,99 Journal Homepage: - www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI: 10.21474/IJAR01/2288
DOI URL: http://dx.doi.org/10.21474/IJAR01/2288
ISSN NO. 2320-5407

RESEARCH ARTICLE

PREVELANCE OF COMORBIDITIES IN PATIENTS WITH TYPE 2 DIABETES MELLITUS.

Gunjan Misra[1,4], S K Bhatter[2], Ajai Kumar[3], Varsha Gupta[1*] and M Y Khan[4].

1. Rheumatology Laboratory, Department of Biotechnology, IBSBT, Chhatrapati Shahu Ji Maharaj University, Kanpur.
2. Senior Consultant, Internal Medicine Department, Regency Hospital, Sarvoday Nagar, Kanpur.
3. Department of Biochemistry, Integral University, Lucknow.
4. Department of Biotechnology, Baba Saheb BhimraoAmbedkar University, Lucknow

Manuscript Info

Manuscript History

Received: 29 September 2016
Final Accepted: 30 October 2016
Published: November 2016

Key words:-
Type 2 Diabetes, co-morbidities, Kanpur, North India

Abstract

Type2 Diabetes affects a huge population of the world with India on the top of the world's list. Present study aims to gain information about the status of diabetes in the study population laying emphasis on the prevalence of co-morbidities. The study was done on 120 asymptomatic controls and 120 diabetics. A standardized questionnaire was used to collect socio-economic and demographic details of the participants. The mean duration of diabetes was 7.07±0.5years. The mean BMI values among diabetics and controls were 27.25±0.25 kg/m^2 and 25.367±0.263 kg/m^2 respectively (p<0.001). About 24.16% patients had abnormal ECG values while 75.83% patients showed typical dyslipidemia. 60% of the affected individuals had abnormal HbA1c values (> 7) and 17.5% patients had frequent non-healing skin and soft tissue infections or ulcers of leg or foot. Kidney function tests displayed deranged values in about 11.66% patients. 62.5% diabetics belonged to the age group of 46-60 (p<0.0018) and 67.5% of them had positive family history (p<0.0001). Socio-demographic factors like marriage, education, occupation, smoking, exercise, cooking medium and consumption of junk food were found to be significantly associated with the disease. Effective treatment modalities and awareness is necessary for diabetes management in known cases and for early diagnosis in future cases.

Introduction:-

Diabetes is an enigma, genetically inherited, very essentially a metabolic disease that is revealing its secrets slowly to the researchers all over the world. There has been a quick upswing in the number of diabetic patients and this stupendous growth is noted in urban as well as rural areas. Ever increasing industrialization, narrowing urban-rural divide, amplified economic growth, changing dietary norms, lesser or no physical activity and alleviated stress levels among all strata of society are the risk factors behind the devil called Diabetes.

In India, the disease is scaling the heights of becoming a potential epidemic with more than 62 million individuals currently diagnosed with it (Joshi and Parikh, 2007; Kumar et al., 2013). The prevalence of diabetes is predicted to

Corresponding Author:- Varsha Gupta.
Address:- Rheumatology Laboratory, Department of Biotechnology, IBSBT, Chhatrapati Shahu Ji Maharaj University, Kanpur.

double globally from 171 million in 2000 to 366 million in 2030 with a maximum increase in India (Wild et al., 2004). It is predicted that by 2030, Diabetes mellitus may afflict up to 79.4 million individuals in India while China (42.3 million) and United States (30.3 million) will also face a significant upsurge in the number of affected individuals (Wild et al., 2004; Whiting et al., 2011). From being considered as the disease of the elderly, diabetes has now become the major cause of morbidity and mortality affecting youth and middle aged as well. Increased prevalence is responsible for putting socio-economic pressure on the most productive age group and health systems in the country (Mohan et al., 2007). 80% of the total burden of diabetes mellitus is from developing countries of which major contributors are India and China. Indians have a high ethnic and genetic susceptibility for the disease, and also have lower threshold limits for the environmental risk factors. It is a matter of major concern that Indians develop T2DM at a younger age than the western populations (Ramachandran et al., 2010).

Despite the increasing incidences of diabetes, a very few multi-centric studies are being conducted on the prevalence of diabetes and its complications (Kaveeshwar and Cornwall, 2014). As far as northern India is concerned, a few epidemiological studies have been conducted in Delhi (Ramachandran and Snehalatha, 2009, Ramachandran et al.; 2001; Misra et al, 2001), Chandigarh (Anjana et al., 2011) and Kashmir (Zargar et al., 2000) in the past. But there is dearth of information available about the disease status at Kanpur district. Owing to better and cheaper medical facilities available here people from surrounding districts and cities flock to it for treatment. Our aim in this study was to gain a detailed insight into the prevalence of co-morbidities in diabetic subjects as well to access the socio-economic as well as demographic risk factors related to the disease in both controls and diabetics.

