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A cross-sectional observational study on drug utilisation pattern, prevalence and risk factors for the development of diabetic nephropathy among type 2 diabetic patients in a south indian tertiary care hospital

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ABSTRACT

Diabetic nephropathy is the leading cause of the end-stage renal disease (ESRD) worldwide, and it is estimated that ~ 20% of type 2 diabetic patients reach ESRD during their lifetime. The objective of the present study was to assess the drug utilization pattern, risk factors, and prevalence of diabetic nephropathy in patients with type 2 diabetes mellitus in a south Indian tertiary care hospital. A cross-sectional observational study was conducted on 613 subjects (254 with and 359 without diabetic nephropathy). Prevalence of diabetic nephropathy was measured, and risk factors for the development of diabetic nephropathy were determined by calculating odds ratios using graph-pad prism statistical software, and drug utilization pattern was assessed. Metformin (47.05%), a combination of Glimepiride and Metformin (30.71%), a combination of insulin isophane and insulin regular (29.41%), teneligliptin (10.45%), insulin regular (9.80%) were the anti-diabetic medications mostly given to the T2DM patients with nephropathy. The present study revealed that the risk factors for the development of diabetic nephropathy were multiple.

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INTRODUCTION

Diabetic nephropathy is one of the most common microvascular complications of type 2 diabetes mellitus (T2DM) and the leading cause of end-stage renal disease worldwide (Lopes, 2009; Ohga *et al.*, 2007). Diabetic kidney disease (DKD) is a thoughtful complication that takes place in 20% to 40% of all diabetics (Gheith *et al.*, 2016; Chen, 2014). The prevalence of diabetes around the world has reached epidemic proportions. While diabetes is already estimated to affect more than 8% of the global population (nearly more than 350 million people), this is predictable to grow to over 550

million people by the year 2035 (Andersen *et al.*, 1983). Many factors contribute to the development of diabetic nephropathy, including hyperglycemia, hypertension, obesity, a sedentary lifestyle, hereditary, smoking, and advancing age (.Rossing, 2006; Romero-Aroca *et al.*, 2010). Diabetic nephropathy is characterized by morphological and ultrastructural changes in the kidney, including an expansion of the molecular matrix and loss of the charge barrier on the glomerular basement membrane.

The progression from normal albuminuria to microalbuminuria is considered the initial step in diabetic nephropathy, which further progresses to macroalbuminuria as the renal function continues to deteriorate and glomerular filtration rate (GFR) starts to decline (Hovind *et al.*, 2001; Parving, 2001) . The World Health Organization (WHO) defines "drug utilization" as the marketing, distribution, prescription, and use of the drugs in a society considering its medical, social, and economic consequences (Sharma *et al.*, 2017) . Drug utilization studies help to assess whether the drug treatment is rational or not and to determine rational drug use, especially in poorer and rural populations (Mandal *et al.*, 2016) . The few studies published on the prevalence of diabetic nephropathy in India have all been clinic-based (Parving, 2001; Elmarakby and Sullivan, 2012). Indeed, the Diabetes Atlas 2006 (2) does not list a single population-based study on diabetic nephropathy from South Asia. This article reports on the first population-based data on the prevalence of diabetic nephropathy in India.

MATERIALS AND METHODS

For this purpose, a cross-sectional observational study was carried out at the outpatients department of Dr. Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation, Gannavaram, Andhra Pradesh, South India (Bazroy *et al.*, 2015). The study was initiated after approval by the Institutes Ethical Review Committee, KVSR Siddhartha College of Pharmaceutical Sciences (SCOPS), Vijayawada, India. KVSR SCOPS was recognized by All India Council of Technical Education (AICTE) and Pharmacy Council of India (PCI), New Delhi, Govt. of India. The protocol approval number was KVSRSCOPS/IEC/ PG/231/2017.

Selection of participants

Patients of either sex diagnosed with or without T2DM of any duration (as per ADA guidelines) and willing to participate were included in the study. A total of 613 patients (359 patients with T2DM and 254 patients with diabetic nephropathy) were enrolled in the study.

Inclusion criteria

Patients of either sex diagnosed with type 2 diabetes mellitus of any duration, established as per American Diabetes Association (ADA) guidelines. Patients who are visiting a public endocrine hospital in the duration of six months would be recruited.

Exclusion criteria

Patients with incomplete case reports. Patients having type 1 diabetes mellitus, gestational diabetes, and maturity-onset diabetes of the young were excluded from the study.

Data collection

Physicians were requested to report the clinical and biochemical data not exceeding 6 months before the observation. The information regarding demographics (age, sex), socioeconomic, and lifestyle characteristics (smoking, alcohol consumption) were collected by interviewing the participant. Biochemical parameters were derived from the latest laboratory investigation reports documented in the clinical records. Socioeconomic status was assessed using the modified Kuppuswamy's scale, which considers the education qualification, occupation of the family head, and family income per month of the participant. The diagnosis of nephropathy was confirmed from the clinical records (if already documented) or if an estimated 24-h protein excretion was $\geq$150 mg/day. All the relevant data were collected in a predesigned paper case record form with the prior consent of the participant. Data was collected from a total of 613 patients (359 patients with T2DM and 254 patients with diabetic nephropathy).

