1. Introduction

Diabetes mellitus presently pesters the world, posing a great socioeconomic burden to each and every nation the world over. It is a metabolic disorder characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both (WHO, 2011).

The International Diabetes Federation (IDF, 2011) estimates that worldwide there are 366 million people with diabetes in 2011 globally and this is expected to be 552 million by 2030 (54% increase). This equates to approximately three new cases every ten seconds or almost ten million per year. IDF also estimates that as many as 183 million people are unaware that they have diabetes. In 2011 there were 71.4 million people with diabetes in the South East Asia region, this number is expected to increase to 120.9 million by 2030. IDF also estimates that 36.2 million people in the region are yet to be diagnosed with the disease.

India has a higher number of people with diabetes than any other country, involving 50.8 million people in the age group of 20 to 79 in 2010 and this number is estimated to reach 87.0 million by 2030 (IDF, 2009). IDF (2011) estimates that India alone has 61.3 million people living with diabetes. Thus India is being designated as ‘diabetes capital’ of the world. Prevalence of diabetes is increasing day by day and has acquired a pandemic status in India (Wild et al., 2004). Specifically, Kerala the southernmost State of India claimed to have the highest number of diabetic patients. According to Soman (2007) the prevalence of type 2 diabetes, in rural Kerala, is similar to or higher than that reported from urban India, which is quite disturbing. But the State of Kerala has not yet taken a serious note of the magnitude of this problem or its developmental consequences seriously.

Due to this rapid progression in the incidence and the long term macrovascular and microvascular complications of the disease; the chronic hyperglycemia, poses a serious threat to manpower development (Nathan et al., 2006).

Higher socioeconomic status with white-collar jobs and minimal physical activity (Mohan et al., 2008) along with excess intake of visible fat along with a positive family history of diabetes (Mohan et al., 2007), has a direct effect on development of the disease. Physical inactivity in fact has synergistic effect with obesity on risk of diabetes (Mohan et al., 2008). More recently vitamin D deficiency
and environmental pollution in urban areas have also been implicated in the diabetic epidemic (Lee et al., 2006).

Risk management of diabetes therefore, encompasses a multi-factorial approach rather than focusing on hyperglycemia alone (Campos, 2007). Eighty percent of type 2 diabetes is preventable by suitable diet, increasing physical activity and improvement of living environment. Yet, without effective prevention and control programmes, the incidence of diabetes is likely to escalate globally (IDF, 2010). In this context, an understanding of the complexity of factors for the development of type-2 diabetes is highly imperative (Michael et al., 2009; Romao and Roth, 2008).

An overview on the definition, diagnosis, potential dangers and current prevention and treatment options available will go a long way in putting a check to this disease and helping the diabetic patients and their relatives themselves who are vulnerable to the risk of developing the disease. A trite intervention is needed to control the alarming diabetic incidence experienced today.

Epidemiological studies on diabetes have been attempted in Kerala, particularly southern and central region. Though patient education is an essential component of chronic disease care and effective health promotion, no substantial effort on the educational intervention in an organised manner has been reported so far. Hence awareness creation on diabetes is a vital step towards its management as well as patient care.

This necessitates the development of diabetic management programme with a multidisciplinary approach including the expertise of physicians, nurses, dieticians and exercise specialists that permit access to comprehensive individual care. Development of such programme is imperative in diabetes research, which would to transform what is currently known as the management of diabetes and prevention of complications into good lifestyle practices. Hence a need based educational programme has to be developed and tested before popularisation.

The present study was an attempt in this direction aiming at the development and feasibility testing of a software package for the management of type 2 diabetes mellitus. The specific objectives of the study entitled “Development of an intervention module for management of type 2 diabetes mellitus” were:

1.1 To identify the risk factors of type 2 diabetes mellitus among the patients.
1.2 To develop a diabetic intervention education package.
1.3 To implement this educational intervention package on target population.
1.4 To evaluate the effectiveness of this package with special reference to their awareness building, self-care and management, and lifestyle modification.

2. Methodology

The locale selected for the conduct of the study was Kannur district in Kerala. Among 14 districts of Kerala, Kannur is located in the northern region. It is a beautiful miniature of the picturesque State of Kerala and is the fourth biggest urban agglomeration in the State after Kochi, Thiruvananthapuram and Kozhikode. Kannur is a virgin area in terms of the present topic of research.

