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**Original Research Article**

# Complications of diabetes mellitus among patients attending the out-patient department of a tertiary care hospital

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## ABSTRACT

**Background:** Diabetes mellitus (DM), a common metabolic disorder, is associated with complications that can affect the quality of life. The current study was taken to study the frequency of complications among DM patients attending Out Patient Department (OPD) of Endocrinology at a tertiary care hospital and to study the association of select socio-demographic factors and select biochemical parameters among patients with complications.
**Methods:** Case record analysis of 250 out patients with DM (Type 1 and 2) in the month of August 2016 was done. Permission from Hospital Administration and Department of Endocrinology was obtained to access records. Socio-demographic details, anthropometry, blood pressure recordings of the past visit, DM duration, laboratory investigations, complications, treatment & other morbidities were noted.
**Results:** Of the 250 patients, 138 (55.2%) were males. Patients with cardiovascular complications, ocular complications, neuropathy, peripheral arterial diseases, nephropathy and cerebrovascular complications were 21.2%, 19.2%, 16.8%, 12.8%, 11.2% and 6.0% respectively. Poor glycemic control (HbA1c>7.5%) was seen in 51.2% of patients with DM related complications. It was noticed that 78.5% of the patients with chronic complications had DM for more than 5 years duration. Logistic regression analysis showed age (≥60 years), gender (males) and serum creatinine levels (>1.2 mg/dl in males and >0.9 mg/dl in females) to be associated with occurrence of complications in patients with DM.
**Conclusions:** Efforts need to be directed at intense glycemic control, strengthening awareness regarding self care, early screening and appropriate management to prevent and minimize complications.

**Keywords:** Diabetes mellitus, Complications, Case record analysis

## INTRODUCTION

Diabetes Mellitus (DM) is a common metabolic disorder and is associated with development of chronic complications leading to significant morbidity and mortality. The complications related to DM pose a significant health care burden and a deterrent to overall quality of life.[1] Effective management of DM requires stringent and sustained glycemic control to lower the risk of macro- and micro-vascular complications.[2]

DM, a chronic metabolic non communicable disease, has attained epidemic proportions worldwide. In 2015, more than 415 million adults have DM globally, and this number is estimated to increase to 642 million by 2040.[3] India is one of the epicenters of the global DM epidemic and has the second highest number of people with the

disease in the world ~69 million individuals as of 2015.[3] The micro vascular and macro vascular complications of DM account for most of the morbidity and mortality associated with the disease. Studies done in Chennai (2000-2008) revealed that the prevalence of diabetic retinopathy (DR) was 17.6%, micro albuminuria was 26.9%, neuropathy was 26.1%, coronary artery disease (CAD) was 21.4% and peripheral vascular disease (PVD) was 6.3%.[4-8] Poor glycaemic control and long duration of illness seem to be the most important risk factors for these complication.[9] Also these long term complications develop gradually as the age advances making the elderly more prone.

More data are needed to evaluate glycemic control and guideline adherence provided by physicians in real-life clinical practice to the patients. The data such collected would help to assess whether glycemic control is being achieved or not and to predict the establishment of diabetes related complications in various ethnic groups.[2] Knowledge about the frequency of occurrence of complications in DM patients will enable clinicians to understand the need for effective management of complications that have developed and halt the progress of disease.

The present study was undertaken to estimate the frequency of complications among DM patients attending OPD of Endocrinology at a tertiary care hospital in Bengaluru and to study the association of select socio-demographic factors and select biochemical parameters with the complications of DM among patients.

## METHODS

### *Study setting, study population and data collection*

The present hospital based cross sectional study based on record analysis study was carried out among the outpatients of Department of Endocrinology of a tertiary care hospital during the month of August 2016.

The sample size for the present study was estimated based on a multi-centric study carried out in India indicating the current glycemic status and diabetes related complications among diabetes patients, which revealed the prevalence of eye complications to be 16.6% with desired confidence levels of 95% and 5% absolute precision. It was estimated that 250 patient records need to be included for the study.[1]

Permission from the Department of Endocrinology and the Hospital Administrator was obtained to access the records. The hospital has got a good medical recording system and the files are being maintained most meticulously in the physical form as well as data being stored in the computers.