Statistical Analysis

Statistical analyses were performed using SPSS version 20 (SPSS Inc., Chicago, IL, USA) and Graph Pad Prism 5.0 software (San Diego, CA). Estimates were expressed as mean $\pm$ SD. One-way analysis of variance or Student's t-test was used to compare groups for continuous variables, and χ^2 test was used to compare proportions between the two groups. Univariate logistic regression analysis was used to examine the association between various exposures (age, gender, place of residence, generalized obesity, cigarette smoking, alcohol consumption, income status, and literacy level) and outcome (T2DM). P-value < 0.05 was considered significant.

RESULTS AND DISCUSSION

A total of 613 subjects (359 with type 2 diabetes and 254 with diabetic nephropathy) were included in the study, and the clinical characteristics of T2DM

Table 1: Biochemical and clinical characteristics of patients with type 2 diabetes mellitus (N = 359)

Variable	Patients with T2DM N (%)
Gender	155 (43.2)
Male	204 (56.8)
Female	
Age	1 (0.3)
0-20 years	83 (23.2)
21-40 years	217 (60.6)
41-60 years	57 (15.9)
Above 60 years	
Marital Status	16 (4.5)
Unmarried	343 (95.5)
Married	
Education	131 (36.5)
Uneducated	228 (63.5)
Educated	
BMI (Kg/m2)	114 (31.8)
<25 Kg/m2	245 (68.2)
>25 Kg/m2	
Body Weight (Kg)	5 (1.3)
<50	161 (45)
50-70	192 (53.6)
>70	
Nature of Work	41 (11.4)
Not working any where	93 (25.9)
Private job	39 (10.8)
Govt. job	38 (10.6)
Daily labor	148 (41.3)
House wife	
Locality	105 (29.2)
Rural	254 (70.7)
Urban	
Monthly Income	170 (47.5)
No income	115 (32.1)
Below 25000	73 (20.4)
Above 25000	
Co-morbidities	131 (29.4)
No	138 (30.8)
HTN	7 (1.56)
History of CVDs	59 (13.2)
Endocrine diseases	112 (25.1)
Other diseases	
HbA1C	141 (44.2)
<7	109 (34.2)
7-9	69 (21.6)
>9	
Fasting Blood Glucose (mg/dL)	10 (3)
70-80	92 (27.6)
80-120	107 (32)
121-160	71 (21.3)
161-200	54 (16.2)
>200	

Continued on next page

Table 1 continued

Post prandial blood glucose levels (mg/dL)	3 (1)
90-110	9 (3)
111-130	33 (10.9)
131-150	165 (54.6)
151-200	92 (30.5)
>200	
Random Blood Glucose (mg/dL)	0
80-100	0
101-120	0
121-140	2 (13.3)
141-160	1 (6.7)
161-200	12 (80)
>200	
HDL (mg/dL)	54 (20.1)
Not available	130 (48.3)
Normal	55 (20.4)
Low	30 (11.2)
High	
Triglycerides (mg/dL)	54 (20.5)
Not available	109 (41.5)
Normal	8 (3)
Low	92 (35)
High	
Total Cholesterol (mg/dL)	54 (19.6)
Not available	151 (54.7)
Normal	6 (2.2)
Low	65 (23.6)
High	
LDL (mg/dL)	57 (20.8)
Not available	163 (59.4)
Normal	9 (3.3)
Low	45 (16.5)
High	
Urea (mg/dL)	72 (36.4)
Not available	78 (39.4)
Normal	0
Low	48 (24.2)
High	
Serum creatinine (mg/dL)	45 (12.6)
Not available	305 (85.2)
Normal	5 (1.4)
Low	3 (0.8)
High	
Duration of T2DM (Years)	172 (47.9)
<5	111 (30.9)
5-10	76 (21.2)
>10	
Following T2DM education	282 (79.2)
Yes	74 (20.8)
No	

T2DM, Type 2 Diabetes Mellitus; BMI, Body Mass Index; HTN, Hypertension;CVDs, Cardiovascular Diseases; HbA1C, Glycated haemoglobin; HDL, High-Density Lipoproteins; LDL, Low-Density Lipoproteins

Table 2: Socio-demographic characteristics of diabetic patients with (N=254) or without diabetic nephropathy (N= 359).

