SUMMARY AND CONCLUSION
SUMMARY AND CONCLUSION

Diabetes Mellitus is the most common metabolic and endocrine disease of mankind. There is a rapid increase in the prevalence of type 2 diabetes mellitus in both urban and rural areas. India is the epicenter of a diabetic epidemic, with more than 42 million diabetic patients. The risk factors of type 2 Diabetes mellitus have regional and ethnic variations. Studies focusing on the rural populations are few, hence a study was conducted among the rural population of North Malabar.

This study was conducted at Academy of Medical Sciences, Pariyaram during a period of four years from June 2004 to June 2008. The detailed protocol and proforma of the study was approved by the doctoral committee of Kannur University, and the institutional ethical committee. Subjects who were in the age group of 25-55 years and permanent residents of North Malabar were included in this study. Type 2 Diabetes mellitus patients were identified based on the American Diabetic Association (ADA) criteria. The objective was to study the distribution and profile of Type 2 Diabetes mellitus and to identify the risk factors associated with Type 2 Diabetes mellitus in the rural population of North Malabar.

The study was conducted in two stages. The first stage was a descriptive study conducted to identify the distribution and profile of type 2 diabetes mellitus (Objective I). A total of 1027 type 2 diabetes mellitus patients both male and female were included in the study. Variables like age, sex, occupation, religion, family history, physical activity, diet, stress, blood pressure, height, weight and Body Mass Index (BMI), biochemical parameters like Fasting Blood sugar (FBS), Random Blood Sugar (RBS), Post Prandial Blood Sugar (PPBS), Serum cholesterol, urea and creatinine were studied. All cases of secondary diabetes and seriously ill patients were excluded.
Stage II was a case control study to fulfill the second objective, i.e., to identify the risk factors associated with type 2 diabetes mellitus. This was a hospital based case-control study with a random sample of 100 cases and 200 control (case control ratio of 1:2). The control was selected from the accompanying persons and visitors of the hospital.

The data was analysed in the biostatistical department of Academy of Medical Sciences Pariyaram. The analysis was done using SPSS 13. In the descriptive study frequency, percentage, the mean and standard deviations were calculated and the associations between variables were performed using chi-square test. Also t-test was performed to find the significant difference of two means and ANOVA was performed to find the significance of more than two means. In the case control study, in addition to the above statistical tools, to find the crude and adjusted Odds Ratio (OR) a simple binary logistic regression analysis was performed. 95% Confidential Interval (CI) was calculated to find the significance of observed OR. In all cases P value <0.05 was considered significant.

Of the 1027 Patients studied, 660 were males (64.2%) and 367 (35.8%) were females. 84.5% patients were from Kannur district, 14.8% from Kasargod district and 0.7% from Wayanad district. The mean age of the study sample was 45.8 years with a SD of 7.4 years. The mean age of onset of diabetes among the male was 44.3±6.9 years and that of female was 43.6±7.5 years. Among those with age less than 40 years, 82 patients (23.3%) were females and 107 patients (16.2%) were males. Compared to male patients 6.1% more number of females were affected in this age group. Highest percentage of type 2 diabetes mellitus (28.5%) was observed in the age group of 45-50 years both among males and females. Analysis of religion in this descriptive study showed that 64.5% were Hindus, 15.9% were Muslims and 19.7% were Christians. Among females, 62 patients (16.9%) were Muslims and 90 patients (24.5%) were Christians. Study showed that 7.6% higher incidence among Christian woman compared to Muslim women. In the present study, mean duration of
onset observed was 1.8 years. In more than 55% of patients the duration of onset of diabetes was less than or equal to one year and in only 4.6% cases the duration was more than 5 years.

The mean height of patients observed was 162.1±6.5cm and the mean weight was 60.38±8.7Kg. The mean height of male patients were 165±5.11cm and that of females were 156.7±5.2 cm. The mean weight of male patients were 62.3±7.9Kg and females were 56.9±8.8Kg. The mean Body Mass Index (BMI) observed was 22.9±2.9 Kg/m^2. In this instance it was observed that 73.8% had a normal BMI in the range of 18.5 to 25 Kg/m^2. Over weight was noticed in 21.8% and obesity in 3.9% patients. Housewives had more BMI compared to manual labourers and farmers.

Regarding the family history, 54.2% of diabetic patients revealed that at least one of their family members had Diabetes Mellitus. A total of 357 Males (54.1%) and 200 females (54.5%) had positive family history showing almost equal distribution. Study of their relationship showed that in 295 cases (53.7%) mother was diabetic, in 139 patients (27.2%) father was diabetic and siblings were diabetic in 13.1% of the cases (brother 9.3% and sister 3.8%). Analysis of the occupation showed that 317 patients were engaged in household activities (30.9%), 176 were farmers (17.1%), 128 manual laborers (12.5%) and 406 patients (39.9%) engaged in other activities.