Medical Records Department retrieved 482 patient case records of Type I and II DM during August 2016. Out of these records, 250 case records were selected by simple random sampling technique. A pre-designed pre-tested semi structured proforma was developed and the following information was obtained: socio-demographic details, the present anthropometric measurements, recording of blood pressure during the latest visit, duration of DM, recorded laboratory investigations during the latest visit, complications after the diagnosis of DM and regarding any other morbidities if present.

Standard methods and definitions were adopted:

1. Weight was recorded up to the nearest 250 grams and height of the individuals up to the nearest 0.5 centimeters. Based on the above parameters BMI is being calculated.
2. Blood pressure was measured using a mercury sphygmomanometer with a standard adult sized blood pressure cuff wrapped round the right upper arm (used left arm when right arm was injured) with the cuff's lower edge one inch above the antecubital fossa and with the participant in the seated position with the participant's arm flexed at the level of the heart. Two recording were taken 5 minutes apart and their average was taken as the final blood pressure measurement.
3. The Asia-Pacific obesity classification was used to categorize BMI and JNC 8 was used for BP.[10,11]
4. The level of glycemic control was defined as optimal (HbA1c <6.5%), fair (6.5% ≤HbA1c ≤7.5%), and poor (HbA1c >7.5%).[12]
5. Serum creatinine was grouped based on the cut off values adopted in the respective laboratory where the tests were carried out.
6. Complications were classified as acute, chronic and other complications of DM (Harrison's Principles of Internal Medicine).[13] Acute complications- attacks of hypoglycemia and diabetic keto acidosis (DKA), chronic complications- cardiovascular and cerebrovascular complications, peripheral arterial diseases, nephropathy, neuropathy and ocular complications that developed after the proper diagnosis of DM and could be attributed to diabetes.
7. Cardiovascular complications were: angina pectoris (both stable and unstable), myocardial infarction, patients who had undergone coronary artery bypass grafting (CABG) and percutaneous transluminal coronary angioplasty (PTCA).
8. Cerebrovascular morbidity: attacks of stroke and transient ischemic attack (TIA),
9. Peripheral arterial diseases: foot ulcer and amputation procedures performed;
10. Nephropathy: micro albuminuria, macro albuminuria, renal hypo function, and renal failure
11. Ocular complications: retinopathy and macular edema.
12. Other complications of DM were grouped under conditions those belonging to gastrointestinal system, genitourinary system, dermatological

conditions, cataract, periodontal diseases, frozen shoulder and abscesses or infections.[13]

13. Any other morbidities if present were categorized under hypertension, dyslipidemia, thyroid related conditions, pancreatic conditions and others.

### *Statistical analysis of data*

Statistical analysis was performed using SPSS version 18. Descriptive statistics were employed to summarize the quantitative data such as age, duration of DM etc. Qualitative variables were expressed as percentages with 95% confidence interval. Differences in the mean values were tested for statistical significance employing student's t test/Mann Whitney test in case of non normal distribution. Chi-square test/Fisher's exact test was employed to find the association between complications and select socio-demographic factors and select biochemical parameters after categorizing the patients into those with and without acute, chronic and other complications. Univariate and multivariate odds ratio with 95% confidence interval were computed. Logistic regression method was employed to assess the independent predictors associated with complications of DM. P<0.05 was considered statistically significant.

## RESULTS

### *General characteristics of patients*

Total of 250 outpatients with DM attending OPD of Endocrinology were included in the present study. Median age was 56.0 years (25-75th percentile: 46.0-63.0 years) and majority i.e., 158 (63.2%) patients were adults (18–59 years). Males constituted 55.2% of the total patients. Type 2 DM was seen in 242 (96.8%) patients and the remaining 3.2% had type 1 DM. Majority i.e., 201 (80.4%) patients were Hindu by religion followed by 10% Muslims and 9.6% Christians.

Among the patients, 154 (61.6%) were found to be obese. Raised blood pressure recordings (≥140/90 mm of Hg) during their last visit were seen among 52 (20.8%) patients. Non optimal glycemic control (HbA1c≥6.5%) was documented in 209 (83.6%) patients i.e., 32.4% with fair control (HbA1c:6.5–7.5%) and 51.2% with poor control (HbA1c>7.5%). Majority of the patients had normal serum creatinine levels among both males (78.1%) and females (80.2%).