Variable	Patients with T2DM N (%)	Patients with T2DM and nephropathy N (%)	P-Value
Gender	155 (43.2)	99 (39)	Ref
Male	204 (56.8)	155 (61)	0.2985
Female			
Age	1 (0.3)	——	Ref
0-20 years	83 (23.2)	20 (7.9)	0.6239
21-40 years	217 (60.6)	152 (59.8)	0.4031
41-60 years	57 (15.9)	82 (32.3)	0.2328
Above 60 years			
Marital Status	16 (4.5)	3 (1.2)	Ref
	343 (95.5)	251 (98.8)	0.0211*
Unmarried			
Married			
Education	131 (36.5)	155 (61)	Ref
Uneducated	228 (63.5)	99 (39)	<0.0001***
Educated			
BMI (Kg/m2)	114 (31.8)	62 (24.5)	Ref
<25 Kg/m2	245 (68.2)	191 (75.5)	0.0511
>/=25 Kg/m2			
Body Weight (Kg)	5 (1.3)	5 (2)	Ref
	161 (45)	112 (44.3)	0.5714
<50	192 (53.7)	136 (53.7)	0.5897
50-70			
>70			
Nature of Work	41 (11.4)	57 (22.5)	Ref
	93 (25.9)	45 (17.7)	<0.0001***
Not working any where	39 (10.8)	14 (5.5)	0.0002***
	38 (10.6)	25 (9.8)	0.0221*
Private job	148 (41.2)	113 (44.4)	0.0120*
Govt. job			
Daily labour			
House wife			
Locality	105 (29.2)	130 (51.2)	Ref
Rural	254 (70.8)	124 (48.8)	<0.0001***
Urban			
Monthly	170 (47.5)	148 (58.3)	Ref
Income	115 (32.1)	87 (34.2)	0.4382
No income	73 (20.4)	19 (7.4)	<0.0001***
Below 25000			
Above 25000			

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Table 2 continued

Co-morbidities	131 (29.4)	37 (8.6)	Ref
No	138 (30.8)	161 (37.44)	<0.0001***
HTN	7 (1.56)	34 (7.90)	<0.0001***
History of CVDs	59 (13.2)	41 (9.53)	0.0009***
Endocrine diseases	112 (25.1)	157 (36.51)	<0.0001***
Other diseases			
Systolic Blood Pressure	259 (72.1)	160 (63)	Ref
<140 mmHg	100 (27.9)	94 (37)	0.0164*
>/=140 mmHg			
Diastolic Blood Pressure	281 (78.3)	203 (79.9)	Ref
<90 mmHg	78 (21.7)	51 (20)	0.6219
>/=90 mmHg			
HbA1C	141 (44.2)	52 (21.8)	Ref
<7	109 (34.2)	100 (42)	<0.0001***
7-9	69 (21.6)	86 (36.1)	<0.0001***
>9			
Fasting Blood Glucose (mg/dL)	10 (3)	2 (0.9)	Ref
70-80	92 (27.6)	54 (24)	0.1572
80-120	107 (32)	62 (27.6)	0.1610
121-160	71 (21.3)	41 (18.2)	0.1678
161-200	54 (16.2)	66 (29.3)	0.0113*
>200			
Post prandial blood glucose levels (mg/dL)	3 (1)	1 (0.5)	0.6885
90-110	9 (3)	5 (2.3)	0.9423
111-130	33 (10.9)	12 (5.6)	0.6143
131-150	165 (54.6)	98 (45.4)	0.2834
151-200	92 (30.5)	100 (46.3)	Ref
>200			
Random Blood Glucose (mg/dL)	0	4 (5.2)	0.3259
80-100	0	5 (6.5)	0.2729
101-120	0	2 (2.6)	0.4857
121-140	2 (13.3)	8 (10.4)	0.9807
141-160	1 (6.7)	9 (11.7)	0.4635
161-200	12 (80)	49 (63.6)	Ref
>200			

Continued on next page

Table 2 continued

HDL (mg/dL)	54 (20.1)	84 (37.8)	Ref
Not available	130 (48.3)	73 (32.9)	<0.0001***
Normal	55 (20.4)	51 (23)	0.0470*
Low	30 (11.2)	14 (6.4)	0.0008***
High			
Triglycerides	54 (20.5)	85 (38.5)	Ref
(mg/dL)	109 (41.5)	46 (20.8)	<0.0001***
Not available	8 (3)	2 (0.9)	0.0108*
Normal	92 (35)	88 (39.8)	0.0293*
Low			
High			
Total Choles-	54 (19.6)	82 (36.8)	Ref
terol (mg/dL)	151 (54.7)	78 (35)	<0.0001***
	6 (2.2)	1 (0.4)	0.0161*
Not available	65 (23.6)	62 (27.8)	0.0617
Normal			
Low			
High			
LDL (mg/dL)	57 (20.8)	82 (37.1)	Ref
Not available	163 (59.4)	71 (32.2)	<0.0001***
Normal	9 (3.3)	4 (1.8)	0.0496*
Low	45 (16.5)	64 (28.9)	0.9649
High			
Urea (mg/dL)	72 (36.4)	120 (59.1)	Ref
Not available	78 (39.4)	22 (10.8)	<0.0001***
Normal	0	0	—–
Low	48 (24.2)	61 (30.1)	0.2656
High			
Serum creati-	45 (12.6)	7 (2.8)	Ref
nine (mg/dL)	305 (85.2)	175 (68.9)	0.0009***
Not available	5 (1.4)	0	0.3811
Normal	3 (0.8)	72 (28.3)	<0.0001***
Low			
High			
Duration of	172 (47.9)	59 (23.2)	Ref
T2DM (Years)	111 (30.9)	101 (39.8)	<0.0001***
	76 (21.2)	94 (37)	<0.0001***
<5			
5-10			
>10			
Following	282 (79.2)	180 (70.9)	Ref
T2DM educa-	74 (20.8)	74 (29.1)	0.0177*
tion			
Yes			
No			

T2DM, Type 2 Diabetes Mellitus; BMI, Body Mass Index; HTN, Hypertension; CVDs, Cardiovascular Diseases; HbA1C, Glycated haemoglobin; HDL, High-Density Lipoproteins; LDL, Low-Density Lipoproteins

Table 3: Food and lifestyle characteristics of diabetic patients with (N=254) or without diabetic nephropathy (N=359).