Materials and Methods:-

Study design- The layout of this study was designed in the rheumatology laboratory of CSJM University, Kanpur in Uttar Pradesh, India. The diabetic patients (n=120) were selected randomly from those attending the OPD of GSVM medical college and hospital and some private clinics in Kanpur. To compare the findings an equal number of age-matched healthy individuals were studied. The population studied comprised of mostly literate people of different socio-economic strata of Kanpur and other surrounding districts. The subjects included were mainly professionals, skilled workers, housewives, retired persons, businessmen and teachers and their staple food was mainly wheat.

Definitions:-

Obesity was defined as BMI >25 kg/m2 (World Health O., 2000). Persistent elevation of blood pressure >140/90mmHg was defined as hypertension. Dyslipidemia was defined by the criteria laid down by National Cholesterol Education Program, Adult Treatment Panel II (National Cholesterol Education Panel, 1994).

Methodology:-

Fasting venous blood was collected using standard clinical procedures**.** Blood glucose was estimated by Autospan kit (GOD-POD, end point and kinetic assay method) of Span diagnostics. HbA1Cwas estimated by the modified colorimetric method of *Fluckiger* (Fluckiger, 1976). In-vitro diagnostic kits from Span diagnostics Ltd. were used For Triglycerides estimation (GPO-PAP end point assay), from Beacon diagnostics Pvt. Ltd. For cholesterol estimation (CHOD-POD method) and from Crest Biosystems for HDL-C estimation (PEG precipitation method).VLDL-C and LDL-C was calculated *Friedewald's* and *Fredrichson's* formulae (1972) (Friedewald et al., 1972).

VLDL-C= TG/5 and LDL-C= T.C- (HDL-C + VLDL-C)

Uric acid (uricase/PAP method) and Creatinine values were estimated in serum by kits from Coral clinical systems. All the estimations were done using UV-1800 SHIMADZU UV Spectrophotometer

With the help of a detailed predesigned questionnaire, information was collected on socio-demographic characteristics, family history of diabetes, smoking and drinking habits, the basic know-how about the disease, its complications, care and awareness pattern associated with it and their physical activity levels. Height and weight were recorded by standard methods and BMI was calculated (kg/m^2).The study was approved by the institutional ethics committee. An informed consent was duly obtained from every participant.

Statistical analysis:-
Data were recorded, tabulated and appropriate statistical test was used wherever applicable. A *p* value of less than 0.05 was considered statistically significant. *P* value represents the difference between type 2 diabetic patients and non-diabetic controls. Intable 1, clinical data are presented as mean ± SEM. Group means were compared by unpaired- t test using Graph-pad software (version 6). Data pertaining to table 3, 4 and 6 were assessed by chi-square test. Data of table 2 and 5 were expressed in frequency and percentage.

Results:-

All the 120 diabetic patients screened had complete records of their clinical profile. Table 1 comprises of the general features of the subjects. Male/female ratio in diabetics was 83/37 as compared to 69/51 seen in controls. The duration of disease ranged from 1 to 28 years with a mean of 7.07±0.5 years. Significantly higher BMI values were obtained in diabetic subjects (27.25±0.25) kg/m^2 as compared to controls (25.367±0.263) kg/m^2.

Table 2 summarizes the results of various tests and clinical facilities utilized by the patients on the prescription of their attending physician for tracking the development of co-morbidities. About 24.16% patients had abnormal ECG values while 75.83% patients showed typical dyslipidemia. 60% of the affected individuals had abnormal values of glycated hemoglobin (> 7) and 17.5% patients had frequent non-healing skin and soft tissue infections or ulcers of leg or foot. Kidney function tests displayed deranged values in about 11.66% patients. To validate the current status of these complications corresponding laboratory tests were performed on patients as well as controls and the results shown in table 1. There was a significant increase observed in fasting glucose (180.5±5.46mg/dl *vs* 108.62±1.44mg/dl) and HbA1c (7.89±0.083 *vs* 6.67±0.042) indicating a state of persistent hyperglycemia in diabetics. Similarly significantly higher values of blood pressure (systolic and diastolic) were observed in diabetics as compared to controls. Lipid profile showed significantly higher values in fasting TG (257.36±7.27mg/dl *vs* 139.14±2.74mg/dl), TC (234.07±4.1mg/dl *vs* 183.52±3.29mg/dl), LDL-c (148.61±4.23mg/dl *vs* 115.63±3.43mg/dl) and VLDL-c (51.47±1.45mg/dl *vs* 27.83±0.55mg/dl) whereas HDL-c values were significantly lower in patients (33.98±0.52mg/dl *vs* 40.06±0.61mg/dl). Significantly higherUric acid (5.86±0.16mg/dl *vs* 3.94±0.08mg/dl) and Creatinine values (1.06±0.02mg/dl *vs* 0.99±0.013mg/dl) were also observed.

Data concerning the age-wise distribution of diabetic subjects is shown in table 3. Majority of the patients (62.5%) belonged to the age group of 46-60 followed by >60 age group (20.83%). Chi square analysis showed highly significant association ($p<0.001$) between age distribution pattern and T2DM.