Among the patients, 231 (92.4%) were suffering from DM for less than 20 years duration and 19 (7.6%) for ≥20 years of duration. The median duration of DM was 7.0 years (25-75th percentile: 3.0-13.0 years).

### *Proportion of complications amongst patients with DM*

During the current visit, 89 (35.6%) of the 250 outpatients with DM had no clinically recognized complications whereas 161 (64.4%; 95% CI 58.4% - 70.4%) suffered from at least one diagnosed complication. The proportions of acute, chronic and other complications of DM are presented in Figure 1.

Among the most common acute complications, attacks of hypoglycemia, was experienced by 25 patients (10%) with only one subject developing diabetic ketoacidosis. The most common chronic complication was cardiovascular (n=53, 21.2%). Proportion of ocular complications, neuropathy, peripheral arterial diseases, nephropathy and cerebrovascular complications were 19.2%, 16.8%, 12.8%, 11.2% and 6.0% respectively.

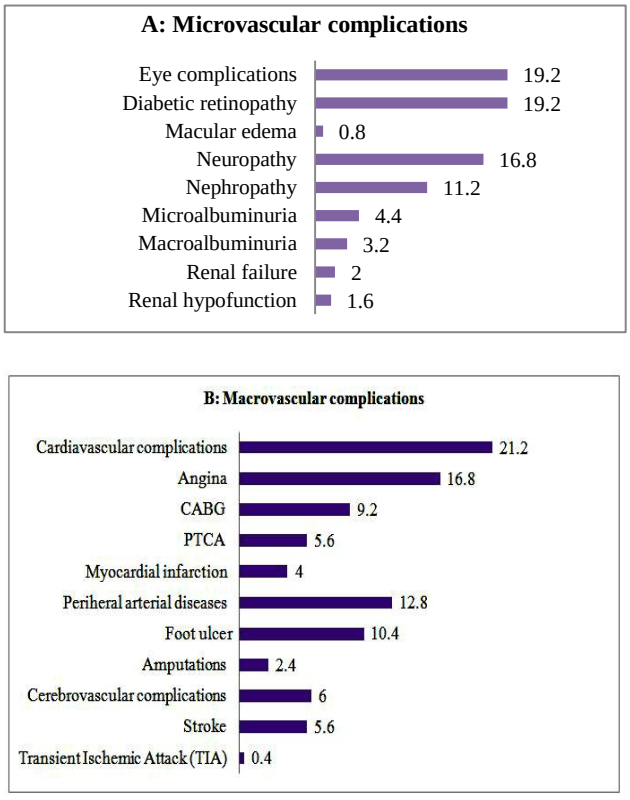


**Figure 1: Proportion of complications among the patients with DM (%). (A= Microvascular complications, B= Macrovascular complications).**

Among the chronic complications, the number of patients with complications pertaining to a single system were 56 (22.4%) patients and to 2, 3 and 4+ systems were 40 (16.0%), 18 (7.2%) and 7 (2.8%) patients respectively. It was also observed that 80 (32.0%) had at least one macro-vascular complication and 87 (34.8%) had at least one micro-vascular complication.

Other complications of DM were seen in 73 (29.2%) patients of which dermatological conditions, infections/ abscesses, cataract, periodontal diseases, gastrointestinal conditions, genitourinary conditions, and frozen shoulder accounted for 43.8%, 36.9%, 8.2%, 4.1%, 4.1%, 4.1% and 2.7%. Dermatological conditions occurred in 32 (12.8%) patients, followed by other complications like infections/ abscesses (occurred in 27 patients).

**Table 1: Association of acute, chronic and overall complications of DM with certain select socio-demographic factors and select laboratory parameters.**