Variable	Patients with T2DM N (%)	Patients with T2DM and nephropathy N (%)	P-value
Food habits	60 (16.7)	37 (14.6)	Ref
Vegetarian	299 (83.3)	217 (85.4)	0.4732
Mixed			
Physical activity	176 (49)	165 (64.9)	Ref
No physical activity	183 (50.9)	89 (35)	<0.0001***
Regular exercise			
Habit of smoking	320 (89.1)	218 (85.8)	Ref
No	22 (6.1)	18 (7.1)	0.5781
Yes	17 (4.7)	18 (7.1)	0.2039
Past smoker			
A habit of drinking alcohol	304 (85.1)	221 (87)	Ref
No	44 (12.3)	25 (9.9)	0.3526
Yes	9 (2.5)	8 (3.2)	0.6834
Past alcoholic			
A habit of taking junk foods	180 (50.3)	123 (48.6)	Ref
No	31 (8.7)	16 (6.3)	0.3931
Weekly once	23 (6.4)	18 (7.1)	0.6860
Weekly twice	28 (7.8)	23 (9.1)	0.5455
Weekly thrice and more	96 (26.8)	73 (28.9)	0.5824
Occasionally			
A habit of taking fruits /fruit juices	66 (18.5)	62 (24.5)	Ref
No	27 (7.5)	17 (6.7)	0.2604
Weekly once	35 (9.8)	22 (8.7)	0.2145
Weekly twice	125 (34.9)	57 (22.4)	0.0023**
Weekly thrice & more	105 (29.3)	96 (37.8)	0.9047
Occasionally			
A habit of taking soft drinks	272 (76.2)	163 (64.1)	Ref
No	6 (1.7)	6 (2.4)	0.3773
Weekly once	5 (1.4)	2 (0.8)	0.6291
Weekly twice	14 (4)	2 (0.8)	0.0417*
Weekly thrice & more	60 (16.8)	81 (31.9)	<0.0001***
Occasionally			
A habit of taking tea/coffee	55 (15.3)	29 (11.5)	Ref
No	54 (15)	32 (12.6)	0.7151
Daily once without sugar	110 (30.6)	107 (42.3)	0.0208*
Daily twice without sugar	58 (16.2)	35 (13.9)	0.6671
Daily thrice without sugar	25 (6.9)	16 (6.3)	0.6226
Daily once with sugar	37 (10.3)	24 (9.5)	0.5518
Daily twice with sugar	20 (5.6)	10 (4)	0.9061
Daily thrice with sugar			
Situations at working places	181 (50.4)	127 (50)	Ref
No stress	178 (49.6)	127 (50)	0.9188
Stress			

Table 4: Univariate regression analysis of modifiable and non-modifiable risk factors for the development of nephropathy in patients with type 2 diabetes mellitus.

Variable	OR (95% CI)	P-value
Gender	1	Ref
Male	1.190 (0.8574 to 1.651)	0.2985
Female		
Age	1	Ref
0-20 years	0.7365 (0.02891 to 18.76)	0.6239
21-40 years	2.103 (0.08505 to 52.02)	0.4031
41-60 years	4.304 (0.1721 to 107.6)	0.2328
Above 60 years		
Marital Status	1	Ref
Unmarried	3.903 (1.125 to 13.54)	0.0211*
Married		
Education	1	Ref
Uneducated	0.3670 (0.2635 to 0.5112)	<0.0001***
Educated		
BMI (Kg/m2)	1	Ref
<25 Kg/m2	1.433 (0.9974 to 2.060)	0.0511
>/=25 Kg/m2		
Body Weight (Kg)	1	Ref
<50	0.6957 (0.1967 to 2.460)	0.5714
50-70	0.7083 (0.2011 to 2.495)	0.5897
>70		
Nature of Work	1	Ref
Not working any where	0.3480 (0.2035 to 0.5952)	<0.0001***
Private job	0.2582 (0.1243 to 0.5363)	0.0002***
Govt. job	0.4732 (0.2483 to 0.9020)	0.0221*
Daily labour	0.5492 (0.3432 to 0.8789)	0.0120*
House wife		
Locality	1	Ref
Rural	0.3943 (0.2820 to 0.5513)	<0.0001***
Urban		
Monthly Income	1	Ref
No income	0.8690 (0.6092 to 1.240)	0.4382
Below 25000	0.2990 (0.1723 to 0.5187)	<0.0001***
Above 25000		
Co-morbidities	1	Ref
No	4.131 (2.687 to 6.350)	<0.0001***
HTN	17.20 (7.049 to 41.95)	<0.0001***
History of CVDs	2.460 (1.433 to 4.224)	0.0009***
Endocrine diseases	4.963 (3.202 to 7.692)	<0.0001***
Other diseases		
Systolic Blood Pressure	1	Ref
<140 mmHg	1.522 (1.079 to 2.146)	0.0164*
>140 mmHg		
Diastolic Blood Pressure	1	Ref
<90mmHg	0.9051 (0.6088 to 1.346)	0.6219
>90mmHg		
HbA1C	1	Ref
<7	2.488 (1.638 to 3.779)	<0.0001***
7-9	3.380 (2.157 to 5.295)	<0.0001***
>9		

