz. height, weight, Body Mass Index (BMI) mid upper arm circumference and triceps skin fold thickness were recorded using standard method given by Jellife (1966). The techniques applied were practiced and standardized on ten preliminary diabetic subjects.

Statistical Analysis: The data on all the blood parameters was analyzed statistically. The mean standard error, percentages, paired t- test and their statistical significance was ascertained using a computer programme package (Cheema and Singh 1990).

RESULTS AND DISCUSSION

The selected 120 male patients suffering from non-insulin dependent diabetes mellitus (NIDDM) were in the age group of 35-65 years. Majority of the subjects were Sikhs and rest were Hindus in group I, II, III and IV respectively with maximum numbers of the subjects having studied up to high school. Majority of the subjects had their own business and maximum of them belong to joint family with family size of 5-6 members.

The mean heights of the subjects were 168.2±0.24, 172.5±0.60, 170.1±0.16 and 169.6±0.17 cm of the subjects in group I, II, III and IV re-

Table 1: Anthropometric measurements of the subjects before and after supplementation of *bael (Aegle marmelos* L.*)* leaf, pulp and seed powder and nutrition intervention

Variables	*Before*	*After*		*% Change*		*Paird t-value*		*Suggested value*
	1	*2 SB*	*3 NI*	*Between 1 and 2*	*Between 1 and 3*	*Between 1 and 2*	*Between 1 and 3*	
Group I								
Height (cm)	168.2±0.24	168.2±0.24	168.2±0.24	-	-	-	-	-
Weight (kg)	77.5±0.31	77.4±0.49	76.8±0.45	0.1	0.9	0.79 ^{NS}	1.91 ^{NS}	68#
BMI (kg/m^2)	27.5±0.15	27.4±0.14	27.2±0.25	0.4	1.1	1.43 ^{NS}	1.81^{NS}	18.5-24.99$^{I\%}$
MUAC (cm)	28.1±0.13	27.9±0.17	27.8±0.23	0.7	1.3	1.79 ^{NS}	2.02*	29.3^{1}
TSFT (mm)	11.9±0.13	11.8±0.13	11.8±0.15	0.6	0.8	1.81 ^{NS}	1.74^{NS}	12.5^{1}
Experimental Group II								
Height (cm)	172.5±0.60	172.5±0.60	172.5±0.60	-	-	-	-	-
Weight (kg)	82.1±0.72	79.8±0.40	78.8±0.34	2.8	4.0	3.13**	6.00**	72#
BMI (kg/m^2)	27.7±0.14	26.9±0.32	26.6±0.34	2.9	3.9	2.96**	3.56**	18.5-24.99$^{I\%}$
MUAC (cm)	29.4±0.22	27.7±0.35	27.6±0.37	5.8	6.1	3.65**	5.88**	29.3^{1}
TSFT (mm)	12.3±0.12	12.0±0.14	11.7±0.23	2.4	4.9	2.80**	3.07**	12.5^{1}
Group III								
Height (cm)	170.13±0.16	170.13±0.16	170.13±0.16	-	-	-	-	-
Weight (kg)	80.9±0.66	79.8±0.53	78.1±0.38	1.4	3.5	2.43*	4.28**	70#
BMI (kg/m^2)	27.9±0.15	27.6±0.21	27.0±0.26	1.1	3.2	1.98*	2.87**	18.5-24.99$^{I\%}$
MUAC (cm)	30.1±0.29	28.1±0.32	27.3±0.39	6.6	9.3	2.88**	4.02**	29.3^{1}
TSFT (mm)								
Group IV	12.4±0.15	12.1±0.13	11.9±0.19	2.4	4.8	2.29*	3.17**	12.5^{1}
Height (cm)	169.6±0.17	169.6±0.17	169.6±0.17	-	-	-	-	-
Weight (kg)	81.1±0.65	80.1±0.61	79.0±0.52	1.2	2.6	2.16*	3.53**	69#
BMI (kg/m^2)	28.6±0.19	28.0±0.22	27.6±0.30	2.1	3.5	2.68**	3.94*	18.5-24.99$^{I\%}$
MUAC (cm)	28.9±0.18	28.2±0.22	27.1±0.40	2.4	6.2	2.90**	4.28**	29.3^{1}
TSFT (mm)	12.5±0.16	12.1±0.14	11.6±0.26	3.2	7.2	2.58**	3.43**	12.5^{1}