Regarding the work pattern 688 patients (65.0%) stated that they were hard working, 250 patients (24.3%) were involved in moderate activity and only 109 (10.6%) were sedentary. Gender wise distribution showed more than 75.0% of females and 58.5% of males were hard workers and 15.3% of males and 2.2% females were sedentary or engaged in minimal works. Mental stress was observed in 140 diabetic patients (13.6%), of which 80 were males (57.1%) and 60 were females (42.9%). Regarding stress, a small difference of 4% higher number was noticed among females. Analysis of dietary pattern revealed that 626 male patients (96.3 %) and 336 females (91.6%) used to consume normal
mixed diet. Tobacco use in the form of smoking was prevalent among males and chewing in females. 172 male patients (26.1%) and 28 females (7.6%) used tobacco. Hypertension was present in 42.6% of patients and the mean systolic BP was 142.15±21.7 mmHg. Gender distribution showed, the mean systolic BP for male patients was 142.5±21.6 mmHg and for females it was 142.15±21.7 mmHg. The mean diastolic BP was 86.20±10.4 mmHg. For male the mean DBP was 87.19±10.7 mmHg and for female mean DBP was 86.2±10.39 mmHg.

Fasting Blood sugar (FBS) was available in 986 patients. The mean FBS value was 211 mg/dl with an SD of 61.86 mg. The mean PPBS obtained was 281 mg/dl with an SD of 50 mg and the mean RBS was 293 mg/dl with a SD of 77.8 mg. For serum cholesterol, the mean and SD observed was 201 mg/dl and 58 mg respectively. The mean and SD of FBS for male subjects were 213±62.6 mg/dl and for female 206±60.3 mg/dl. The mean and SD of serum cholesterol was 204±62.9 mg/dl for females and 200±54.9/ dl for males. No significant gender differences were observed in Fasting, Random or Post Prandial Blood Sugar or Serum Cholesterol values. Blood urea less than 50 mg% was noticed in 785 patients (90.4%), and higher than these values in 71 patients (9.6%) patients. Creatinine less than 2.5 mg was noticed in 823 patients (96.4%) and more than 2.5 mg in 31 patients (3.6%) cases.

The case control study showed that the mean age of the cases were 41.07±9.03 years and that of controls were 45.63±7.88 years. 41% of cases and 36.5% control subjects were in the age group of 40-49 years. Age distribution showed that 83% of the diabetic patients and 56.5% of control were above 40 years and below 55 years. To find the association between age and the occurrence of diabetic mellitus, Pearson Chi-square test was applied which showed that age is a significant factor (p < 0.001). Case control study showed that 60.5% in the control group and 67% among the cases are Hindus, 21% control and 17% cases are Christians and 18.5% controls and 16% in case
group are Muslims. Religion did not appear to be a significant factor when tested with Pearson chi-square test.

With regard to occupation 29% in the control and 25% among the cases were engaged in household works and 8% in the control and 7% in the case group were manual labourers. Farmers were more in the case group (29%) compared to control (6.5%). Also 53% control and 33% cases were engaged in other occupations. Occupation appeared as a significant factor (P <0.001) when a pearson chi square test was applied.

When physical activity was considered, more subjects were found to be hard working among the case (42%) than control in (14.5%). Those involved in moderate activity in control was 18% and in case it was 39%. 67.5% controls and 19% cases were sedentary workers. Physical activity appears to be a significant factor (P<0.001), and Diabetes mellitus was less in hard working compared to sedentary and moderately working group. Analyzing the family history, 37.5% control and 55.0% cases had positive family history of diabetes. Mother was diabetic in 11.5% control and 24% of case group. Father was diabetic in 10.5% control and 7.0% of cases. Statistical analysis showed that family history was a significant factor in the occurrence of diabetic mellitus (P<0.002).

The mean BMI of cases were 23±3.31Kg/m² and that of control were 23.39±3.09Kg/m². Body Mass Index was normal in 62% controls and 67% of cases. Over weight was noticed in 29% controls and 25% of cases, obesity was noticed in 4.5% controls and 3% of cases. Obesity did not appear to be a significant factor. Dietary analysis showed that 93% of control and 83% of case had normal dietary pattern. 11% subjects were taking a mixed diet and 7% were vegetarian. Dietary pattern did not appear to be significant factor for the occurrence of diabetes mellitus. Tobacco use was noticed in 18.5% of the control group and in 38% cases. Use of tobacco was found to be a significant factor (P< 0.001). Mental stress was noticed in 10% control and 12.5% cases.

Summary & Conclusion
In this study it was found that there was no association between mental stress and occurrence of diabetic mellitus. Normal blood pressure was observed in 93.5% controls and 61% cases. The mean systolic Blood Pressure in case group was 125.93±13.5 mm Hg, and in the control was 141.6±19.44. mm Hg. The mean diastolic BP in cases was 81.44±8.94 mm Hg and in control was 85.44±10.53 mm Hg. 39% cases and 13% control had high systolic blood pressure. In this study 18% cases and 23% controls had elevated diastolic blood pressure. This study observed that Systolic hypertension is associated with the occurrence of diabetic mellitus (P<0.001).