| Variables | N (%) | Acute complications* n (n/N%) | Chronic complications** n (n/N%) | Overall complications*** n (n/N%) |
|---|---|---|---|---|
| **Age** | | | | |
| Paediatric and adult | 161 (64.4) | 12 (7.5) | 57 (35.4) | 88 (54.7) |
| Elderly | 89 (35.6) | 13 (14.6) | 64 (71.9) | 73 (82.0) |
| | | $\chi^2$=3.259 p=0.071 | $\chi^2$=30.586 p<0.001 | $\chi^2$=18.720 p<0.001 |
| **Gender** | | | | |
| Female | 112(44.8) | 9 (8.0) | 42(37.5) | 102 (73.9) |
| Male | 138 (55.2) | 16 (11.6) | 79 (57.2) | 59 (52.7) |
| | | $\chi^2$=0.870 p=0.351 | $\chi^2$=9.652 p=0.002 | $\chi^2$=12.159 p<0.001 |
| **Duration of DM** | | | | |
| ≤5 years | 107 (42.8) | 7 (6.5) | 26 (24.3) | 53 (49.5) |
| 6-10 years | 60 (24.0) | 6 (10.0) | 37 (61.7) | 41 (68.3) |
| ≥11 years | 83 (33.2) | 12 (14.5) | 58 (69.9) | 67 (80.7) |
| | | $\chi^2$=3.254 p=0.196 | $\chi^2$=4.448 p<0.001 | $\chi^2$=20.367 p<0.001 |
| **HbA1c** | | | | |
| Optimal control | 41(16.4) | 3 (7.3) | 9 (22.0) | 18 (43.9) |
| Fair control | 81 (32.4) | 8 (9.9) | 36 (44.4) | 50 (61.7) |
| Poor control | 128 (51.2) | 14 (10.9) | 76 (59.4) | 93 (72.7) |
| | | $\chi^2$=0.454 p=0.797 | $\chi^2$=18.165 p<0.001 | $\chi^2$=11.572 p=0.003 |
| **Serum creatinine** | | | | |
| Normal | 197 (77.8) | 15 (7.6) | 78 (39.6) | 112 (56.9) |
| Abnormal | 53 (21.2) | 10 (18.9) | 43 (81.1) | 49 (92.5) |
| | | $\chi^2$=5.877 p=0.015 | $\chi^2$=28.854 p<0.001 | $\chi^2$=23.087 p<0.001 |

P<0.05 statistically significant; *If any one of the acute complications is present; **If any one of the chronic complications is present; ***If any one of the acute or chronic or other complications is present.

**Table 2: Association of categorized chronic complications of DM with certain selected factors.**

| Variables | N (%) | Cardiovascular complications* n (n/N%) | Cerebrovascular complications* n (n/N%) | PAD* n (n/N%) | Neuropathy* n (n/N%) | Nephropathy* n (n/N%) | Ocular complications* n (n/N%) |
|---|---|---|---|---|---|---|---|
| **Age** | | | | | | | |
| **Paediatric and adult** | 161 (64.4) | 20 (12.4) | 7 (4.3) | 12 (7.5) | 23 (14.3) | 12 (7.5) | 23 (14.3) |
| **Elderly** | 89 (35.6) | 33 (37.1) | 8 (9.0) | 20 (22.5) | 19 (21.3) | 16 (18.0) | 25 (28.1) |
| | | $\chi^2$=20.858 p<0.001 | $\chi^2$=2.189 p=0.139 | $\chi^2$=11.582 p=0.001 | $\chi^2$=2.045 p=0.153 | $\chi^2$=6.383 p=0.012 | $\chi^2$=7.040 p=0.008 |
| **Gender** | | | | | | | |
| **Female** | 112 (44.8) | 13 (11.6) | 4 (3.6) | 11 (9.8) | 18 (16.1) | 5 (4.5) | 19 (17.0) |
| **Male** | 138 (55.2) | 40 (29.0) | 11 (8.0) | 21 (15.2) | 24 (17.4) | 23 (16.7) | 29 (21.0) |
| | | $\chi^2$=11.177 p=0.001 | $\chi^2$=2.122 p=0.145 | $\chi^2$=1.613 p=0.204 | $\chi^2$=0.007 p=0.781 | $\chi^2$=9.256 p=0.002 | $\chi^2$=0.654 p=0.419 |
| **Duration of DM** | | | | | | | |
| **≤5 years** | 107 (42.8) | 7 (6.5) | 1 (0.9) | 5 (4.7) | 11 (10.3) | 3 (2.8) | 9 (8.4) |
| **6–10 years** | 60 (24.0) | 20 (33.3) | 4 (6.7) | 9 (15.0) | 11 (18.3) | 7 (11.7) | 12 (20.0) |
| **≥11 years** | 83 (33.2) | 26 (31.3) | 10 (12.0) | 18 (21.7) | 20 (24.1) | 18 (21.7) | 27 (32.5) |
| | | $\chi^2$=24.143 p<0.001 | $\chi^2$=8.261 p=0.004 | $\chi^2$=12.465 p=0.002 | $\chi^2$ =6.516 p=0.038 | $\chi^2$=16.775 p<0.001 | $\chi^2$=17.560 p<0.001 |