Values represent Mean±SE, ** Significant 1%, *Significant 5%, $^{\#}$ ICMR (2010), $^{\cdot}$Anonumous (2005), ^{1}Jelliffe (1996), NS – Non significant
SB-Supplementation of bael *(Aegle marmelos L.)* leaf, pulp and seed powder,NI- Supplementation of bael *(Aegle marmelos L.)* leaf, pulp and seed powder + Nutrition counseling

spectively. The increase in height was statistically insignificant.

The initial mean weight recorded were 77.5±0.31, 82.1±0.72, 80.9±0.66 and 81.1±0.65 kg of the subjects in group I, II, III and IV respectively. After nutrition intervention the figure were 78.8±0.34, 78.1±0.38 and 79.0±0.52 kg of the subjects in group II, III and IV respectively. The per cent reduction was less, that is, 4.0, 3.5 and 2.6 by the subjects of group II, III and IV respectively. The decrease in the weight of the subjects in group II, III and IV could be due to the impact of nutrition education where they were taught to decrease the intake of refined foods and increase intake of fiber rich foods. They were explained the beneficial effects of exercise and motivated to do the same. There was a significant decrease ($p \leq 0.01$) in the weight of the subjects in group II, III and IV respectively and a non-significant decrease ($p \leq 0.01$) in the weight of subjects in group I after study. Balagopal et al. (2008) and Choudhary (2010) reported that education intervention was useful in reducing obesity (Table 1).

The initial mean values of BMI were 27.5±0.15, 27.7±0.14, 27.9±0.15 and 28.6±0.19 kg/m^2 of the subjects in group I, II, III and IV respectively. After nutrition intervention the corresponding values recorded were 26.6±0.34, 27.0±0.26 and 27.6±0.30 kg/m^2 of the subjects in group II, III and IV respectively. The decrease in BMI of the subjects in group II, III and IV could be due to the impact of nutrition education. There was a significant reduction ($p \leq 0.01$) in the mean values of BMI in the subjects of group II, III and IV after study and a non-significant reduction ($p \leq 0.01$) in the mean values of BMI of the subjects in group I. Heydari et al. (2006) also found that dietary counseling was effective in reducing BMI in diabetic patients (Table 1).

The initial mean value mid upper arm circumference of the subjects in group I, II, III and IV were 28.1±0.13, 29.4±0.22, 30.1±0.29 and 28.9±0.18 cm respectively. After nutrition intervention, the corresponding values recorded were 27.8±0.23, 27.6±0.37, 28.5±0.39 and 27.1±0.40 cm of the subjects in group I, II, III and IV. The decrease in MUAC of the subjects in group II, III and IV could be due to the impact of nutrition education. The per cent reduction in the mid upper arm circumference of the subjects in group II, III and IV were 6.1, 5.3 and 6.2 respectively. There was a significant reduction (pd"0.01) in the mean values of mid upper arm circumference of the subjects in group II, III and IV respectively and a non significant reduction ($p \leq 0.01$) in mean values of mid upper arm circumference of the subjects in group I after study (Table 1). The similar results were also reported by Choudhary (2010).

The initial mean triceps skin fold thickness values recorded were 11.9±0.13, 12.3±0.12, 12.4±0.15 and 12.5±0.16 mm of the subjects in group I, II, III and IV respectively. After nutrition intervention, the corresponding values were 11.7±0.23, 11.9±0.19 and 11.6±0.26 mm of the subjects in group II, III and IV respectively after study. There was a significant decrease (pd"0.01) in the mean triceps skin fold thickness values of the subjects in group II, III and IV after study and a non-significant reduction ($p \leq 0.01$) in the mean triceps skin fold thickness values of the subjects in group I. The per cent reduction in the triceps skin fold thickness of the subjects in group II, III and IV were 2.68, 2.09 and 2.41 respectively (Table 1). The similar results were also reported by Choudhary (2010).