Table 4 shows the family history of the subjects. 67.5% diabetics had a family history indicating the strong genetic component of the disease. However, 14.16% controls also showed family history suggesting their susceptibility for development of the disease. Results of chi square analysis showed extremely significant association ($p<0.0001$) between family history of diabetes and T2DM.

Table 5 depicts the pattern of care and awareness among the diabetics as well as healthy controls. 86.66% patients appeared for regular follow-up visits and about 82.5% were regular in using the prescribed drug regimen however only 75.83% complied with dietary recommendations. Those practicing self-monitoring of glucose at home constituted only 26.6% of the patients. A basic knowledge about the disease was present in about 67.5% of the patients as against 56.66% of the controls whereas knowledge pertaining to future complications was seen to vary from 43.33% in controls to 55% in diabetics. 9.16% patients needed physical help in reaching the clinic. The outstanding feature of the table is the highly positive role of family (94.16%) in administering proper care to the diseased individual.

Table 6 shows the demographic features of the subjects. Diabetic subjects were present in all the three economic strata with highest (38.33%) in MIG followed by HIG (35%) and LIG (26.66%). However the trend was not statistically significant. Servicemen appeared to be the frontrunners in the occupation section (50.83% diabetics) followed by business men (26.66%), unemployed (5%) and others (17.5%). The education profile pointed out that about 40.83% patients were graduates while slightly less than a quarter of them (24.16%) were intermediate qualified, one-fifth (20%) of the patients held university degrees and 15% were junior high school pass outs. Majority of the subjects were married (80.83%) while the rest were single (14.16%) and widowed (5%). Non-smokers (81.66%) and non-drinkers (79.16%) comprised a significant group of the diabetic subjects. The difference between alcohol consuming patients and controls was non-significant. Mild physical activity was the most prevalent form of exercise among the patients (84.16%) followed by moderate and vigorous one. Refined oil was the chosen

cooking medium among the patients (60.83%). 60% of the patients accepted that they sometimes enjoyed junk food while 36.66% accepted to doing so frequently and only a meagre 3.33% did so rarely.

Table 1:- General and clinical *features of subjects (controls and diabetics),* n is the number of participants.

Parameter	Control(n=120)	Diabetic(n=120)	*P* value
Sex(male/female)	69/51	83/37	-
BMI (kg/m^2)	25.367±0.263	27.25±0.25	<0.001
Disease duration(year)	NA	7.07±0.51	-
Plasma glucose (mg/dl)	108.62±1.44*	180.5±5.46*	<0.001
HbA1c(%)	6.67±0.042*	7.89±0.083*	<0.001
Systolic BP (mmHg)	125.79±0.84*	143.24±1.45*	<0.001
Diastolic BP (mmHg)	81.34±0.48*	87.73±1.09*	<0.001
Creatinine (mg/dl)	0.995±0.013*	1.068±.024*	<0.05
Uric acid (mg/dl)	3.94±0.08*	5.86±0.16*	<0.001
TC (mg/dl)	183.52±3.29*	234.07±4.10*	<0.001
TG (mg/dl)	139.14±2.74*	257.36±7.27*	<0.001
HDL (mg/dl)	40.06±0.61*	33.98±0.52*	<0.001
LDL (mg/dl)	115.63±3.43*	148.61±4.23*	<0.001
VLDL (mg/dl)	27.83±0.55*	51.47±1.45*	<0.001

values are expressed as mean ± SEM,

Table 2:- Clinical facilities utilized by the diabetic patients (within one year) for tracking co-morbidities*

Facility	No. of patients availing the facilities (%)	No. of patients with abnormal values (%)
ECG	41(34.16%)	29(24.16%)
Lipid profile	97(80.83%)	91(75.83%)
HbA1C	103(85.83%)	72(60%)
Foot inspection	46(38.33%)	21(17.5%)
kidney function tests	33(27.5%)	14(11.66%)

values expressed in frequency (percentage)

Table 3:- Age profile of subjects (controls and diabetics) screened.

Age group (years)	Control(n=120)	Diabetic(n=120)
<35	11 (9.16%)	5 (4.16%)
36-45	24 (20%)	15 (12.5%)
46-60	62 (51.66%)	75 (62.5%)
>60	23 (19.16%)	25 (20.83%)
Total	120	120

χ^2 =15.013 df=3, *p*<0.0018

Table 4:- Distribution of subjects (controls and diabetics) according to family history of T2DM.

