AN OBSERVATIONAL STUDY OF LIPID PROFILE AND PREVALENCE OF MICROVASCULAR COMPLICATION IN TYPE 2 DIABETES MELLITUS PATIENTS: A HOSPITAL BASED STUDY

Atul Kumar[1], Md. Izhar Alam[2], Taskeen Ahmad Reza[3], Shruti Sonal[4], Kaushal Kumar Sinha[5], Karan Bhargav[6], Wasim Alam[7]

[1]*Associate Professor, Department of Medicine, Katihar Medical College, Katihar, Bihar, India.*
[2]*Assistant Professor, Department of Pathology, Katihar Medical College, Katihar, Bihar, India.*
[3]*Assistant Professor, Department of Medicine, Katihar Medical College, Katihar, Bihar, India.*
[4]*Post Graduate Trainee, Department of Medicine, Katihar Medical College, Katihar, Bihar, India.*
[5]*Post Graduate Trainee, Department of Medicine, Katihar Medical College, Katihar, Bihar, India.*
[6]*Post Graduate Trainee, Department of Medicine, Katihar Medical College, Katihar, Bihar, India.*
[7]*Post Graduate Trainee, Department of Medicine, Katihar Medical College, Katihar, Bihar, India.*

ABSTRACT

AIM
To evaluate the prevalence and microvascular complication of type 2 diabetes mellitus patients.

METHODOLOGY
A detailed history, clinical examination and investigative procedure were used.

RESULTS
Pearson correlation coefficient, t-test and Fisher exact test were applied for statistical analysis. And P value was taken less than 0.05 for significant differences. Conclusions: Microvascular complication was more common in higher age group patients; its prevalence was 39%. And dyslipidaemia was present in 36% patients and, the most common pattern of dyslipidaemia was increased TG with reduced HDL–C with or without elevated LDL-C.

KEYWORDS
Type 2 Diabetes Mellitus, Microvascular Complication, Dyslipidaemia.

INTRODUCTION: Diabetes is one of the commonest chronic non-communicable diseases affecting the society at large both in developing and developed countries. It is generally classified as type 1, type 2 or other specific types.[1]

India leads the world with largest number of diabetic subjects earning the dubious distinction of being termed the "Diabetes Capital of the World". According to ICMR-INDIAB (Indian Council of Medical Research – India Diabetes) National diabetes study, currently there are an estimated 62.4 million individuals with diabetes in India.[2]

Type 2 diabetes is accompanied by a high prevalence of associated disorders like the various components of the metabolic syndrome like hypertension, dyslipidaemia and obesity; microvascular complications like retinopathy (Rt), nephropathy (Np), neuropathy (Nu) and macrovascular complications like coronary artery disease, peripheral vascular disease and cerebrovascular disease resulting in significantly high morbidity and mortality.[3,4] The chronic complications of diabetes mellitus translate into a significant economic burden on individuals and community at large.[4]

The first national study on the prevalence of type 2 diabetes in India was done from 1972 and 1975 by the Indian Council Medical Research (ICMR, New Delhi).[5] The prevalence was 2.1% in urban population and 1.5% in rural population; while in those above 40 years of age the prevalence was 5% in urban and 2.8% in rural areas. Various studies on urban and rural diabetes prevalence in India from 1966-75 showed the prevalence to range from 1.2% to 5.6%.[6]

A cross-sectional study conducted in 2012 in 11 medium-sized cities across the country (Jammu, Chandigarh, Karnal, Bikaner, Ahmadabad, Jaipur, Lucknow, Patna, Dibrugarh, Madurai, Hyderabad, Belgaum, Indore and Nagpur) reported a prevalence of diabetes to be 16.7% in men and 14.4% in women.[7] Prevalence of diabetes reported in 2014 amongst rural hilly population of North Eastern India was 19.8%.[8]

Type 2 diabetes mellitus is associated with the development of premature arteriosclerosis and a higher cardiovascular morbidity and mortality.[3,9] Diabetic dyslipidaemia is believed to play an important role in the pathogenesis of accelerated atherosclerosis in this condition.[10,11] The predominant lipid abnormalities seen in diabetes mellitus are an elevated serum triglyceride (Tg) level and a low HDL-C level.[12] Several studies have found a significant association of fasting hypertriglyceridaemia[11] and coronary artery disease(CAD) in diabetes mellitus.

