INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction and failure of various organs, especially the eyes, kidneys, heart, and blood vessels [1]. Diabetic nephropathy is the leading cause of end-stage renal failure in patients with Type 2 DM, and its prevalence is increasing annually worldwide. Compared to 20 years ago, the incidence of diabetic complications without diabetic nephropathy has decreased; however, it is still the main complication in diabetes [2]. Microalbuminuria is defined as levels of albumin ranging from 30 to 300 mg in a 24-hrs urine collection [3]. Microalbuminuria was the strongest predictor of cardiovascular events in a high-risk population with underlying atherosclerosis. It was found to be stronger than other risk factors such as coronary artery disease and diabetes [4]. Microalbuminuria does not directly cause cardiovascular events; it serves as a marker for identifying those who may be at increased risk. Microalbuminuria is caused by glomerular capillary injury and so may be a marker for diffuse endothelial dysfunction [5]. There is a positive link between high blood pressure (BP) and microalbuminuria. High BP may cause microalbuminuria by increasing glomerular filtration pressure and subsequent renal damage [6]. A study from Iran documented the linear relationship of the degree of microalbuminuria with BP, and duration of diabetes [7]. This study was aimed to determine the prevalence of microalbuminuria in Type 2 diabetes patients and to evaluate the relation between microalbuminuria and age, duration, glycated hemoglobin (HbA1c), blood sugar levels, blood pressure (BP), and renal parameters of Type 2 diabetes patients.

METHODS

The prospective study includes 115 patients with Type 2 diabetes, visiting in outpatient diabetes hospital, Chennai. The questionnaire was filled by the patients at the time of enrollment. The case reports were assessed by the attending physician. The selected patients were studied in detail with history and physical examination. The BP was recorded using a sphygmomanometer. Patients were categorized as hypertensive patients if the systolic BP >130 mm Hg and/or diastolic BP was >85 mmHg [8]. BMI was calculated from the height and weight measurements of the patients. A blood sample was taken from the patient after overnight fasting of 12 hrs to measure FBS, HbA1c, serum cholesterol, serum triglyceride levels, and serum creatinine. Urine samples were collected early in the morning after overnight fasting. The first morning urine sample was
In this conditions urine for microalbumin levels increased. Less than 30 mg/day was considered as normal, 30-300 mg/day may indicate as microalbuminuria (early kidney disease).

Data analysis was done using the student’s t-test to evaluate the significance of microalbuminuric and normoalbuminuric patients. A Pearson correlation test used to analyze the correlation of microalbuminuria with independent variables such as age, duration, HbA1c, FBS, PPBS, renal parameter, and BP. p < 0.05 was considered as statistically significant.

**RESULTS**

Data collected were analyzed by the student’s t-test. The Pearson correlation test was used to analyze the correlation of microalbuminuria with independent variables such as age, BMI, FBS, postprandial blood sugar, HbA1c, serum creatinine, systolic and diastolic BP, and creatinine clearance. p < 0.05 were regarded as statistically significant. A total of 115 patients, 59 males and 56 females, were included in the study. The overall prevalence of microalbuminuria in the present study was 27.82%. Among the patients with microalbuminuria, 16 (50%) were males, and 16 (50%) were females. Baseline characteristics of the patients are shown in Table 1. Age of the patient at diagnosis ranged between 18 and 86 years. Mean age at onset of DM was 54.74 ± 12.43 and in microalbuminuric patients was 57.13 ± 12.04 and in normoalbuminuric patients was 53.82 ± 12.53. The difference between the two groups was not statistically significant. There was statistically significant difference in FBS, PPBS, and serum creatinine of albuminuric and normoalbuminuric patients shown in Table 1. The mean BMI of microalbuminuric patients was 27.30 ± 5.30 and in normoalbuminuric patients was 26.84 ± 4.98. The difference between the two groups was not statistically significant. The mean HbA1c of microalbuminuric patients was 9.25 ± 2.72 and in normoalbuminuric patients was 8.63 ± 6.70. The difference between the two groups was not statistically significant (Table 1). The Pearson correlation did not show any significance for microalbuminuria and HbA1c (r = 0.06, p > 0.05) are shown in Table 2. Creatinine clearance did not show any significant difference between the two groups, but in gender-wise distribution shows statistically significant difference are shown in Table 3. The mean duration of Type 2 DM was found to be 10.98 ± 7.28, there is no significant difference between the two groups in both baseline characteristics and in the Pearson correlation. The maximum number of patients (30) had the duration of 11-15 years. Among these, eight patients had microalbuminuria. Twenty-nine patients had the duration of diabetes between 6 and 10 years; among them, also eight patients had microalbuminuria. Twenty-eight patients had the duration of diabetes >20 years, among them seven had microalbuminuria. This prospective study presents data on the prevalence and significance of microalbuminuria with age, duration of diabetes.