Family history	Controls	Diabetic	Total
Yes	17 (14.16%)	81 (67.5%)	98
No	103 (85.83%)	39 (32.5%)	142
Total	120	120	240

χ^2=155.594 df=1, *p*<0.0001

Table 5:- Pattern of care and awareness about the disease among the subjects (controls and diabetics)*

Parameter	Control(n=120)	Diabetic(n=120)
Regular follow-up visits	NA	104(86.66%)
Regular use of prescribed drugs	NA	99 (82.5%)
Self-testing of blood glucose at home	NA	32(26.66%)
Compliance with diet recommendations	NA	91(75.83%)
Basic know-how about disease	68(56.66%)	81(67.5%)

(through Print/audio-visual or IT media)		
Knowledge about future complications	52(43.33%)	66(55%)
Positive role of family in disease care	NA	113(94.16%)
Need help in reaching clinic	NA	11(9.16%)

values expressed in frequency (percentage)

Table 6:- Socio-economic and demographic features of subjects

Parameter	**Control(n=120)**	**Diabetic(n=120)**	***P* value**
Economic status (a)LIG **(b)MIG** **(c)HIG**	24(20%) 50(41.66%) 46(38.33%)	32(26.66%) 46(38.33%) 42(35%)	χ^2=3.334, df=2,*p*=0.1888 not significant
Marital status(a)single **(b)Married** **© Widowed**	35(29.16%) 80(66.66%) 5(4.16%)	17(14.16%) 97(80.83%) 6(5%)	χ^2=13.070, df=2,*p*<.0015 statistically significant
Education(a) Junior **(b) Intermediate** **(c) Graduate** **(d) University**	4(3.33%) 31(25.83%) 47(39.16%) 38(31.66%)	18(15%) 29(24.16%) 49(40.83%) 24(20%)	χ^2=19.275, df=3,*p*=.0002 statistically significant
Occupation (a)service **(b) business** **(c) unemployed** **(d) others**	52(43.33%) 26(21.66%) 30(25%) 12(10%)	61(50.83%) 32(26.66%) 6(5%) 21(17.5%)	χ^2=28.892, df=3,*p*<.0001 statistically significant
Smoking (a)No **(b)Current** **(c)Ex-smoker**	70(58.33%) 33(27.5%) 17(14.16%)	98(81.66%) 13(10.83%) 9(7.5%)	χ^2=27.086,df=2,*p*<.0001 statistically significant
Exercise (a) Mild **(b) Moderate** **(c) Vigorous**	87(72.5%) 17(14.16%) 16(13.33%)	101(84.16%) 13(10.83%) 6(5%)	χ^2=9.444,df-2,*p*=0.0089 statistically significant
Drinking (a) No **(b) Sometimes** **(c) Regular**	93(77.5%) 22(18.33%) 5(4.16%)	95(79.16%) 17(14.16%) 8(6.66%)	χ^2=2.979,df=2,*p*=0.2254 not significant

Table 6:- Contd. from page 19

Parameter	**Control(n=120)**	**Diabetic(n=120)**	***P* value**
Cooking medium **(a) Dalda** **(b) refined oil** **(c) mustard oil**	 11(9.16%) 56(46.66%) 53(44.16%)	 8(6.66%) 73(60.83%) 39(32.5%)	χ^2=9.677,df=2,*p*=.0079 statistically significant
Consumption of junk food **(a)rarely** **(b) sometimes** **© frequently**	 5(4.16%) 57(47.5%) 58(48.33%)	 4(3.33%) 72(60%) 44(36.66%)	χ^2=7.527,df=2,*p*=0.0232 statistically significant

**values expressed in frequency (percentage)*

Discussion:-

The present case control study was undertaken to establish the current status of diabetes and its co-morbidities in Kanpur district**.** The study is significant because this population is a fair representative of the phenomenon of internal (rural to urban) migration. Promise of economic uplift and better living conditions lures people from rural to urban areas. The findings of this study try to reveal new vistas in our knowledge of the epidemic of T2DM in study region.

Based on the patient's health profile (table 2), different clinical tests were performed and the results of these tests (table 1) aimed at detecting the presence and extent of any type of co-morbidity. Glycated hemoglobin (HbA1C) is a routinely used marker for long term glycemic control. In accordance with its function as an indicator for the mean blood glucose level, HbA1C predicts the risk for the development of diabetic complications in diabetic patients. Dyslipidemia is defined by alterations in blood lipid levels. The significantly high levels of TG, TC and low levels of HDL-c observed in our subjects probably contribute to insulin resistance (Mooradian, 2009). It is in line with another study done at Naini region of Allahabad which concluded that Hypercholesterolemia, Hypertriglyceridaemia and lipoprotein are the main lipid abnormalities found in diabetes which is risk for coronary artery disease (Smith and Lall, 2008). This is validated by our study as about 24.16% of our patients were hypertensive had abnormal ECG values and were on the brink of developing Coronary Heart disease which is a major co-morbidity attached with diabetes. American Diabetes Association (ADA) has also discussed about the rationale for management of dyslipidemia in Adults with diabetes (Haffner, 1998).

In the present study, it was observed that serum UA level was significantly increasing ($p<0.001$) in T2DM patients as compared to controls. This finding is concurrent with other studies in which hyperuricemia is linked to development of T2DM and its complications especially cardiovascular (Zoppini et al., 2009) and renal complications (Bo et al., 2001; Rosolowsky et al., 2008). Uric acid is a strong endogenous antioxidant that scavenges nitric oxide directly thus decreasing the bioavailability of nitric oxide in vascular smooth muscles and endothelial cells. This promotes endothelial dysfunction enhancing the risk of progression of Coronary vascular disease (Conen et al, 2004; Feig et al., 2008).