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Table 4 continued

Fasting Blood Glucose	1	Ref
(mg/dL)	2.935 (0.6196 to 13.90)	0.1572
70-80	2.897 (0.6146 to 13.66)	0.1610
81-120	2.887 (0.6028 to 13.83)	0.1678
121-160	6.111 (1.283 to 29.10)	0.0113*
161-200		
>200		
Post prandial blood glucose	1	Ref
levels (mg/dL)	1.667 (0.1349 to 20.59)	0.6885
90-110	1.091 (0.1032 to 11.53)	0.9423
111-130	1.782 (0.1827 to 17.38)	0.6143
131-150	3.261 (0.3331 to 31.92)	0.2834
151-200		
>200		
Random Blood Glucose	2.273 (0.1146 to 45.09)	0.3259
(mg/dL)	2.778 (0.1437 to 53.69)	0.2729
80-100	1.263 (0.05689 to 28.02)	0.4857
101-120	0.9796 (0.1837 to 5.222)	0.9807
121-140	2.204 (0.2540 to 19.13)	0.4635
141-160	1	Ref
161-200		
>200		
HDL (mg/dL)	1	Ref
Not available	0.3610 (0.2310 to 0.5640)	<0.0001***
Normal	0.5961 (0.3572 to 0.9947)	0.0470*
Low	0.3000 (0.1459 to 0.6168)	0.0008***
High		
Triglycerides (mg/dL)	1	Ref
Not available	0.2681 (0.1651 to 0.4354)	<0.0001***
Normal	0.1588 (0.03249 to0.7765)	0.0108*
Low	0.6077 (0.3878 to 0.9523)	0.0293*
High		
Total Cholesterol (mg/dL)	1	Ref
Not available	0.3402 (0.2193 to 0.5277)	<0.0001***
Normal	0.1098 (0.01285 to0.9377)	0.0161*
Low	0.6281 (0.3852 to 1.024)	0.0617
High		
LDL (mg/dL)	1	Ref
Not available	0.3028 (0.1954 to 0.4693)	<0.0001***
Normal	0.3089 (0.09070 to 1.052)	0.0496*
Low	0.9886 (0.5939 to 1.646)	0.9649
High		
Urea (mg/dL)	1	Ref
Not available	0.1692 (0.09703 to 0.2951)	<0.0001***
Normal	0.7625 (0.4728 to 1.230)	0.2656
Low		
High		
Serum creatinine (mg/dL)	1	Ref
Not available	3.689 (1.628 to 8.358)	0.0009***
Normal	0.5515 (0.02754 to 11.05)	0.3811
Low	154.3 (37.92 to 627.7)	<0.0001***
High		

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Table 4 continued

Duration of T2DM (Years)	1	Ref
<5	2.653 (1.778 to 3.958)	<0.0001***
5-10	3.606 (2.362 to 5.504)	<0.0001***
>10		
Following T2DM education	1	Ref
Yes	1.567 (1.079 to 2.274)	0.0177*
No		
Food habits	1	Ref
Vegetarian	1.177 (0.7538 to 1.838)	0.4732
Mixed		
Physical activity	1	Ref
No physical activity	0.5188 (0.3727 to 0.7220)	<0.0001***
Regular exercise		
Habit of smoking	1	Ref
No	1.201 (0.6292 to 2.292)	0.5781
Yes	1.554 (0.7835 to 3.083)	0.2039
Past smoker		
A habit of drinking alcohol	1	Ref
No	0.7816 (0.4643 to 1.316)	0.3526
Yes	1.223 (0.4643 to 3.220)	0.6834
Past alcoholic		
A habit of taking junk foods	1	Ref
No	0.7553 (0.3960 to 1.440)	0.3931
Weekly once	1.145 (0.5930 to 2.212)	0.6860
Weekly twice	1.202 (0.6614 to 2.185)	0.5455
Weekly thrice and more	1.113 (0.7601 to 1.629)	0.5824
Occasionally		
A habit of taking fruits /fruit	1	Ref
juices	0.6703 (0.3332 to 1.348)	0.2604
No	0.6691 (0.3542 to 1.264)	0.2145
Weekly once	0.4854 (0.3042 to 0.7746)	0.0023**
Weekly twice	0.9733 (0.6245 to 1.517)	0.9047
Weekly thrice & more		
Occasionally		
A habit of taking soft drinks	1	Ref
No	1.669 (0.5292 to 5.262)	0.3773
Weekly once	0.6675 (0.1280 to 3.481)	0.6291
Weekly twice	0.2384 (0.05348 to 1.063)	0.0417*
Weekly thrice & more	2.253 (1.531 to 3.315)	<0.0001***
Occasionally		
A habit of taking tea/coffee	1	Ref
No	1.124 (0.6001 to 2.105)	0.7151
Daily once without sugar	1.845 (1.094 to 3.112)	0.0208*
Daily twice without sugar	1.144 (0.6186 to 2.117)	0.6671
Daily thrice without sugar	1.214 (0.5607 to 2.627)	0.6226
Daily once with sugar	1.230 (0.6214 to 2.435)	0.5518
Daily twice with sugar	0.9483 (0.3923 to 2.292)	0.9061
Daily thrice with sugar		
Situations at working places	1	Ref
No stress	1.017 (0.7373 to 1.402)	0.9188
Stress		