| Variables | N (%) | Cardiovascular complications* n (n/N%) | Cerebrovascular complications* n (n/N%) | PAD* n (n/N%) | Neuropathy* n (n/N%) | Nephropathy* n (n/N%) | Ocular complications* n (n/N%) |
|---|---|---|---|---|---|---|---|
| **HbA1c** | | | | | | | |
| **Optimal control** | 41(16.4) | 5 (12.2) | 1 (2.4) | 2 (4.9) | 3 (7.3) | 1 (1.4) | 0 |
| **Fair control** | 81 (32.4) | 14 (17.3) | 3 (3.7) | 11 (13.6) | 13 (16.0) | 4 (4.9) | 12 (14.8) |
| **Poor control** | 128 (51.2) | 34 (26.6) | 11 (8.6) | 19 (14.8) | 26 (20.3) | 23 (18.0) | 36 (28.1) |
| | | $\chi^2$=4.937 p=0.085 | $\chi^2$=3.206 p=0.201 | $\chi^2$=2.828 p=0.243 | $\chi^2$=3.800 p=0.150 | $\chi^2$=12.254 p=0.002 | $\chi^2$=17.319 p<0.001 |
| **Serum creatinine** | | | | | | | |
| **Normal** | 197 (77.8) | 37 (18.8) | 10 (5.1) | 18 (9.1) | 27 (13.7) | 8 (4.1) | 31 (15.7) |
| **Abnormal** | 53 (21.2) | 16 (30.2) | 5 (9.4) | 14 (26.4) | 15 (28.3) | 20 (37.7) | 17 (32.1) |
| | | $\chi^2$=3.253 p=0.071 | $\chi^2$=2.893 p=0.235 | $\chi^2$=11.170 p=0.001 | $\chi^2$=6.366 p=0.012 | $\chi^2$=47.619 p<0.001 | $\chi^2$=7.187 p=0.007 |

P<0.05 statistically significant PAD: Peripheral arterial diseases; *If any of the related system/organ complications is present.

**Table 3: Factors associated with complications of DM: univariate and multivariate odds ratio with 95% confidence interval.**

| | | Acute complications | | Chronic complications | | Overall complications | |
|---|---|---|---|---|---|---|---|
| **Variables** | **Levels** | **Univariate OR (95% CI)** | **Multivariate OR (95% CI)** | **Univariate OR (95% CI)** | **Multivariate OR (95% CI)** | **Univariate OR (95% CI)** | **Multivariate OR (95% CI)** |
| **Age** | Elderly | 2.1 (0.92-4.88) | | 4.7 (2.66–8.21) | 3.0 (1.54-5.71) | 3.8 (2.03–7.06) | 2.5 (1.27–4.96) |
| | Pediatric and adult | 1 | | 1 | 1 | 1 | 1 |
| **Gender** | Male | 1.5 (0.64–3.54) | | 2.2 (1.34–3.72) | 2.3 (1.22–4.22) | 2.5 (1.50–4.33) | 2.4 (1.32–4.31) |
| | Female | 1 | | 1 | 1 | 1 | 1 |
| **Duration** | ≥11 yrs | 2.4 (0.91–6.44) | | 7.2 (3.80–13.77) | 1.0 (0.45–2.12) | 4.3 (2.20–8.29) | 0.7 (0.30–1.59) |
| | 6–10 yrs | 1.6 (0.51–4.96) | | 5.0 (2.53–9.92) | 0.2 (0.10–1.43) | 2.2 (1.13–4.27) | 0.5 (0.25–1.08) |
| | ≤5 yrs | 1 | | 1 | 1 | 1 | 1 |
| **HbA1c** | Poor | 1.6 (0.43–5.71) | | 5.2 (2.29–11.79) | | 3.4 (1.64–7.04) | |
| | Fair | 1.4 (0.35–5.54) | | 2.8 (1.20–6.72) | | 2.1 (0.96–4.42) | |
| | Optimal | 1 | | 1 | | 1 | |
| **Serum creatinine** | Abnormal | 2.8 (1.19–6.71) | 2.8 (1.19–6.71) | 6.6 (3.11–13.82) | 6.1 (2.65–14.15) | 9.3 (3.23–26.77) | 7.9 (2.63–23.44) |
| | Normal | 1 | 1 | 1 | 1 | 1 | 1 |

***Association between complications and select socio-demographic factors and select biochemical parameters***

The analysis using chi-square test revealed an association of serum creatinine with acute complications; age, gender, duration of DM, HbA1c and serum creatinine with chronic complications and overall complications of DM (Table 1).