### Table 1: Baseline characteristics of the patients

| Variable               | All patients (n=115) | Microalbuminuric patients (n=32) | Normoalbuminuric patients (n=83) | p value |
|------------------------|----------------------|----------------------------------|----------------------------------|---------|
| Sex (M/F)              | 59/56                | 16/16                            | 40/43                            |         |
| Mean age (years)       | 54.74±12.43          | 57.13±12.04                      | 53.82±12.53                      | 0.20    |
| BMI (kg/m²)            | 26.57±5.04           | 27.00±5.30                       | 26.94±4.98                       | 0.66    |
| PPBS (mg/dl)           | 143.61±48.95         | 156.16±59.86                     | 134.92±41.24                     | <0.05   |
| HbA1c (%)              | 8.80±5.86            | 9.25±2.72                        | 8.63±6.70                        |         |
| Serum creatinine (mg/dl)| 0.96±0.28           | 1.13±0.38                        | 0.89±0.19                        | <0.001  |
| Creatinine clearance (ml/minute) | 86.26±27.02      | 76.47±35.29                      | 87.27±22.62                      | 0.054   |
| Duration of diabetes   | 10.98±7.28           | 12.59±8.25                       | 10.36±6.81                       | 0.14    |
| Systolic BP (mmHg)     | 135.05±17.52         | 144.09±20.30                     | 131.56±16.06                     | <0.0001 |
| Diastolic BP (mmHg)    | 80.21±11.05          | 81.03±13.57                      | 79.90±9.99                       | 0.47    |

### Table 2: Correlation of microalbuminuria with independent variables

| Variable               | Mean±SD (n=115) | Correlation coefficient (r) | p value |
|------------------------|-----------------|-----------------------------|---------|
| Mean age (years)       | 54.74±12.43     | 0.206                       |         |
| BMI (kg/m²)            | 26.57±5.04      | −0.027                      |         |
| PPBS (mg/dl)           | 143.61±48.95    | 0.323                       |         |
| HbA1c (%)              | 8.80±5.86       | 0.066                       |         |
| Serum creatinine (mg/dl)| 0.96±0.28      | 0.451                       |         |
| Creatinine clearance (ml/minute) | 86.26±27.02   | 0.31                        |         |
| Duration of diabetes   | 10.98±7.28      | 0.176                       |         |
| Systolic BP (mmHg)     | 135.05±17.52    | 0.438                       |         |
| Diastolic BP (mmHg)    | 80.21±11.05     | 0.029                       |         |

### Table 3: Gender-wise comparison of the patients

| Variables               | Male         | Female        | p value |
|-------------------------|--------------|---------------|---------|
| Mean age (years)        | 54.74±12.91  | 57.40±12.03   | 0.26    |
| BMI (kg/m²)             | 26.05±4.55   | 27.96±5.33    | <0.05   |
| PPBS (mg/dl)            | 138.47±45.46 | 149.02±52.04  | 0.24    |
| HbA1c (%)               | 9.16±7.93    | 8.42±12.3     | 0.50    |
| Serum creatinine (mg/dl)| 0.99±0.25    | 0.92±0.30     | 0.17    |
| Creatinine clearance (ml/minute) | 90.02±29.69 | 78.20±22.61   | <0.05   |
| Duration of diabetes    | 11.31±7.68   | 10.64±6.88    | 0.62    |
| Systolic BP (mmHg)      | 133.33±16.11 | 136.85±18.87  | 0.13    |
| Diastolic BP (mmHg)     | 80.79±11.08  | 79.60±11.09   | 0.41    |