Micro and macrovascular complications of diabetes are major contributing factor for the morbidity and mortality in type 2 diabetes and dyslipidaemia is an important factor in pathogenesis of atherosclerosis in type 2 diabetes which in turn is responsible for the macrovascular complications. Furthermore, a significant percentage of patients may have complications at the time of diagnosis and are frequently diagnosed due to the complications arising out of diabetes. This study was undertaken at our institute to identify the diabetic complications in newly diagnosed type 2 DM patients and to assess the prevalence of dyslipidaemia and pattern of dyslipidaemia in these patients. Aim of our study was to evaluate the pattern and prevalence of lipid profile abnormality and prevalence of microvascular complications in newly diagnosed type 2 diabetes mellitus.

METHOD AND MATERIALS: A total of 100 diabetes patients with age of 36 years to 65 years was included in this study. A cross section of both male and female diabetes patients diagnosed within the last 3 months (new onset) attending the General Medicine Indoor and Outpatient Department of Katihar Medical College, Bihar, were taken.

All the subjects signed an informed consent, approved by Institutional Ethical Committee of Katihar Medical College, Katihar, Bihar, India. Data was collected from Indoor and Outdoor Department of Medicine, Katihar Medical College, Katihar, Bihar, India, during period of December 2013 to June 2015.

Study Population: Newly diagnosed diabetes patients (diagnosed within last 3 months) with age of 36 years to 65 years of both sex male and female were randomly selected.

Procedures: A detailed history and clinical examination and relevant investigations were performed. Body mass index was calculated. BMI =Weight in kg/ (height in meter).[2] Blood pressure was measured by a sphygmomanometer in supine and standing position, after the patient took rest for about 10 minutes. Diastolic BP. was recorded at the disappearance of the Korotkoff sound (phase V). Ophthalmoscopic examination included a detailed dilated fundus examination done by indirect ophthalmoscopy. Non-proliferative diabetic retinopathy (NPDR) was diagnosed by the presence of microaneurysms, blot haemorrhages or cotton wool spots. Proliferative diabetic retinopathy (PDR) was defined as the presence of abnormal new vessels on the disc or elsewhere. Neuropathy was diagnosed by evaluating history of numbness, paraesthesias, tingling sensation, and burning sensation. Loss of touch sensation, loss of pin prick test, vibration sense testing with 128 Hz tuning fork and loss of ankle reflex. A 10 g monofilament test was done to identify foot prone to ulcer.

Autonomic neuropathy was rule out by the history of change of bowel or bladder habits, examination of skin to note the change in colour, temperature, sweating and changes in heart rate and blood pressure, resting pulse rate and normal variation with respiration, response of heart rate to carotid massage. The patient was rested on the examination couch for 15 minutes; a sphygmomanometer cuff was tied around the arm. Supine BP was recorded and patient was asked to stand. After 3 minutes, BP was recorded again. A fall in systolic pressure of more than 20 mm of Hg on standing indicates autonomic neuropathy. Deep breaths test: The pulse rate of the patient was noted while lying flat. Then, the pulse rates during 6 maximal breaths was recorded. More than 15 beats fall per minute is normal. In autonomic neuropathy, the fall is less than 10. Valsalva test: The patient was asked to blow in a sphygmomanometer cuff to maintain a pressure of 40 mmHg for 15 seconds. The ratio of highest pulse rate to lowest pulse rate was measured. Normally, it is more than 1.5; in case of autonomic neuropathy it is less than 1.1.

Biochemical Analysis: American Diabetes Association Guidelines 2011 (ADA 2011): Fasting and/or 2 hr. post 75 oral anhydrous glucose plasma glucose level was estimated by enzymatic glucose oxidation method. A basal FPG>126 mg/dL, and a plasma glucose >200 mg/dL at 2 hr. post 75 glucose confirmed on a second occasion was diagnostic of diabetes. Glycosylated haemoglobin (HbA1c) was estimated by ion exchange chromatography. In diabetes mellitus, the value is ≥ 6.5. It gives an idea of the plasma glucose control on the preceding 3 months. Serum urea levels were determined spectrophotometrically using the product formed when urea reacted with diacetyl in the presence of a strong acid- method of Fearon. Normal value is 15 -40 mg/dL. Serum creatinine estimation was done by the method of Brod and Sirota using Jaffe reaction. Normal value is up to 1.4 mg/dL. Urinary albumin creatinine ratio (ACR) was done <30 μg/mg was taken as normal, 30-300 μg/mg and >300 μg/mg were considered to have microalbuminuria and macroalbuminuria respectively. Presence of microalbuminuria was taken as indicative for nephropathy when at least two out of three tests were positive for microalbuminuria. Lipid Profile: Blood sample was taken after 12 hours fast and the estimation of following was done – total cholesterol level, triglyceride level, HDL (high density lipoprotein) cholesterol level, LDL (low density lipoprotein) cholesterol level, VLDL (very low density lipoprotein) cholesterol level.