T2DM, Type 2 Diabetes Mellitus; BMI, Body Mass Index; HTN, Hypertension; CVDs, Cardiovascular Diseases; HbA1C, Glycated haemoglobin; HDL, High-Density Lipoproteins; LDL, Low-Density Lipoproteins

were presented in Tables 1 and 2 andTable 3 show the socio-demographic and lifestyle characteristics of subjects with and without diabetic nephropathy, respectively. The prevalence of diabetic nephropathy was significantly higher in subjects who are married(98.8%,P=0.0211), uneducated(61%, p<0.0001), nature of work (house wives 44.4%,P=0.0120), rural residents(51.2%) and risk factors were co-morbidities(HTN 37.44%, P<0.0001, other diseases 36.51%, P<0.0001, endocrine diseases 9.53%, P=0.009, history of CVDs 7.90%, P< 0.0001), no physical activity (64.9%, P<0.0001), soft drinks (taking occasionally 31.9%, P<0.0001), habit of taking tea /coffee (twice without sugar 42.3%, p=0.0208), HbA1C(7-9% 42%, P<0.0001), FBS (>200 29.3%, P=0.0113), low HDL(23%, P=0.0470), high triglyceride levels (39.8%,P=0.0293), high serum creatinine (28.3%, P<0.0001), duration of T2DM(5-10years 39.8% & >10 years 37% , p<0.0001). Gender, age, BMI, body weight, monthly income, food habits, the habit of smoking, alcohol, stress levels, blood glucose levels are not significantly associated with the development of diabetic nephropathy.

Univariate regression analysis was performed to determine the odds ratios for the modifiable and non modifiable risk factors for T2DM (Table 4). The analysis showed that married (OR, 3.903; 95% CI, 1.125-13.54, P=0.0211), poorly educated (OR, 0.3670;95%CI, 0.2635-0.5112, P<0.0001), house wives (OR, 0.5492; 95% CI, 0.3432 - 0.8789, P=0.0120), rural residents (OR, 0.3943; 95% CI, 0.2820-0.5513, P<0.0001), hypertension (OR, 4.131; 95% CI, 2.687-6.350, P<0.0001), other diseases (OR, 4.963; 95% CI, 3.202 -7.692, P<0.0001), Endocrine diseases (OR, 2.460; 95% CI, 1.433-4.224, P=0.0009), history of CVD (OR, 17.20; 95% CI, 7.049- 41.95, P<0.0001), HbA1c (OR, 3.380; 95% CI,2.157- 5.295, P<0.0001), low HDL (OR, 0.5961; 95% CI, 0.3572 - 0.9947 , P=0.0470), high FBS levels (OR, 6.111; 95%CI, 1.283 -29.10, P=0.0113), high triglyceride levels (OR, 0.6077; 95%CI, 0.3878 -0.9523, P=0.0293), high serum creatinine (OR, 154.3; 95% CI, 37.92- 627.7, P<0.0001), duration of T2DM (5-10years OR, 2.653;95% CI 1.778 - 3.958, & >10 years , OR, 3.606 ; 95% CI, 2.362-5.504, P<0.0001). physical inactivity(OR, 0.5188;95% CI, 0.3727-0.7220 , P<0.0001), soft drinks occasionally (OR, 2.253; 95% CI,1.531-3.315, P<0.0001), habit of taking tea /coffee twice without sugar(OR, 1.845; 95% CI, 1.094 to 3.112, P=0.0208). Drug utilization pattern was assessed and presented the results in Table 5. Metformin, combination of Glimepiride and Metformin, combination of insulin isophane and insulin regular, Teneligliptin, insulin regular were the anti-diabetic medications mostly given to the T2DM patients with nephropathy.

The present study's results suggested that subjects who are married, uneducated, nature of work (housewives), rural residents and risk factors were co-morbidities(HTN, other diseases, endocrine diseases, history of CVDs), no physical activity, soft drinks (taking occasionally), habit of taking tea /coffee (twice without sugar),poor glycemic control, FBS (>200), low HDL, high triglyceride levels, high serum creatinine, duration of T2DM are major risk factors for the development of nephropathy complications.