In the present study purposive random sampling method was adopted to select the sample. The study covered 300 type 2 diabetic patients (150 males and 150 females), from the three speciality hospitals in Kannur. Geographical coverage, availability of diabetic clinics and the sample population from different strata of the community in the hospital, accessibility and willingness of the sample, co-operation on the part of physicians and hospital authorities were the chief criteria considered for the selection of hospitals.

Data collection has been done in two phases such as:

2.1 Phase I: Collection of baseline information, which forms the basis for planning a suitable and subject appropriate intervention programme to address the issue and also to evaluate the effectiveness of the programme after intervention. The data on socioeconomic and demographic dimensions, lifestyle and other risk factors like dietary, BMI and physical activity level, history and duration of diabetes and the associated complications and co-morbidities, prevailing managerial practices including medical monitoring, alternative therapies and current diabetic profiles in terms of clinical and biochemical parameters were collected with the help of interview schedule developed for the purpose.

2.2 Phase II: Development and evaluation of an educational module.

A need-oriented educational package has been developed. The specific objectives of the package were to create awareness on various aspects of diabetic care, to stress the significance of self-care management, importance of medical monitoring, prevention and control of co-morbidities and complications, and to build confidence to bring-in necessary modifications in lifestyle with respect to diet, exercise and stress alleviation in diabetes.
Total sample size for the intervention programme was 68, including 35 and 33 subjects respectively of control and experimental groups. The educational intervention was conducted, once in a fortnight sparing duration of three months.

The educational intervention aims to explore changes in knowledge and practices of the selected subjects (n=33) and also their approach to deal with the problem - the diabetic management. A test instrument was designed in the present study for assessment of knowledge, attitude and practices (KAP) before and after intervention. The instrument consisted of three sections to assess the knowledge, attitude and practice of the subject. A suitable set of questions framed based on the major concepts dealt with the package were framed. The KAP of the subjects were assessed by administering the test instrument prior to and 10 days after the completion of the educational programme, on both control (n=35) and experimental (n=33) groups.

The data collected was processed using the Statistical Package for the Social Sciences (SPSS) for Windows version 17.0. The results were presented using percentages, descriptive statistics like mean and standard deviation. Paired t-test was used to compare the mean pre and post-education scores. Other statistical tools like Independent t-test, Analysis of variance (ANOVA), correlations and logistic regression methods were also used for data analysis. z-test were used for comparing the difference in practices of dietary, medical monitoring and other management proportions.

3. Major findings

3.1. Baseline information:

Eighty percent of the respondents, irrespective of gender, were in the age group of 41 to 70 years. Thirty three percent of the respondents were from urban areas, 4.3 percent belonging to suburban areas and the patients hailing from rural areas were the highest (62.7 %). Majority (70.3%) of the respondents belonged to nuclear families and more than half of them (52.0%) had two to three children. Majority of the respondents (36%) earned a monthly income between 5001 to 10000 rupees and 87.42 percent belonged to middle income status. Sixteen percent each was categorised as lower and upper socioeconomic status. None of them were found to be illiterate. Majority of them (37.3%) had either primary school or secondary education. Full time housewives constituted a total of 77.3 percent of the female diabetics and
men were mostly engaged in small business enterprise (34%) and 20.7 percent of them were farmers.

The maximum number of patients (37.3%) developed diabetes at the age of 41 to 50 years, followed by 31 to 40 years (23.3%). The mean age of onset of diabetes and their current age revealed that majority in the age group of 51 to 60 years had diagnosed the disease in their late 40’s with a mean age of 47.93±6.35 years. The significant difference in the mean age of onset of diabetes further prompted to analyse the data and one way ANOVA showed that the income and education significantly (P< 0.05) influenced the onset of diabetes.

Anthropometric results showed that majority (86.7%) of the female subjects had waist circumference above normal value (>80 cm) and majority of male (67.7%) and female (98.7%) subjects had waist-hip ratio higher than normal. A significant (P<0.05) influence of exercise on WHR has been observed among the male patients. But female patients failed to show any such significant influence. Body mass index (BMI) of all subjects showed that a sizable section (62%) of the subjects was either obese (37.7%) or overweight (24.3%) and more among women than men.