STATISTICAL ANALYSIS: Data was analysed by using standard statistical software. Pearson correlation coefficient, t-test and Fisher exact test were used. And P value was taken less than 0.05 for significant differences.

RESULTS: 39% of population were having diabetic complication at the time of diagnosis. Prevalence of complication of age group 36-45 years was 21.42%, age 46-55 years was 25.49% and highest prevalence of complication 65.71% was seen in age group 56–65 yrs.

Patients with nephropathy in age group 36-45 years (N=14), microalbuminuria ACR (30-299 μg/mg) was 2 and microalbuminuria ACR was 0. That is percentage of affected patients in this age group was 14.28. In age group 46-55 years (N=51), microalbuminuria ACR (30-299 μg/mg) was 4

and microalbuminuria ACR (≥300 μg/mg) was 1. That is percentage of affected patients in this age group was 9.80. And in age group 56-65 (N=35) microalbuminuria ACR (30-299 μg/mg) was 8 and microalbuminuria ACR (≥300 μg/mg) was 4. That is percentage of affected patients in this age group was 34.28. It was shown that highest prevalence of nephropathy was in 56-65 years age group. And 21.66% of male and 15% of female patients were involved with nephropathy.

Patients with retinopathy in age group 36-45 years (N=14), NPDR was 1 and PDR was 0, that is percentage of age involved was 7.14. In age group 46-55 years (N=51), NPDR was 1 and PDR was 0, percentage of age involved was

1.96. And in age group 56-65 years (N=35), NPDR was 3, PDR was 2, percentage of age involve was 14.28. Hence, highest prevalence of retinopathy was seen in 56-65 years age group. And 10% of female and 5% of male were involved with retinopathy.

In age group 36-45 years (N=14), 0% patients suffered with neuropathy. In age group 46-55 years (N=51), 19.6% patients suffered. And in 56-65 years (N=35), 40% patients were involved. Hence, highest neuropathy was seen in 56-65 years age group. And 35% females and 16.66% males were involved with neuropathy.

Microvascular Complication	No. of Patients	% Age of Total Population
Retinopathy (RT)	7	7
Neuropathy (NU)	24	24
Nephropathy (NP)	19	19
Retinopathy with Nephropathy (RT +NP)	6	6
Nephropathy (NP) with Neuropathy (NP+NU)	5	5
Neuropathy (NU) + Retinopathy (RT)(NU+RT)	2	2
Retinopathy with Nephropathy with Neuropathy (RT+NP+NU)	2	2
Table 1: Prevalence of Microvascular Complications		

Retinopathy was present in 7% cases, Neuropathy in 24% cases, Nephropathy in 19% cases, retinopathy with nephropathy in 6% cases and 2% were having all the three micro vascular complication.
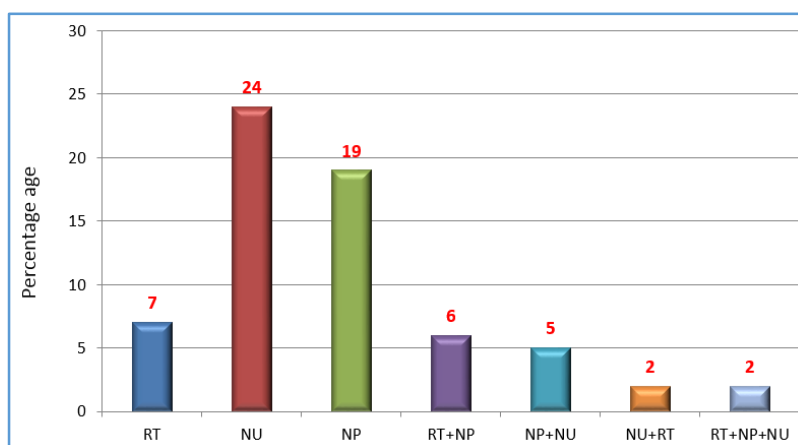