Marital status

The present study's results revealed that marital status (98.8%, P=0.0211) was significantly associated and was the major risk factor for diabetic nephropathy (OR, 3.903; 95% CI, 1.125-13.54). Therefore, further studies are needed to evaluate the exact impact of marital status on risk for diabetic nephropathy.

Education

Education is one of the risk factors for the development of diabetic nephropathy. Abdulhakeemhamood et al. conducted a study on Prevalence and Risk Factors of Diabetic Nephropathy in Omani Type 2 Diabetics in Al-Dakhiliyah Region and concluded that decreased literacy was significantly related to the presence of diabetic nephropathy (Alrawahi *et al.*, 2012) . The present study's results suggested that educational status was significantly associated with (61%, P<0.0001), and a risk factor for the development of diabetic nephropathy.

Nature of work

The present study's results revealed that housewives (44.4%, p=0.0120) were significantly associated and was the major risk factor for diabetic nephropathy (OR, 0.5492; 95% CI, 0.3432 - 0.8789). Therefore, further studies are needed to evaluate the exact impact of the nature of work on risk for diabetic nephropathy.

Rural residence

The present study's results revealed that rural residents (51.2%, P<0.0001) were significantly associated and was the major risk factor for diabetic nephropathy. Therefore, further studies are needed to evaluate the exact impact of rural residence on risk for diabetic nephropathy.

Co-morbidities

Hypertension (P < 0.0001) was positively associated with diabetic nephropathy. Khalid Al-Rubeaan et al., conducted a study on "Diabetic Nephropathy

Table 5: Medication given for the patients with diabetic nephropathy

S. No	Generic Name of Drugs	N (%)
1	Metformin	72 (47.05)
2	Glimepiride + Metformin	47 (30.71)
3	Insulin Isophane + Regular Insulin	45 (29.41)
4	Teneligliptin	16 (10.45)
5	Insulin Regular	15 (9.80)
6	Glimepiride	10 (6.53)
7	Pioglitazone	10 (6.53)
8	Gliclazide + Metformin	8 (5.22)
9	Insulin Glargine	7 (4.57)
10	Gliclazide	6 (3.92)
11	Sitagliptin + Metformin	4 (2.61)
12	Teneligliptin + Metformin	4 (2.61)
13	Metformin + Voglibose	4 (2.61)
14	Insulin Aspart	4 (2.61)
15	Glipizide + Metformin	3 (1.96)
16	Glibenclamide + Metformin	3 (1.96)
17	Metformin + Vildagliptin	3 (1.96)
18	Lantus Insulin	2 (1.30)
19	Glimepiride + Metformin + Voglibose	2 (1.30)
20	Glimepiride + Metformin + Pioglitazone	2 (1.30)
21	Sitagliptin	2 (1.30)
22	Acarbose	1 (0.65)
23	Linagliptin	1 (0.65)
24	Voglibose	1 (0.65)
25	Dapagliflozin	1 (0.65)
26	Empagliflozin	1 (0.65)

and Its Risk Factors in a Society with a Type 2 Diabetes Epidemic: A Saudi National Diabetes Registry-Based Study" and concluded that the hypertension was the most significant risk factor for diabetic nephropathy in Saudi type 2 diabetic population (Al-Rubeaan *et al.*, 2014) . The present study's results are also supported that hypertension (37.44%, P < 0.0001) was a risk factor for diabetic nephropathy (OR, 4.131; 95% CI, 2.687-6.350).

Physical inactivity

The present study's results revealed that physical inactivity (64.9%, P<0.0001) was significantly associated and was the major risk factor for diabetic nephropathy.Therefore, further studies are needed to evaluate the exact impact of physical inactivity on risk for diabetic nephropathy.

Soft drinks

The present study's results revealed that habit of taking soft drinks occasionally (31.9%, P<0.0001) was significantly associated and was the major risk factor for diabetic nephropathy (OR, 2.253; 95% CI, 1.531-3.315). Therefore, further studies are needed to evaluate the exact impact of the habit of taking soft drinks on risk for diabetic nephropathy.

A habit of taking tea/coffee

The present study's results revealed that the habit of taking tea/coffee twice without sugar (42.3%, P =0.0208) was significantly associated and was the major risk factor for diabetic nephropathy (OR, 1.845; 95% CI, 1.094-3.112). Therefore, further studies are needed to evaluate the exact impact of the habit of taking tea/coffee on risk for diabetic nephropathy.

HbA1c

Poor glycemic control was significantly associated with the development of diabetic nephropathy. (Alrawahi *et al.*, 2012) conducted a study on Prevalence and Risk Factors of Diabetic Nephropathy in Omani Type 2 Diabetics in Al-Dakhiliyah Region and concluded that poor glycemic control was a significant risk factor for the development of nephropathy (Alrawahi *et al.*, 2012). Another

study conducted by Feng *et al.,* (2008) on the prevalence and risk factors of diabetic nephropathy in taiwanese Type 2 diabetes–A hospital-based study and concluded that risk factors associated with diabetic nephropathy included the poor glycemic control. Other relevant studies conducted by (Al-Rubeaan *et al.*, 2014) concluded that poor glycemic control is the most significant risk factor. In the present study, it was significant that poor glycemic control (42%, P<0.0001) was a major risk factor (OR, 2.488; 95% CI, 1.638-3.779).