Analysis of association of categorized chronic complications of DM with certain select socio-demographic factors and select laboratory parameters using chi-square test revealed an association between age and proportion of cardio vascular complications, peripheral arterial diseases, nephropathy and ocular complications; gender and proportion of cardio vascular complications and nephropathy, duration of DM and proportion of all the chronic complications; HbA1c and proportion of nephropathy and ocular complications; serum creatinine and peripheral arterial diseases, neuropathy, nephropathy and ocular complications (Table 2).

Association of acute complications was attempted with select socio-demographic factors and select biochemical parameters such as age, gender, duration of DM, HbA1c and serum creatinine. In the univariate analysis, serum creatinine alone revealed significant OR at 95% CI which is 2.8 (1.19–6.71). Association of chronic complications with the same selected factors was attempted and all the factors revealed statistical significance in univariate analysis with OR (95% CI) ranging from 2.2 (1.34–3.72) to 7.2 (3.80–13.77). However in the multivariate analysis, serum creatinine, age and gender alone showed statistical significance with OR (95% CI) ranging from 2.3 (1.22–4.22) to 6.1 (2.65–14.15). Analysis of association of overall complications with the same select factors revealed a statistical significant association of the same with all the factors in univariate analysis with OR (95% CI) ranging from 2.2 (1.13–4.27) to 9.3 (3.23–26.77) but the multivariate analysis showed significant association at 95% CI only between serum creatinine, age and gender and that of proportion of overall complications with OR (95% CI) ranging from 2.4 (1.32–4.31) to 7.9 (2.63–23.44) (Table 3).

***Other morbidities***

Of the 250 outpatients with DM, other morbidities were documented in 200 patients (80.0%). Among these 200 outpatients with morbidities, 136 (68.0%), 57 (37.5%), 36 (18.0%), 32 (16.0%) and 3 (1.5%) have hypertension, thyroid related conditions, other morbidities, dyslipidemia and pancreatic conditions respectively.

## DISCUSSION

DM is the commonest metabolic disorder and has a high prevalence in India and especially in Bengaluru. The prognosis of the patients with DM chiefly depends on the complications developed in the natural course of the disease.

The present cross sectional study was carried out based on the record analysis from OPD of Endocrinology of a tertiary care hospital. This NABH accredited tertiary care hospital follows meticulous procedure in the maintenance of records with complete information. At regular intervals, records are being scrutinized with all the quality control measures for the maintenance of completeness and appropriateness of the record information.

The present study had a large sample (250 records) through which the effect of several confounding factors could be studied and also helped to make more précised estimates. The data were more efficiently distributed in the categories of the adjustment variables thus improving the precision. To reduce systematic error in the present study, focus was made on the fundamental definitions and criteria used by the clinicians that must be satisfied to obtain the occurrence of the type of complications (acute, chronic and other complications) among the patients with DM. The anthropometric measures and BP recordings that were made in the OPD during the latest visit of the study subject were according to the standard methods thus taking care of the measurement bias. The laboratory, that is located in the hospital, is NABL accredited and adopts stringent quality control measures for all the laboratory investigations including the biochemical parameters which were considered in the present study.

The present study results revealed that the percentage of cardiovascular complications, ocular complications, neuropathy, peripheral arterial diseases, nephropathy and cerebrovascular complications were 21.2%, 19.2%, 16.8%, 12.8%, 11.2% and 6.0% respectively, which nearly correlates with the results of another cross-sectional observational hospital based study done at Bellary, Karnataka (2013) that showed occurrence of diabetic retinopathy, nephropathy, neuropathy, cardiovascular, cerebrovascular and peripheral vascular disease was 20%, 37%, 16%, 26%, 8% and 11%, respectively among newly detected patients with T2DM.[14] Only the occurrence of nephropathy was higher than when compared to the present study. This would be as the Bellary study included both in patients and out patients and also it had included only the newly detected DM cases with majority of them having a very poor glycemic control.