Fig. 1: Prevalence of Microvascular Complication

Age Groups (In yrs.)	↑TG	↑TG+ ↓HDL	↑TG +↓HDL +↑LDL	Mixed	Total	Percentage
36-45 (N=14)	1	2	0	1	4	28.57
46-55 (N=51)	8	5	2	3	18	35.29
56-65 (N=35)	3	5	3	3	14	40
Table 2: Prevalence of Dyslipidaemia in Different Age Groups						

28.57 % of the patients who suffered from dyslipidaemia were of age group 36-45 years (N=14). 35.29 % of patients suffering from dyslipidaemia was of age group 46-55 years (N=51). And 40 % of the patients suffering from dyslipidaemia were of age group 56-65 years (N=35). Hence, highest prevalence of dyslipidaemia was present in 56 -65 age group patients. And 36.66% of male and 35 % of female suffered with dyslipidaemia.
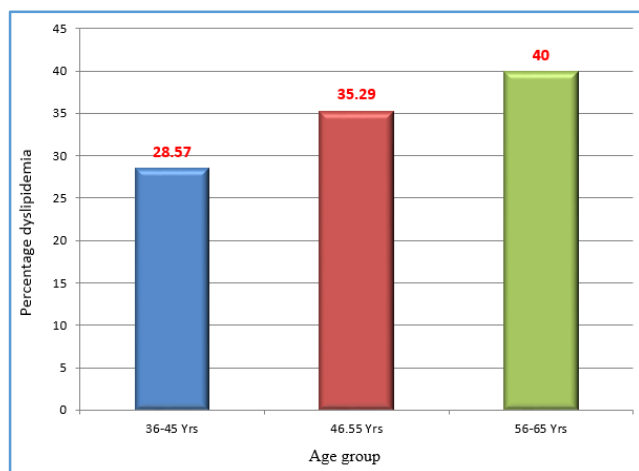

Fig. 2: Prevalence of Dyslipidaemia in Different Age Groups

Hypertriglyceridemia was present in 33.33% of cases, Hypertriglyceridemia with low HDL-C was present in 33.33 % of cases, Hypertriglyceridemia with low HDL-C and low LDL–C was present in 13.88% of cases while 19.44 % were having other mixed pattern of dyslipidaemia.

	Nephropathy present	Nephropathy absent	Total	p-value
Dyslipidaemia present	13	23	36	< 0.05
Dyslipidaemia absent	6	58	64	

Table 3: Association Between Dyslipidaemia and Nephropathy

36.11% (N 13) of dyslipidaemic patients were having nephropathy. Fisher's Exact Test shows the two-sided P value to be less than 0.05 which was considered as significant. Thus dyslipidaemia and nephropathy were significantly associated.

	Nephropathy present	Nephropathy absent	Total	P-Value
Retinopathy Present	6	1	7	< 0.05
Retinopathy Absent	13	80	93	

Table 4: Association between Retinopathy and Nephropathy

85.71% of retinopathy patients were having coexisting nephropathy.

Fisher's Exact Test shows the two-sided P value less than 0.05 which was considered as significant. Thus, retinopathy was significantly associated with nephropathy.

DISCUSSION: The present cross-sectional study was carried out on 100 consecutive patients of type 2 diabetes who were diagnosed recently (duration less than 3 months). The mean age at diagnosis was found to be 53.7 years. This signifies that in our hospital, diabetic patients are presenting late. Among the newly diagnosed patients, 60 were male and 40 patients were female.

Age wise analysis of the patients reveal that most of the patients were in age group 46-55 yrs. n =51 (51%), followed by in age group 56–65, n =35 (35%) and least number in 35–45, n= 14 (14%). This corroborates with the work done by Ramachandra et al[13] which shows that in developing countries, the majority of diabetes patients are in the age range of 45-64 years whereas in the developed countries are aged >65 years. In our study, 86% of population was in age group 46 – 65 yrs.

39% of the newly diagnosed type 2 diabetics were having one or more than one diabetic complication, this agrees well with the finding of UKPDS[3] study in which up to 50% of newly detected type 2 diabetics were having diabetic complications at the time of diagnosis. Of these, 20 (33.3%) were male and 19 (47.5%) were female, so females have higher preponderance of complication than male.