Fasting blood glucose

The present study's results revealed that FBS levels (29.3%, P=0.0113) was significantly associated and was the major risk factor for diabetic nephropathy (OR, 6.111; 95%CI, 1.283-29.10). Therefore, further studies are needed to evaluate the exact impact of FBS levels on risk for diabetic nephropathy.

HDL

Feng *et al.* (2008) conducted a study on the prevalence and risk factors of diabetic nephropathy in taiwanese Type 2 diabetes–A hospital-based study and concluded that risk factors associated with diabetic nephropathy include HDL- cholesterol. The present study's results are also supported that HDL (23%, P=0.0470) was a significant risk factor for diabetic nephropathy (OR, 0.5961; 95% CI, 0.3572-0.9947).

Triglycerides

Serum triglycerides levels are significantly associated with the development of diabetic nephropathy. Feng *et al.* (2008) conducted a study on the prevalence and risk factors of diabetic nephropathy in taiwanese Type 2 diabetes–A hospital-based study and concluded that triglyceride levels were the most significant risk factor associated with the development of diabetic nephropathy. Another study conducted by (Al-Rubeaan *et al.*, 2014) on "Diabetic Nephropathy and Its Risk Factors in a Society with a Type 2 Diabetes Epidemic: A Saudi National Diabetes Registry-Based Study" and concluded that the most significant risk factors for diabetic nephropathy in Saudi type 2 diabetic population was hyperlipidemia. In the present study, it was also significant that high serum triglyceride levels (39.8%, P=0.0293) were a major risk factor (OR, 0.6077; 95% CI, 0.3878-0.9523) for the development of diabetic nephropathy.

Serum creatinine

Feng *et al.* (2008) conducted a study on the prevalence and risk factors of diabetic nephropathy in taiwanese Type 2 diabetes–A hospital-based study and concluded that serum creatinine levels was a significant risk factor associated with the development of diabetic nephropathy. The present study's results are also supported that serum creatinine levels (28.3%, P<0.0001) were the most significant risk factor for diabetic nephropathy (OR, 154.3; 95% CI, 37.92-627.7).

Duration of T2DM

Alrawahi *et al.* (2012) conducted a study on Prevalence and Risk Factors of Diabetic Nephropathy in Omani Type 2 Diabetics in Al-Dakhiliyah Region and concluded that long-standing diabetes was one of the significant risk factors for diabetic nephropathy. Other relevant studies conducted by Feng *et al.* (2008) also conclude that long-standing diabetes was the most significant risk factor for the development of diabetic nephropathy. The present study's results are also supported that long-standing diabetes (39.8%, P<0.0001) was the significant risk factor (OR, 2.653; 95% CI, 1.778 -3.958).

CONCLUSIONS

Subjects who are married, uneducated, nature of work (housewives), rural residents and risk factors were co-morbidities(HTN, other diseases, endocrine diseases, history of CVDs), no physical activity, soft drinks (taking occasionally), habit of taking tea /coffee (twice without sugar), HbA1C(7-9%), FBS (>200), low HDL, high triglyceride levels, high serum creatinine, duration of T2DM(5-10years & 10 years) were significant risk factors for development of nephropathy. Metformin, a combination of Glimepiride and Metformin, a combination of Insulin Isophane and Insulin Regular, Teneligliptin, Insulin Regular, were the anti-diabetic medications mostly given to the T2DM patients with nephropathy.

Key findings

1. The prevalence of nephropathy was found to be 20.58%.
2. Nephropathy prevalence was higher in females compared to males (P=0.2985).
3. The prevalence of nephropathy was significantly higher in subjects who are married (98.8%, P=0.0211) when compared to unmarried.
4. The prevalence of nephropathy was significantly higher in subjects who are poorly educated (61%, p<0.0001) when compared to educated.
5. The prevalence of nephropathy was significantly higher in subjects who are not doing any work when compared to others.

6. The major comorbidities for the development of nephropathy complications include Hypertension (P<0.0001), other diseases (P<0.0001), endocrine diseases (P=0.009), history of CVDs (P< 0.0001).

7. Locality, physical inactivity, soft drinks, a habit of taking tea /coffee are significantly associated with the development of diabetic nephropathy.

8. Poor glycemic control, blood glucose levels, HDL, Triglycerides, serum creatinine levels are significantly associated with the development of diabetic nephropathy.

9. Duration of T2DM (5-10years 39.8 %, P<0.0001, >10 years 37%, P<0.0001) was significantly associated with the development of diabetic nephropathy.

10. Metformin, a combination of Glimepiride and Metformin, a combination of Insulin Isophane and Insulin Regular, Teneligliptin, Insulin Regular, were the anti-diabetic medications mostly given to the T2DM patients with nephropathy.

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Conflict of interest

The authors declare that they have no conflict of interest.

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