Serum creatinine levels in T2DM patients were also significantly higher when compared statistically with controls ($p < 0.05$) indicating the derangement of kidney function. It is believed that one can plot the inverse of creatinine (I/Cr) over time and get a straight line which can thus be used for "monitoring disease progression" (Mitch and Walser, 1986). A study on progression of nephropathy in T2DM pointed out that T2DM is single most common cause of end stage renal disease (ESRD), but decline in kidney function varies among individuals (Rossing et al., 2004).

These findings are further corroborated by a retrospective analytic study, conducted by reviewing the clinical records of the patients with type 2 diabetes who attended the National Diabetes Centre of Sri Lanka from January 2005 to December 2010. It was observed that nephropathy was significantly associated with poor glycemic control, high HbA1c, high fasting blood glucose, high systolic blood pressure (Wijesuriya, 2012). Hence the pathogenesis of diabetic nephropathy is multi-factorial with contribution from various metabolic abnormalities and marked heterogeneity in clinical picture is seen in long-term diabetics.

Obesity is one of the major risk factors for diabetes, yet there has been little research focusing on this risk factor across India (Rao et al., 2011). Despite having lower overweight and obesity rates, India has a higher prevalence of diabetes compared to western countries suggesting that diabetes may occur at a much lower body mass index (BMI) in Indians compared with Europeans (Rao et al., 2011; Mohan and Deepa, 2006). Significantly higher values ($p<0.001$) were observed in our study in diabetics as compared to controls. The increasing incidences of obesity may result in more than a million extra cases of type 2 DM, cardiovascular disease and cancer.

Our study has shown that the population most affected by diabetes is of the age group 46-60 (see table 3). This is corroborated by another study in district Sonepat of Haryana state (Madaan et al., 2014). This is a disturbing finding as pervasion and persistence of diabetes in the most economically productive age group means staggering economic growth of society.

About 67% of diabetic subjects had either one or both parents affected by diabetes (table 4). Upon analysis, a highly significant association ($p<0.0001$) between family history and T2DM was observed. Similar results were reported by other studies (Rao et al., 2010; Shah et al.,1999; Ramachandran et al., 2008; Ravikumar et al., 2011; Patil and Gothankar, 2013). Family history in T2DM is thus a major risk factor in transferring the disease to next generation. It can however be exploited as a preventable tool to avoid diabetes development in early age.

Table 6 shows the similarities and contrasts in various socio-demographic features among controls and diabetics. A study has shown that being married may confer health advantage against type 2 DM as against bachelors, divorcees

and widowers (Cornelis et al 2014). Similar significant trend (p<0.0015) is seen in our study proving that it is a key support mechanism for the subjects.

The role of junk food in diabetes is highlighted by a study on Musmusculusalbinus mice, which were exclusively fed junk food for thirty days. Their body weight and blood sugar levels clearly indicated that fast food enhanced the risk of obesity and diabetes (Wast et al., 2012). Our study points out that most of the diabetics (about 60%) indulge in fast food sometimes while 47.5% of healthy controls do so and the difference was significant (p<0.0232). An interesting contrast is seen when controls are shown to be frequent consumers (48.3%) as against diabetics (36.6%). This can be attributed to the fact that once the disease is diagnosed, patients tend to make healthier food choices. Similarly, majority of the subjects being non-smokers and non-drinkers points towards adoption of a healthier lifestyle especially by diabetics in view of their diseased state.

Edible oils constitute an important part of diet of a person. A study on the effect of edible oils on biochemical parameters of subjects in kharagpur, west Bengal shows that sesame oil followed by mustard oil proved to be most beneficial against diabetes (Dineshkumar et al., 2009). Our findings show that use of refined oil is more prevalent than mustard oil and the difference in consumption pattern is significant (p<0.0079). It is perhaps advisable to revert to our traditional dietary ways to reduce the incidence of diabetes.

Physical activity or exercise has impact on various components of diabetes. Ever increasing urbanization and socio-economic prosperity has led to decline in the physical activity levels of people. Statistically significant values (p<0.0089) from our study indicates the same and is corroborated by many other findings (Bhatti et al., 2007; Williams et al., 1994; Lip et al., 1996; Hughes et al., 1990) which have shown that South Asians and Asian Indians are lesser physically active than other ethnic groups. It is interesting to note that in our study most of the controls as well as patients seem to follow a mild exercise routine. This resistance towards strenuous physical activity tips the balance in favor of strong insulin resistance in diabetics and may pave the way towards impaired glucose tolerance in controls later on. This agrees with a south Indian study which has shown that diabetes prevalence is almost three times higher in individuals with light physical activity compared to those having heavy physical activity (Mohan et al., 2003).

Environmental barriers responsible for limited physical activity include unsafe walking areas, transportation problems, medical conditions and also the attitudes and knowledge of subjects (Dutton et al., 2005).