The complication rate was highest in 56 -65 age group, with 23 patients out of 35 in this population group (65.71%) presenting with complication at the time of diagnosis. The association was statistically significant (p value < 0.05). This agrees with the findings of Agrawal et al[14] which shows association between the age of diagnosis and diabetic complications. Various other studies have shown that microvascular complications increase with advancing age.[14]

Diabetic retinopathy was seen in 7 (7%) patients. The result concurs with the study done by Reema et al,[15] Premlatha et al,[16] Cures[17] and recently published multicentre observational study from India conducted by Sosale et al[18] who reported a prevalence of 6.1% but was lower than most of the studies from the western world.[19] It was difficult to identify the reasons for such variation in prevalence rates among various populations but ethnic susceptibility, age, healthcare facilities and other risk factors could have contributed to the differences. Retinopathy was seen in 5% of males and 10% of females, but this was statistically not significant. The mean age of patients having retinopathy was higher than those without it (56.71 yrs. vs. 53.49 yrs.), but this was statistically not significant.

Neuropathy was seen in 24% of patients which was quite similar to study done by Ramachandran et al. in Southern India which found a prevalence to 27.5%,[20] Agrawal et al. − 26.8 %.[21] The prevalence of neuropathy in our study was less than the other studies done by Dutta et al [22] and Hamman et al.[23] The result can be explained by the fact they used electrophysiological studies for the diagnosis

of neuropathy which were more accurate in diagnosing neuropathy and can even diagnose subclinical diabetic neuropathy. Much lower prevalence i.e. 14% was found by Knuiman et al (West Australia) which might be due to real ethnic variation and different genetic susceptibility to develop neuropathy in presence of hyperglycaemia.[24]

Out of 24 patients, 14 (35%) were female and 10 (16.66%) were male, so in our study neuropathy was more in females as compared to males, but it was statistically insignificant. The finding agrees with the study by Dutta et al.,[22] in their study also they found female preponderance of neuropathy.

Age wise analysis shows that no neuropathy was present in 35-45 yrs. age group, 19.60% neuropathy in 46–55 yrs. age group, 40% neuropathy in 56-65 age group.

Nephropathy was seen in 19 (19%) of newly diagnosed diabetics. The result was higher than the other studies in India, 8.9% in Vellore and 5.5% in Chennai but lower than prevalence of nephropathy in Asian Indians in U K, population. However, another study by Agrawal et al.[25] from Jhansi had found the prevalence to be 17.34% which was quite similar to our study. WHO multicentric study[26] of vascular disease in diabetes reported a wide variation in prevalence of nephropathy. It ranged from 2.4% (Hong Kong), 23% (Delhi) to 37 % (Oklahoma, USA). Thus, it can be concluded that prevalence of nephropathy varies considerably between different geographic regions. Multiple factors may be responsible for this like genetic predisposition, smoking pattern, coexisting hypertension or other socioeconomical and cultural/ environmental factors. Simultaneously, quality and quantity of protein may also play an important role in evolution of diabetic nephropathy.

When assessing the prevalence of nephropathy using albuminuria, it is important to consider the prevalence of albuminuria in background population which may also contribute positively to the result. Nephropathy was seen in 13 (21.66%) of male and 6 (15%) of females. It was statistically not significant (P value >0.05).

The prevalence of nephropathy was highest in 56-65 age group (34.28%). Out of 19 cases of nephropathy, 6 were having coexisting retinopathy. So 31.57% of nephropathy were having retinopathy. The association was statistically significant (P value < 0.05).

The above association between nephropathy with retinopathy is in concordance with the study done by Chandy et al[27] which has found the similar association and concluded that close association between diabetic nephropathy and other micro and macrovascular complications exist in our Indian patients also. Other studies [28] have reported similar strong correlation between these two.

36% of newly diagnosed diabetics were having one or other type of dyslipidaemia. This agrees well with the work of Gupta et al[29] which reported the prevalence of dyslipidaemia above 30%, and CINDI (complication in newly diagnosed diabetes in India)[29] study which reported prevalence of dyslipidaemia around 34%. Dyslipidaemia was seen in 22 (36.66%) of male and 14 (35%) of female at the time of diagnosis.