With regard to blood sugar 86 percent, reported having fasting blood sugar level on a higher side (>125 mg/dl). Comparatively more number of male diabetics (68%) than females (52%) had normal range of systolic and diastolic pressure. Serum cholesterol level within the desirable limit (<200 mg/100ml) was reported by 59.3 percent of the subjects studied comprising more men than women. The mean duration of diabetes was found to increase significantly (P<0.01) with the age of the subjects. Considering the complications polyneuropathy (23%) and retinopathy (23%) were the major complications observed among the subjects. The complication next in order was diabetic foot (14%). Both male (14.7%) and female (13.3%) diabetics were equally exposed to this problem.

Nearly one third (31.3%) of the diabetic patients did not have a family history. Among the rest, first degree relatives (either of the parents or both) showed the highest (34.7%) genetic influence for development of diabetes. Considering the family history of other degenerative health problems, it was obtained that 33.67 percent had health problems in the family such as obesity (13%) and related risks like heart attack (12%), CVD (5%) and stroke (3.7%). Female diabetics (20.67%) had a strong family history with respect to degenerative diseases when compared to male (13%).
Regarding food habit 85.7 percent of the subjects were nonvegetarians, followed by pure vegetarians (10%) and ova vegetarians (4.3%). Meal pattern of the subjects revealed that majority (69.7%) had four meals a day. Highly preferred food items with a percent scores of 74.7 was cereal products and next was fish (51.7%). The food items to be essentially included in the diet of diabetic patients such as raw salads, vegetables and fruits were aptly preferred only by 14.67 percent, 16 percent, and 25.3 percent of the subjects respectively. The food items to be restricted such as fleshy foods (45.7%), fried items (46%) and egg (47.7%) were extremely preferred by nearly half of the subjects studied. Fast foods (50.4%), bakery products (46%) and sweets (43.7%) were also found to be delicacies of majority. All food items supposed to be avoided in the diabetic diet have found a place in their meal pattern either as extremely preferred or preferred items. Regarding dietary modification 71.3 percent of the subjects had made no modification in their food habits and only 28.7 percent said they had.

Personal habits like smoking (44.7 %) and alcohol consumption (30.7 %) were seen to be prominent in male diabetics. Slight reduction in such habits during post-diagnostic period was reported but half of them were still continuing it. Most (57.3%) of the diabetic patients irrespective of gender were engaged in sedentary work. This was followed by the moderate (41.3%) activity. Only a negligible (1.3%) number were said to be engaged in strenuous activities on daily basis. With regard to exercise pattern more than half of diabetics (51.0%) did no exercise at all. Walking was the only exercise taken seriously, either daily (22.7%) or twice/thrice a week (13%) by a small group of the sample.

Stress was a common phenomenon observed among both male and female subjects. Majority (84.0%) of the subjects were prone to stress, but it was slightly higher among females (86.7%) than male (81.3%). Majority (60.0%) of the subjects did not follow any relaxation techniques knowingly. Seventeen percent of the subjects found relaxation through prayer, followed by listening to music (9.0%), meditation (6.3%), yoga (4.0%) and outing (3.7%).

With regard to medical monitoring, majority (44%) of the subjects were only occasionally checked their sugar level. Regarding the frequency of visiting doctors also, the major chunk (38.3%) reported only occasional visits.

Regarding the treatment modalities, majority (60.3%) of subjects were on oral hypoglycaemic agent (OHA). A small portion (2.7%) did not have any antidiabetic
therapy, but only dietary management and 2.7 percent totally depended on diet and exercise.

### 3.2. Impact of Educational Intervention

Out of the total of 68 patients who enrolled themselves for educational intervention including control (n=35) and experimental (n=33) groups, 31 (45.6%) were male and 37 (54.4%) were female. The age group of the majority of subjects ranged between 41 to 60 years (64.7%) and the average age of the subjects in the educational intervention group was 50.46±10.83.

The educational status of the group ranged between primary school to post graduate/professional education and none was illiterate. Government servants and professionals like officers, teachers, nurses and retired hands together constituted 45.6 percent of the subjects. The second highest was housewives (29.4%) followed by business men (16.2%) and agriculturists (8.8%). Majority of the subjects (51.5%) had a monthly income of Rs. 7000 to 15000/-.

Independent ‘t’ test was used for comparing the pre-test scores on KAP of control and experimental groups, and the results showed that at baseline there was no significant difference between the two groups.