The care and awareness profile of our subjects (table 5) indicates need for an over-all improvement in the area. However, patients are unaware of the multi-factorial nature of the disease. This highlights the fact that apart from clinical treatment, counseling and education of the patients is important. A similar study from rural Tamaka, Kolar district of Karnataka revealed that 75% of the patients were unfamiliar with the long term diabetic complications and diabetic care (Muninarayana et al., 2010). CURES-9 study in Chennai has shown how increasing awareness and empowerment of community can possibly help in the prevention of diabetes and other non-communicable disorders (Mohan et al., 2005). To reduce the disease burden appropriate government interventions and combined efforts of the society should go hand in hand (2).Government policies may help in creating guidelines on diabetes management, funding community programmes for public awareness about the diabetes risk reduction, availability of medicines and diagnostic services to all sections of community (Verma et al., 2012). A significant landmark of our study is the positive role played by family of more than 90% of the diabetics.

It is directly in line with the results of DAWN2 (Diabetes Attitudes, wishes and Needs) study which involved participants from 17 countries of varying socio-cultural environment. The study revealed that family members of Indian diabetics had the least likelihood of feeling depressed and perceiving significant burden in helping the diseased person (Kovacs et al., 2013).

Conclusion:-

Persistent hyperglycemia, marked dyslipidemia along with the surfacing of co-morbidities like renal impairment and Coronary heart disease are the clinical highlights of our study showing that treatment outcome is far from ideal. These when viewed together with the trends of the social and demographic factors and awareness levels clearly indicate the staggering metabolic profile of the study participants. However the results need to be validated by further studies involving much larger cohort size. Patients require aggressive screening and, multi-factorial approach towards drugs and other supplements is needed for improved glycemic control and tackling other complications

related to T2DM. Patient education and empowerment are key steps in assuring good glycemic control.Priority must be given for creating awareness among the public for motivating them to adhere to the preventive strategies.

Abbreviations:-
BMI- Body Mass Index; TC- Total Cholesterol; TG-Triglycerides; HDL-c-High Density Lipoprotein cholesterol; LDL-c-Low Density Lipoprotein cholesterol; VLDL-c- Very Low Density Lipoprotein cholesterol; BP- Blood Pressure; LIG- Lower Income Group; MIG- Medium Income Group; HIG- High Income Group; ECG- Electrocardiography; HbA1c- Glycated Hemoglobin.

Acknowledgments:-

Funding: The work was supported by grant of CSIR, New Delhi (9/737(0010)-EMR I) and DBT (BT/PR10980/GBD/27/134/2008).

Author Contributions:.All the authors contributed in conceiving and designing the experiments. First author completed the experimental work with inputs from other authors. The samples were provided by second author and experimental work was done at CSJMU, Kanpur. All the authors helped in conceiving the layout of the manuscript and it was written by the first author.

Conflicts of Interest: The authors declare no conflict of interest.

References:-

1. Anjana, R. M.; Pradeepa, R.; Deepa, M.; Datta, M.; Sudha, V.; Unnikrishnan, R.; Bhansali, A.; Joshi, S. R.; Joshi, P. P.; Yajnik, C. S.; Dhandhania, V. K.; Nath, L. M.; Das, A. K.; Rao, P. V.; Madhu, S. V.; Shukla, D. K.; Kaur, T.; Priya, M.; Nirmal, E.; Parvathi, S. J.; Subhashini, S.; Subashini, R.; Ali, M. K.; Mohan, V., Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: phase I results of the Indian Council of Medical Research-INdiaDIABetes (ICMR-INDIAB) study. *Diabetologia***2011,** 54, (12), 3022-7.
2. Bhatti, J. S.; Bhatti, G. K.; Joshi, A.; Rai, S.; Mastana, S. S.; Ralhan, S. K.; Bansal, D. D.; Tewari, R., Identification of the risk factors for the high prevalence of type 2 diabetes and its complications in a Punjabi population: North Indian Diabetes Study: A case-control study. *International Journal of Diabetes in Developing Countries* **2007,** 27, (4).
3. Bo, S.; Cavallo-Perin, P.; Gentile, L.; Repetti, E.; Pagano, G., Hypouricemia and hyperuricemia in type 2 diabetes: two different phenotypes. *European journal of clinical investigation* **2001,** 31, (4), 318-321.
4. Conen, D.; Wietlisbach, V.; Bovet, P.; Shamlaye, C.; Riesen, W.; Paccaud, F.; Burnier, M., Prevalence of hyperuricemia and relation of serum uric acid with cardiovascular risk factors in a developing country. *BMC Public Health* **2004,** 4, 9.
5. Cornelis, M. C.; Chiuve, S. E.; Glymour, M. M.; Chang, S. C.; TchetgenTchetgen, E. J.; Liang, L.; Koenen, K. C.; Rimm, E. B.; Kawachi, I.; Kubzansky, L. D., Bachelors, divorcees, and widowers: does marriage protect men from type 2 diabetes? *PLoS One***2014**, 9, (9), e106720.
6. Dineshkumar, B.; Mukherjee, S.; Pradhan, R.; Mitra, A.; Chakraborty, C., Effects Of Edible Oils In Type 2 Diabetes Mellitus. *Journal of Clinical and Diagnostic Research* **2009,** 3, 1389-1394.
7. Dutton, G. R.; Johnson, J.; Whitehead, D.; Bodenlos, J. S.; Brantley, P. J., Barriers to physical activity among predominantly low-income African-American patients with type 2 diabetes. *Diabetes Care* **2005,** 28, (5), 1209-10.
8. Feig, D. I.; Kang, D. H.; Johnson, R. J., Uric acid and cardiovascular risk. *N Engl J Med* **2008,** 359, (17), 1811-21.
9. Fluckiger , R.; Winter halter, K. H. In vitro synthesis of HbA1C.*REBS lett.***1976**, 71, 356-360.
10. Friedewald, W. T.; Levy, R. I.; Fredrickson, D. S., Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical chemistry* **1972,** 18, (6), 499-502.
11. Haffner, S. M., Management of dyslipidemia in adults with diabetes. *Diabetes Care* **1998,** 21, (1), 160-78.
12. Hughes, K.; Lun, K. C.; Yeo, P. P., Cardiovascular diseases in Chinese, Malays, and Indians in Singapore. I. Differences in mortality. *J Epidemiol Community Health* **1990,** 44, (1), 24-8.
13. Joshi, S. R.; Parikh, R. M., India--diabetes capital of the world: now heading towards hypertension. *J Assoc Physicians India* **2007,** 55, 323-4.