The classical diabetic dyslipidaemia that is increased TG with reduced HDL with or without elevated LDL was present in 17 (47.22%) of patients and it was the commonest pattern identified in our study, this is followed by isolated increased TG seen in 12 (33.33%) of patients, 7 (19.44%) were having other mixed pattern of dyslipidaemia. Among the dyslipidaemics, 16 (44.44%) patients were having diabetic complication at the time of diagnosis.

38.88% of dyslipidaemic patients were having nephropathy. The association was statistically significant (p value< 0.05). A statistically significant (p value<0.05) correlation was found between ACR and dyslipidaemia.

Future Research: Science is dynamic and there is always a scope of improvement and change in time to come ahead. With progressive aim to move ahead, we aspire to achieve highly accurate and reliable results. Thus, every study leaves back scopes for other researcher to do something more advanced and varied in order to touch the height of perfection. This study examined only 100 patients, future researchers can expand the study by including more number of subjects so as to make generalisation of the results and practice, further studies with a larger sample size and in multiple centres are required. Thus, it could be applied to real life situation.

Relevance to Clinical Practice: This study is relevant to the type 2 diabetes mellitus and its prevalence and microvascular complication. It opens up new possibilities of identification or prevention of type 2 diabetes mellitus in Indian population. Such interventions in future would not only reduce morbidity but also have a significant financial impact on the health care systems.

LIMITATION: The sample size was relatively small as compared to the prevalence of type 2 DM which has taken an epidemic proportion. This was a hospital based study which may lead to high prevalence of complications and thus may not reflect the actual prevalence of complications in the community. So a community based study may be more helpful in getting a more realistic picture in this part of the country. Economic constraints and feasibility was a major limiting factor in carrying out more advanced investigation for diagnosis of diabetic complications. As it was a hospital based study, hence, there is a possibility of referral bias affecting the results.

SUMMARY AND CONCLUSION: Diabetic complications are fairly common in newly diagnosed type 2 DM patients. Prevalence of microvascular complication was found to be 39%. The complications were more common in higher age group.

The prevalence of microvascular complication was found to be 7% for retinopathy, 19% for nephropathy, 24% for neuropathy, and significant association was found between retinopathy and nephropathy.

Dyslipidaemia was present in 36% of newly diagnosed type 2 diabetics and the most common pattern of dyslipidaemia was increased TG with reduced HDL–C with or without elevated LDL-C present in 47.22% of patients; however, isolated hypertriglyceridaemia was also fairly common, seen in 33.33% of patients. Dyslipidaemia was significantly associated with nephropathy.

Prevalence of complications was quite high even at the time of diagnosis of Type 2 diabetes. This was probably because of the insidious onset of diabetes and long duration of asymptomatic disease before symptoms develop. Hence screening tests for complications were strongly recommended at the time of diagnosis not only for early detection, but also to prevent the progression into end-stage disease.