The knowledge gain of the subjects is shown in the Table 2. Nutrition counseling was imparted to the subjects of group II, III and IV by individual and group contacts in the form of nutrition lectures and demonstration etc. for a period of three months. The subjects of group I were not imparted any nutrition counseling during these three months. The evaluation of the scores was done before (pre-test) and after three months (post-test) of intervention to assess the diabetes and knowledge of the subjects about *bael* in group II, III and IV.

It was seen that there was a significant increase ($p \leq 0.01$) in knowledge, attitude, practices and hence total knowledge of the subjects in group II, III and IV after three months of the study while there was a non-significant increase ($p \leq 0.01$) in knowledge, attitude, practices of the subjects in group I. The increase in KAP scores of the subjects in group II, III and IV could be due to the effect of nutrition counseling given to the subjects like increase in consumption of whole cereals, sprouted pulses, green leafy vegetables, salads, fruits etc. they were also told to do exercise daily. Similar study was also done by Monga et al. (2008).

CONCLUSION

It can be inferred from the results that nutrition counseling improved the anthropometric parameters of the subjects. Nutrition counsel-

Table 2: Knowledge, attitude and practice scores obtained by the subjects before and after supplementation of bael *(Aegle marmelos* L.*)* leaf, pulp and seed powder and nutrition intervention

Variables	*Before*	*After*		*% Change*		*Paird t-value*	
	1	*2 SB*	*3 NI*	*Between 1 and 2*	*Between 1 and 3*	*Between 1 and 2*	*Between 1 and 3*
Group I		*3 months*	*6 months*				
Knowledge	13.9±0.12	14.1±0.21	14.1±0.15	0.9	1.2	1.12 ^{NS}	
Attitude	8.2±0.14	8.3±0.17	8.4±0.21	1.6	2.4	1.81 ^{NS}	1.74 ^{NS}
Practice	7.6±0.23	7.7±0.25	7.9±0.32	1.7	4.3	1.67 ^{NS}	1.90 ^{NS}
Total KAP	29.7±0.33	30.1±0.51	30.4±0.49	1.3	2.3	1.74 ^{NS}	1.69 ^{NS}
Experimental Group II							
Knowledge	9.9±0.22	29.1±0.88	41.3±1.14	65.9	76.0	23.51**	29.15**
Attitude	8.1±0.15	15.6±0.19	24.8±0.29	48.1	67.3	30.43**	48.05**
Practice	9.5±0.23	14.3±0.43	20.9±0.32	33.7	54.5	11.13**	38.72**
Total KAP	27.5±0.15	59.0±0.94	87.0±0.69	53.4	68.4	40.01**	69.26**
Group III							
Knowledge	10.7±0.12	24.4±0.23	42.2±0.21	56.2	74.6	22.06**	47.74**
Attitude	8.9±0.21	14.6±0.50	22.9±0.76	39.0	61.4	10.66**	21.18**
Practice	7.9±0.27	12.5±0.17	20.0±0.20	36.8	60.6	17.80**	35.71**
Total KAP	27.5±0.21	51.5±0.54	85.1±0.65	46.6	67.7	41.07**	74.83**
Group IV							
Knowledge	9.8±0.24	23.9±0.35	39.2±0.56	58.9	75.0	36.72**	51.71**
Attitude	9.2±0.26	13.1±0.17	24.1±0.33	29.8	61.8	14.26**	40.65**
Practice	8.1±0.27	12.4±0.17	19.4±0.17	34.9	58.4	16.58**	30.21**
Total KAP	27.1±0.22	49.4±0.68	82.7±0.87	45.2	67.3	29.61**	72.80**

Values represent Mean±SE, ** Significant 1%, *Significant 5%, NS – Non significant
SB-Supplementation of bael *(Aegle marmelos L.)* leaf, pulp and seed powder
NI- Supplementation of bael *(Aegle marmelos L.)* leaf, pulp and seed powder + Nutrition counseling

ing improved the knowledge, attitude and practices score of the subjects.

RECOMMENDATIONS

Nutrition counseling by the dietician plays an important role in the management of diabetes. There is a need to conduct well designed community based diabetes prevention programme to stem the rising trends of diabetes in the country.

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