After intervention education a highly significant \((P<0.01)\) difference in KAP scores of experimental group, in all the aspects of diabetes care and management dealt with in the package was observed. Some positive changes in the knowledge and practices of control group was visible, significant at one percent level. The high level scores on KAP among experimental group indicates a significant \((P<0.01)\) positive impact of the educational intervention. Areas of behavioural modifications includes healthy eating (including meal spacing, meal balance and meal regularity and increased consumption of pulses, vegetables and fish as well as reduced intake of fat and simple sugar), exercise, and regular check-up and medication.

Of the various factors influencing the KAP scores of experimental group, only age of the respondents indicated a significant \((P< 0.01)\) influence on the practice score of the sample. It was found that the youngest (≤30 years) and oldest (>60 years) of the lot, adopted desirable practices more regularly than middle age group. The age-wise comparison failed to show any significant influence on the quantum of knowledge acquired and desirable attitudinal changes.

Net gain in KAP scores, due to educational intervention did not show any statistical difference between male and female diabetics. This indicates that
irrespective of gender the experimental group was benefited by the intervention. When individual scores were considered, the gain in KAP scores by female diabetics was higher than their male counterparts.

Similarly no significant influence on KAP scores in post-test stage was reported due to educational, socioeconomic levels or occupational pattern of the subjects. This indicates the compatibility of the package to diversified populations, for improving the KAP scores to a significant level. This justifies the feasibility of the educational package for people of varying educational status, different economic status and subjects irrespective of occupational background. Hence the educational intervention in the present study helped to improve the health outcomes in patients by improving their treatment adherence behaviour and practices of healthy life styles.

Correlation analysis of KAP in experimental group revealed that improvement in knowledge did not help to bring about a significant change in the attitude and practice of the subjects. Whereas a significant attitudinal change resulted in significant (P<0.01) behavioural modifications among the subjects. So the study clearly demonstrated a significant (P<0.01) correlation between attitude and practice.

The opinion of the subjects about the intervention package was also obtained in terms of the content (coverage, suitability, adaptability in day today life), presentation and duration of programme. The educational package in general was very much appreciated by the subjects.

Dietary modifications as reflected by the percentage adequacy of food consumption, male diabetics showed a significant improvement after the educational intervention. The intake was hardly sufficient to meet the RDA for other vegetables (11.05±20.32%), pulses (21.05±28.09%), milk (27.19±15.92%) and green leafy vegetable (31.05±31.91%). But after intervention education, the intake of such food had increased significantly (P<0.01). The female subjects also exhibited a similar trend.

The percentage adequacy of nutrient intake of male subjects was found to improve in the post-intervention period with respect to fibre (10.45% vs. 18.54%) and iron (77.20% to 98.14%). Among female diabetics the dietary modifications due to education helped to bring about desirable changes in nutrient intake such as a significant reduction in fat intake and a significant improvement in iron and fibre intake.
Desirable behavioural changes in the management practices of diabetes were also noticed in the case of medical monitoring. There was a significant (P< 0.01) increase in the periodic blood testing and regular visits to physicians among the patients who underwent the education programme. Daily exercise for half an hour by the patients, became more popular after the education programme and was adopted by a significantly (P< 0.01) more number of patients who belonged to the experimental group.

Most of the diabetic patients in the study had poor glycemic control (84.85%) and a high Fasting Plasma Glucose (FPG) level (87.87%) during the pre-test period. There was notable reduction in FPG level of the subjects from 87.87 percent (pre-test) to 54.55 percent (post-test). Similarly HbA1C level also showed a remarkable decline between pre (84.85%) and post (39.39%) test period. This statistically significant (P<0.01) reduction in the mean values of HbA1c and FPG of experimental subjects due to educational intervention, indicates a significant improvement in the glycemic control by the subjects; as an outcome of diabetic education.

**Conclusion**

From the results, it has been revealed that type 2 diabetes, a product of genetic and environmental factors, is mainly due to changing trends in lifestyle. Even after diagnosis and initiation of medical intervention, majority of the patients were still continuing with the symptoms and risk factors, like high waist-hip ratio, BMI, blood sugar, blood pressure, serum cholesterol, unhealthy dietary practices and low physical activity which might lead to severe complications of diabetes.

The two main lifestyle related risk factors with strong impact on diabetes incidence are nutrition and physical activity. Therefore, in the present study, focus was on educating the subjects regarding healthy behaviour modifications in these two factors. The results showed that the educational intervention programme had improved and enhanced the diabetic patients’ knowledge, attitude, practices and self-care skills with regard to diabetic management, irrespective of age, educational, economic, occupational and gender variations of the subjects.