REFERENCES

1. Mohan V, Pradeepa R, Anjana RM. Diabetes in India- an epidemiological review. Current controversies and consensus in diabetes management. 1st edn. 2015:1.
2. Anjana RM, Pradeepa R, Deepa M, et al. Prevalence of diabetes and prediabetes in urban and rural India. Phase 1 results of the Indian council of medical research- India diabetes (ICMR-INDIAB) study. Diabetologia 2011;54(12):3022-3027.
3. Garcia MJ, McNamara PM, Gordon T, et al. Morbidity and mortality in diabetics in the Framingham population. Sixteen year follow-up study. Diabetes 1974;23(2):105-111.
4. Wirta O, Pasternak A, Mustonen J, et al. Retinopathy is independently related to microalbuminuria in type 2 diabetes mellitus. Clin Nephrol 1999;51(6):329-334.
5. Ahuja MMS. Epidemiological studies on diabetes mellitus in India. In: Ahuja MMS. ed. Epidemiology of diabetes in developing countries. New Delhi: Interprint 1979:29-38.
6. Viswanathan M, Moses SGP, Krishnamoorty M. Prevalence of diabetes in Madras. In: Diabetes in the tropics. Patel JC, Talwalker NG. ed. Diabetes Association of India Bombay 1966:29-32.
7. Gupta R, Deedwania PC, Sharma K, et al. Association of educational occupational and socioeconomic status with cardiovascular risk factors in Asian Indians: a cross sectional study. PloS one 2012;7(8):e44098.
8. Zaman FA, Borang A. Prevalence of diabetes mellitus amongst rural hilly population of north eastern India and its relationship with associated risk factors and related co-morbidities. J Nat Sci Biol Med 2014;5(20):383-388.
9. Haffiner SM, Lehto S, Ronnemaa T, et al. Mortality from coronary heart disease in subjects with type 2 diabetes and in non-diabetic subjects. N Engl J Med 1998;339(4):229-234.
10. Fontbonne A. Relationship between diabetic dyslipoproteinemia and coronary heart disease risk in non-insulin dependent diabetes. Diabetes Metab Rev 1991;7(3):179-189.
11. Fontbonne A, Eschewege E, Cambien F, et al. Hypertriglyceridemia as a risk factor for coronary heart disease mortality in subjects with impaired glucose tolerance or diabetes: results from 11 year follow up of the Paris prospective study. Diabetologia 1989;32(5):300-304.
12. Taskinen MR. Quantitative and qualitative lipoprotein abnormalities in diabetes mellitus. Diabetes 1992;41(suppl 2):12-17.
13. Ramachandran A. Socioeconomic burden of diabetes in India. Suppl JAPI 2007;55:9-12.
14. Gomez FJDC, Perez FC, Ruiz MI, et al. Microvascular complications and risk factors in patients with type 2 diabetes. Endocrinologia y Nutricion 2011;58(4):163-168.
15. Rema M, Deepa R, Mohan V. Prevalence of retinopathy at diagnosis among type 2 diabetic patients attending a diabetic centre in south India. Br J Ophthalmol 2000;84(9):1058-1060.
16. Premlata G, Rema M, Mohan V. Complications of diabetes mellitus at diagnosis in south Indian type 2 diabetic patients. Int J Diab Dev Countries 1998;18:58-63.
17. Rema M, Premkumar S, Anitha B, et al. Prevalence of diabetic retinopathy in urban India: the Chennai urban rural epidemiology study (CURES) eye study, l. Invest Ophthalmol Vis Sci 2005;46(7):2328-2333.
18. Sosale A, Kumar PKM, Sadikot SM, et al. Chronic complications in newly diagnosed patients with type 2 diabetes mellitus in India. Indian J Endocrinol Metab 2014;18(3):335-360.
19. Owens DR, Volund A, Jones D, et al. Retinopathy in newly presenting non-insulin-dependent type 2 diabetic patients. Diabetes Res 1988;9(2):59-65.
20. Ramachandran A, Snehalatha C, Satyavani K, et al. Prevalence of vascular complications and their risk factors in type 2 diabetes. Journal Assoc Physicians India 1999;47(12):1152-1156.
21. Agrawal RP, Ola V, Bishnoi P, et al. Prevalence of micro and macrovascular complications and their risk factors in type 2 diabetes mellitus. J Assoc Physicians India 2014;62(6):504-508.
22. Dutta A, Naorem S, Singh TP, et al. Prevalence of peripheral neuropathy in newly diagnosed type 2 diabetics. Int J Diab Dev Countries 2005;25:30-32.
23. Hamman RF, Franklin GA, Mayer EJ, et al. Microvascular complications of NIDDM in Hispanics and Non-Hispanic whites. San Luis Valley diabetes study. Diabetes Care 1991;14(7):655-664.

24. Knuiman MW, Welborn TA, McCann VJ, et al. Prevalence of diabetic complications in relation to risk factors. Diabetes 1986;35(12):1332-1339.

25. Agrawal PR, Ranka M, Beniwal R, et al. Prevalence of micro and macro vascular complications in type 2 diabetes and their risk factors. Int J Diab Dev Countries 2004;24:11.

26. Diabetes drafting group. Prevalence of small vessel and large vessel disease in diabetic patients from 14 centers. WHO multinational study of vascular disease in diabetics. Diabetologia 1985;28:615-640.

27. Chandy A, Pawar B, John M, et al. Association between diabetic nephropathy and other diabetic microvascular and macrovascular complications. Saudi J Kidney Dis Transpl 2008;19(6):924-928.

28. Mociran M, Dragos C, Hancu N. Risk factors and severity of diabetic retinopathy in maramures. Applied Medical Informatics 2009;24(1-2):47-54.

29. Gupta S, Kapse A. Lipid profile pattern in diabetics from central india. Int J Diab Dev Ctries 2001;21:138-145.

J. Evid. Based Med. Healthc., pISSN- 2349-2562, eISSN- 2349-2570/ Vol. 3/Issue 52/June 30, 2016

Page 2661