All the values expressed as mean±SD; Students t-test, BMI: Body mass index, FBS: Fasting blood sugar, PPBS: Post prandial blood sugar, BP: Blood pressure, SD: Standard deviation, HbA1c: Glycated hemoglobin

± 48.95 mg/dl. In microalbuminuric patients and nonalbuminuric patients FBS was 156.16 ± 59.56 and 134.92 ± 41.24 mg/dl. The relationship between the two groups was significant. The mean PPBS was 198.18 ± 61.20 mg/dl. In microalbuminuric patients and nonalbuminuric patients PPBS were found to be 226.5 ± 65.66 and 187.27 ± 26.07 mg/dl. It was found to be statistically significant in baseline characteristics but not in the Pearson correlation coefficient.

**DISCUSSION**

This prospective study presents data on the prevalence and significance of microalbuminuria with age, duration of diabetes,
HbA1c, blood sugar profile, BP, and renal parameters of Type 2 diabetes patients. In our present study, the overall prevalence of microalbuminuria has shown at 27.82%, which was much higher when compared to the study by Afkhami-Ardekani et al. were prevalent reported at 14.2% [7]. In the present study, the prevalence of microalbuminuria among males and females were equal percentage 13.91% and 13.91%, respectively. The prevalence of microalbuminuria was not statistically different from the males and females. The similar study was conducted in India by Varghese et al. reported an increased prevalence of microalbuminuria in Indian men compared with Indian women [9]. In our study, there was statistically significant difference in FBS and postprandial blood sugar in both groups. In our study, the mean HbA1c level was significantly higher in males and lower in females. Another one study by Haghighatpanah et al., the mean of HbA1c level was significantly higher in females and lower in males [10]. A study conducted by Acharya et al., reported that their study had a positive correlation of microalbuminuria with duration of diabetes and HbA1c level [11]. Another one similar study conducted by Mandal and Jyothrimayi results insignificant increase in urine microalbumin levels and HbA1c levels in the study group when compared to control group [12].

The present study results in weak positive correlation of degree of albuminuria with age. Previous studies have also shown positive correlation of microalbuminuria with the age of Type 2 diabetes patients [13,14]. A similar study conducted by Varghese et al. reported that there was statistical correlation was found between microalbuminuria and age [9]. Our study has shown significant differences between both groups in baseline characteristics of BMI and but the correlation between microalbuminuria and BMI was not seen.

Creatinine clearance has shown a weak negative correlation with microalbuminuria in our study and statistically significant, indicating impaired kidney function. Similar studies have also shown negative correlation with microalbuminuria [15-17]. Gender-wise significance has seen in creatinine clearance. Our present study has shown a positive correlation of microalbuminuria with duration of diabetes which was in accordance with many previous reports. Another one study conducted by Shastry et al., reported that 95% of elderly diabetes and 50% of younger diabetes had impaired creatinine clearance [18].

The present study has shown the moderate positive correlation of systolic BP was seen. A similar study carried out by Debbarma et al. reported the microalbuminuric patients had significantly increased systolic and diastolic BP compared to normoalbuminuric subjects. Plasma glucose, especially postprandial glucose level and HbA1c level were significantly higher in microalbuminuric group compared with the normoalbuminuric group [19].

CONCLUSION

The prevalence of microalbuminuria in this study was 27.82% in Type 2 DM, which is the predictor of later development of diabetic nephropathy. Incidence of microalbuminuria increases with age, duration of diabetes, blood sugar levels, and hypertension. There is no association of BMI and sex on the prevalence of microalbuminuria in Type 2 DM. Creatinine clearance has shown a weak negative correlation with microalbuminuria in our study and statistically significant indicating impaired kidney function. American diabetes association recommends that patients with Type 2 diabetes be tested for albuminuria at the time of initial diabetes diagnosis and yearly thereafter.

Study limitations

This study had a relatively small sample size. Larger sample size must be considered in the future investigate the associations observed in the present study. However, it can serve as the pilot study for such investigations.

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