14. Kaveeshwar, S. A.; Cornwall, J., The current state of diabetes mellitus in India. *Australas Med J* **2014,** 7, (1), 45-8.
15. Kovacs Burns, K.; Nicolucci, A.; Holt, R. I.; Willaing, I.; Hermanns, N.; Kalra, S.; Wens, J.; Pouwer, F.; Skovlund, S. E.; Peyrot, M., Diabetes Attitudes, Wishes and Needs second study (DAWN2): cross-national benchmarking indicators for family members living with people with diabetes. *Diabet Med* **2013**, 30, (7), 778-88.
16. Kumar, A.; Goel, M. K.; Jain, R. B.; Khanna, P.; Chaudhary, V., India towards diabetes control: Key issues. *Australas Med J***2013,** 6, (10), 524-31.
17. Lip, G. Y.; Luscombe, C.; McCarry, M.; Malik, I.; Beevers, G., Ethnic differences in public health awareness, health perceptions and physical exercise: implications for heart disease prevention. *Ethn Health* **1996,** 1, (1), 47-53.
18. Madaan, H.; Agrawal, P.; Garg, R.; Sachdeva, A.; Partra, S. K.; Nair, R., Prevalence of diabetes mellitus in rural population of district Sonepat, India.*Int J Med Sci Public Health***2014**, 3, 261-264 .
19. Misra, A.; Pandey, R. M.; Devi, J. R.; Sharma, R.; Vikram, N. K.; Khanna, N., High prevalence of diabetes, obesity and dyslipidaemia in urban slum population in northern India. *Int J ObesRelatMetabDisord***2001,** 25, (11), 1722-9.
20. Mitch WE, Walser M. Nutrition therapy of uremic patients. In: Brenner BM, Rector Jr., eds. *The kidney***1986** , 1759-90.
21. Mohan, V.; Shanthirani, C. S.; Deepa, R., Glucose intolerance (diabetes and IGT) in a selected South Indian population with special reference to family history, obesity and lifestyle factors--the Chennai Urban Population Study (CUPS 14). *J Assoc Physicians India* **2003,** 51, 771-7.
22. Mohan, D.; Raj, D.; Shanthirani, C. S.; Datta, M.; Unwin, N. C.; Kapur, A.; Mohan, V., Awareness and knowledge of diabetes in Chennai--the Chennai Urban Rural Epidemiology Study [CURES-9]. *J Assoc Physicians India* **2005,** 53, 283-7.
23. . Mohan, V.; Deepa, R., Obesity and abdominal obesity in Asian Indians. *Indian J Med Res* **2006,** 123, (5), 593-6.
24. Mohan, V.; Sandeep, S.; Deepa, R.; Shah, B.; Varghese, C., Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res* **2007,** 125, (3), 217-30.
25. Mooradian, A. D., Dyslipidemia in type 2 diabetes mellitus. *Nat ClinPractEndocrinolMetab***2009,** 5, (3), 150-9.
26. Muninarayana, C.; Balachandra, G.; Hiremath, S. G.; Iyengar, K.; Anil, N. S., Prevalence and awareness regarding diabetes mellitus in rural Tamaka, Kolar. *Int J Diabetes DevCtries***2010**, 30, (1), 18-21.
27. National Cholesterol Education Panel. Second report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Pressure in Adults (Adult Treatment Panel II).*Circulation***1994**, 89, 1329 – 1445.
28. Patil, R. S.; Gothankar, J. S., Prevalence of type-2 diabetes mellitus and associated risk factors in an urban slum of Pune City, India. *Natl J Med Res.***2013**, 3, (4), 346-349.
29. Ramachandran, A.; Snehalatha, C.; Kapur, A.; Vijay, V.; Mohan, V.; Das, A. K.; Rao, P. V.; Yajnik, C. S.; Prasanna Kumar, K. M.; Nair, J. D., High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia***2001,** 44, (9), 1094-101.
30. Ramachandran, A.; Mary, S.; Yamuna, A.; Murugesan, N.; Snehalatha, C., High prevalence of diabetes and cardiovascular risk factors associated with urbanization in India. *Diabetes Care* **2008,** 31, (5), 893-8
31. Ramachandran, A.; Snehalatha, C., Current scenario of diabetes in India. *J Diabetes* **2009,** 1, (1), 18-28.
32. Ramachandran, A.; Ma, R. C.; Snehalatha, C., Diabetes in Asia. *Lancet* **2010**, 375, (9712), 408-18.
33. Rao, C. R.; Kamath, V. G.; Shetty, A.; Kamath, A., A study on the prevalence of type 2 diabetes in coastal Karnataka. *Int J Diabetes DevCtries***2010**, 30, (2), 80-5.
34. Rao, C. R.; Kamath, V. G.; Shetty, A.; Kamath, A., A cross-sectional analysis of obesity among a rural population in coastal Southern Karnataka, India. *Australas Med J***2011**, 4, (1), 53-7.
35. Ravikumar, P.; Bhansali, A.; Ravikiran, M.; Bhansali, S.; Walia, R.; Shanmugasundar, G.; Thakur, J. S.; Kumar Bhadada, S.; Dutta, P., Prevalence and risk factors of diabetes in a community-based study in North India: the Chandigarh Urban Diabetes Study (CUDS). *Diabetes Metab***2011**, 37, (3), 216-21.
36. Rosolowsky, E. T.; Ficociello, L. H.; Maselli, N. J.; Niewczas, M. A.; Binns, A. L.; Roshan, B.; Warram, J. H.; Krolewski, A. S., High-normal serum uric acid is associated with impaired glomerular filtration rate in nonproteinuric patients with type 1 diabetes. *Clin J Am SocNephrol***2008,** 3, (3), 706-13.
37. Rossing, K.; Christensen, P. K.; Hovind, P.; Tarnow, L.; Rossing, P.; Parving, H.-H., Progression of nephropathy in type 2 diabetic patients. *Kidney international* **2004,** 66, (4), 1596-1605.
38. 38. Shah, S. K.; Saikia, M.; Burman, N. N.; Snehalatha, C.; Ramachandran, A., High prevalence of type 2 diabetes in urban population in north eastern India. *Int J Diabetes Dev Countries* **1999,** 19, 144-7.