Mohan et al's cross-sectional multi-centric study done in India (2013) reported the prevalence of neuropathy (24.6%) was the most common complication followed by cardiovascular (23.6%), renal (21.1%) and eye (16.6%) complications.[1] The prevalence of foot ulcer was 5.1% & many patients had multiple complications. These results show higher prevalence rates than when compared with the present study because the mean HbA1c levels were 9.2±1.4 indicating again a poor glycemic control among those patients resulting in higher prevalence of complications.

A prospective, cross-sectional study (2015) conducted in out-patient department of medicine at a tertiary care hospital in Srinagar, Jammu and Kashmir, India revealed neuropathy was present in 33% patients; retinopathy was present in 6% of patients and nephropathy was present in 50% patients.[15] Microalbuminuria was present in 44% patients, whereas macroalbuminuria was present in 6% patients. Untreated long standing hyperglycemia is responsible for these relatively high prevalence rates of microvascular complications in newly diagnosed DM than when compared to the present study.

Results from the DiabCare India 2011 multi-centric study reported that neuropathy was the most common complication (41.4%); other complications were: Foot (32.7%), eye (19.7%), cardiovascular (6.8%) and nephropathy (6.2%).[16] These proportions divert from the present study results as it included not only tertiary care hospitals but has included general hospitals, diabetes clinics and referral clinics in India.

Majority of the patients (21.2%) of the present study had cardiovascular complications which are on par with the results of other similar studies. Cardiovascular disease is increased in individuals with type 1 or type 2 DM. The Framingham heart study revealed diabetes mellitus to be a major risk factor for cardiovascular disease.[17]

Age (≥60 years), gender (males) and serum creatinine levels (>1.2 mg/dl in males and >0.9 mg/dl in females) were observed to be associated with occurrence of complications in patients with DM in the present study. Many previous studies.[18-20] also revealed that age was most significant time related factor for the occurrence of micro and macro vascular complications in patients with DM. A previous study revealed that females are at a greater burden of diabetic complications but in contrary to this, our study revealed that males were associated with more proportion of complications.[21] This can be explained by the reason that males visit the hospital more than females and points out to the fact of the study design.

The present study did not reveal any association of duration of DM and the glycemic control (HbA1c levels) with that of the proportion of complications which many other literatures and studies stated.[13] This may be because the present study was a tertiary care hospital based record analysis and could not the exact role of the associated risk factors for the complications in the general population. Serum creatinine levels were found associated with proportion of complications in patients with DM in our present study.

The present study is based on a sufficiently large sample size but still has certain limitations as applicable to hospital based studies. Being a tertiary care set up, the findings cannot be extrapolated to the community making generalizability not applicable. The chronology of occurrence of complications is not considered in the study and hence the temporality (cause-and-effect relationships) cannot be established. It can, however, provide a comprehensible snapshot of the current condition and may help improve the management and design of future studies to investigate further.

Taking into consideration the major impact of complications on DM-related morbidity and mortality, and the resulting pressure on health care resources, understanding the epidemiology of DM complications and co-morbidities is of immense significance.[22,23] It is increasingly evident that not only a cure for the current worldwide diabetes epidemic is essential, but also for its major complications, affecting both small and large blood vessels. These complications occur in the majority of individuals with both type 1 and type 2 diabetes.

These complications are wide ranging and are at least in part due to chronic elevation of blood glucose levels, which leads to cellular changes and damage of blood vessels.[24] The pathologic hallmark of DM involves the vasculature leading to both microvascular and macrovascular complications.[25] The mechanisms of hyperglycemia-induced polyol pathway, injury from advanced glycation end product (AGEs), and enhanced oxidative stress have been implicated in the pathogenesis of complications.[26] Chronicity of hyperglycemia is associated with long-term damage and failure of various organ systems mainly affecting the eyes, nerves, kidneys, and the heart.[27]

## CONCLUSION

Optimal or fair glycemic control was not achieved in a greater proportion of patients with DM. Hence strategies should be aimed at rigid management of glycemic control. In the present study, it has been shown that serum creatinine levels can be used as a tool to assess the occurrence of complications during follow up. But further longitudinal and community based studies can prove the temporality of serum creatinine levels and complications. Strengthening awareness on self care and screening to prevent complications are the need of the hour.

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