Chi-square test showed that age, sex, occupation, family history, physical activity, smoking, and systolic hypertension were significant risk factors for the occurrence of diabetes mellitus. A simple binary logistic regression analysis was performed to find crude Odds Ratio (OR) for all the significant factors. Those factors which were found to be significant in simple binary logistic regression were included in multiple logistic regression models to find adjusted Odds Ratio (adjusting all other factors). These results showed that age above 50 years [p<0.002, OR 5.4, with a 95% CI (2.14-29.36)] Family History [P=0.001, OR 3.09, 95% CI (1.56-6.12)], Physical activity [P=<0.001,OR 0.1 95% CI (0.05-0.24)], Smoking [P=0.034, OR=2.49, 95% CI (1.22-5.15)] and systolic hypertension [P<0.001, OR=4.69, 95% CI (2.12 -10.40)] appeared to be statistically significant factors for the development of diabetes mellitus.

So it can be concluded that there is a linear increase in the development of diabetes as age increases. Those above 40 years are most vulnerable to develop type 2 diabetes mellitus and are 2.6 times higher than that of 30 years. When compared to the 25 year age group, the chance to develop Type 2 Diabetes mellitus is five times higher in the 50-55 age groups. So age is an important risk factor in the development of Type 2 Diabetes mellitus. There is no gender difference in the development of Diabetes mellitus. Among 25-40 year age group more females were affected than males. The reason could be hormonal or ethnic difference rather than environmental factors and this finding

Summary & Conclusion

[Page 146]
need further studies. Manual laborers are less affected compared to other occupation. Those engaged in hard work has less chance to develop diabetes than those with sedentary habits. This also proves the protective effect of physical activity in the prevention of type 2 diabetes mellitus. Those with a family history of diabetes have three times more chance to get type 2 diabetes mellitus. The chance to develop type 2 diabetes mellitus is 3.6 times higher if mother is diabetic, and 2.8 times higher if father had diabetes mellitus. Several families with clustering of diabetes mellitus also noticed. Tobacco use in any form has 2.5 times higher chance to get type 2 diabetes. Obesity as indicated by high BMI is not a risk factor for the development of T2DM in the present study. In this aspect the finding is markedly different from the Western and few Indian Urban studies. Stress and dietary factors were not a statistically significant risk factor in the development of T2DM. Hypertension is a significant risk factor in the development of T2DM. Those with systolic hypertension have 4.7 times more chance. So in conclusion many factors like obesity, diet, stress, occupation which are considered more important in the western and urban studies found to be not of significance in this rural area, where as strong genetic factors, tobacco use, less physical activity and systolic hypertension emerged as strong risk factors in the region.

RECOMMENDATIONS

The rapid upsurge of type 2 diabetes mellitus and metabolic syndrome is an emerging threat, and a health burden to societies and economies globally. So it is imperative on the part of scientific community and society at large to explore ways to detect and prevent diabetes. Regional studies and the inferences based on such studies are most useful in planning, and optimal utilization of limited resources available in the health care system of Kerala. This study concluded that the risk factors hither to implicated in the genesis of type 2 diabetes cannot be fully applied in a rural set up, and there are some marked differences in the risk profile of urban population and rural population. So based on the above finding I recommend following measures and intervention to detect and prevent diabetes in the North Malabar.
This study recommends early screening of all subjects with a family history of diabetes at 30 years and above so that diabetic prevention programmes can be implemented in them early.

Hypertension especially systolic hypertension is found to be an independent risk factor for the development of diabetes with five times higher chance than non-hypertensive. Adequate control of hypertension should be given due importance as a preventive measure for type 2 diabetes. So far this aspect is considered only in the prevention of complications of diabetes. Hence all hypertensive patients irrespective of their age should be screened for diabetes and appropriate treatment should be given as early as possible.

Tobacco use was found to be a major risk factor in the development of diabetes in the rural community. The relation of smoking and type 2 diabetes mellitus is a less discussed issue in the diabetic prevention programmes. Hence quitting tobacco use in the primary prevention of diabetes need more stress in the health education programmes of diabetes.

Since the presentation of diabetes mellitus has regional and ethnic variations there is need for strategic planning to screen, treat and prevent complication of diabetes mellitus based on the regional, social, cultural and economic factors. Diabetes mellitus poses severe burden on the already under resourced health care system of Kerala. Obesity, dietary factors and stress which are given much importance in the etiology of type 2 diabetes mellitus in the western and urban literature found to be less important factor in the genesis of diabetes in North Malabar. A strong underlying genetic factor emerged as an important factor in the region. So based on this study I recommend a pedigree analysis and other genetic studies focusing the cluster of families identified in this work. The issue of Late Onset Autoimmune Diabetes and Maturity onset diabetes mellitus also need more studies in the area.
because of higher number of diabetes patients had a normal BMI in contrast to the reports from the western countries.

- This study highlighted that diabetes occur at an earlier age among the population of this area, and hence there is an urgent need for strategic planning to detect more cases and prevent further complications. In order to facilitate and coordinate further studies in Diabetes mellitus in the region, I suggest establishment of a Regional institute of Diabetology in North Malabar based at Academy of Medical Sciences, Pariyaram in Kerala to pursue more research in Diabetes, to streamline the prevention, education, and treatment of Diabetes mellitus.