39. Smith, S.; Lall, A. M., A Study on lipid profile levels of diabetics and non-diabetics among Naini region of Allahabad, India. *Turk BiyokimyaDergisi [Turkish Journal of Biochemistry* **2008,** 33, (4), 138-141.
40. Verma, R.; Khanna, P.; Mehta, B., National programme on prevention and control of diabetes in India: Need to focus. *Australas Med J* **2012**, 5, (6), 310-5.
41. Wast, N. S.; Gaherwal, M; Prakash, M., Fast Food Induced Obesity and Diabetes in Mice. *Archives of Applied Science Research***2012**, 4, (6),2396-2399.
42. Whiting, D. R.; Guariguata, L.; Weil, C.; Shaw, J., IDF diabetes atlas: global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res ClinPract***2011,** 94, (3), 311-21.
43. Wijesuriya, M. A.; De-Abrew, W. K.; Weerathunga, A.; Perera, A.; Vasantharajah, L., Association of chronic complications of type 2 diabetes with the biochemical and physical estimations in subjects attending single visit screening for complications. *Journal of Diabetology***2012**, 1, (3), 1-10.
44. Wild, S.; Roglic, G.; Green, A.; Sicree, R.; King, H., Global prevalence of diabetes estimates for the year 2000 and projections for 2030. *Diabetes care* **2004,** 27, (5), 1047-1053.
45. Williams, R.; Bhopal, R.; Hunt, K., Coronary risk in a British Punjabi population: comparative profile of non-biochemical factors. *Int J Epidemiol***1994,** 23, (1), 28-37.
46. World Health, O., The Asia-Pacific perspective: redefining obesity and its treatment. **2000**.
47. Zargar, A. H.; Khan, A. K.; Masoodi, S. R.; Laway, B. A.; Wani, A. I.; Bashir, M. I.; Dar, F. A., Prevalence of type 2 diabetes mellitus and impaired glucose tolerance in the Kashmir Valley of the Indian subcontinent. *Diabetes Res ClinPract***2000,** 47, (2), 135-46.
48. Zoppini, G.; Targher, G.; Negri, C.; Stoico, V.; Perrone, F.; Muggeo, M.; Bonora, E., Elevated serum uric acid concentrations independently predict cardiovascular mortality in type 2 diabetic patients. *Diabetes Care* **2009,** 32, (9), 1716-20.