ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACEUTICAL SCIENCES

Published by JK Welfare & Pharmascope Foundation Journal Home Page: www.ijrps.com

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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Article History:

Received on: 14.07.2019
Revised on: 18.10.2019
Accepted on: 23.10.2019

Keywords:

Type 2 diabetes,
Prevalence,
Risk Factors,
Diabetic Nephropathy,
Metformin,
Insulin

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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ISSN: 0975-7538

DOI: https://doi.org/10.26452/ijrps.v11i1.1791

Production and Hosted by

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

Continued on next page

Table 1 continued

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

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			
Male	155 (43.2)	99 (39)	Ref
Female	204 (56.8)	155 (61)	0.2985
Age			
0-20 years	1 (0.3)	——	Ref
21-40 years	83 (23.2)	20 (7.9)	0.6239
41-60 years	217 (60.6)	152 (59.8)	0.4031
Above 60 years	57 (15.9)	82 (32.3)	0.2328
Marital Status			
Unmarried	16 (4.5)	3 (1.2)	Ref
Married	343 (95.5)	251 (98.8)	0.0211*
Education			
Uneducated	131 (36.5)	155 (61)	Ref
Educated	228 (63.5)	99 (39)	<0.0001***
BMI (Kg/m^2)			
<25 Kg/m^2	114 (31.8)	62 (24.5)	Ref
>/=25 Kg/m^2	245 (68.2)	191 (75.5)	0.0511
Body Weight (Kg)			
<50	5 (1.3)	5 (2)	Ref
50-70	161 (45)	112 (44.3)	0.5714
>70	192 (53.7)	136 (53.7)	0.5897
Nature of Work			
Not working any where	41 (11.4)	57 (22.5)	Ref
Private job	93 (25.9)	45 (17.7)	<0.0001***
Govt. job	39 (10.8)	14 (5.5)	0.0002***
Daily labour	38 (10.6)	25 (9.8)	0.0221*
House wife	148 (41.2)	113 (44.4)	0.0120*
Locality			
Rural	105 (29.2)	130 (51.2)	Ref
Urban	254 (70.8)	124 (48.8)	<0.0001***
Monthly Income			

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Table 2 continued

No income	170 (47.5)	148 (58.3)	Ref
Below 25000	115 (32.1)	87 (34.2)	0.4382
Above 25000	73 (20.4)	19 (7.4)	<0.0001***
Co-morbidities			
No	131 (29.4)	37 (8.6)	Ref
HTN	138 (30.8)	161 (37.44)	<0.0001***
History of CVDs	7 (1.56)	34 (7.90)	<0.0001***
Endocrine diseases	59 (13.2)	41 (9.53)	0.0009***
Other diseases	112 (25.1)	157 (36.51)	<0.0001***
Systolic Blood Pressure			
<140 mmHg	259 (72.1)	160 (63)	Ref
>/=140 mmHg	100 (27.9)	94 (37)	0.0164*
Diastolic Blood Pressure			
<90 mmHg	281 (78.3)	203 (79.9)	Ref
>/=90 mmHg	78 (21.7)	51 (20)	0.6219
HbA1C			
<7	141 (44.2)	52 (21.8)	Ref
7-9	109 (34.2)	100 (42)	<0.0001***
>9	69 (21.6)	86 (36.1)	<0.0001***
Fasting Blood Glucose (mg/dL)			
70-80	10 (3)	2 (0.9)	Ref
80-120	92 (27.6)	54 (24)	0.1572
121-160	107 (32)	62 (27.6)	0.1610
161-200	71 (21.3)	41 (18.2)	0.1678
>200	54 (16.2)	66 (29.3)	0.0113*
Post prandial blood glucose levels (mg/dL)			
90-110	3 (1)	1 (0.5)	0.6885
111-130	9 (3)	5 (2.3)	0.9423
131-150	33 (10.9)	12 (5.6)	0.6143
151-200	165 (54.6)	98 (45.4)	0.2834
>200	92 (30.5)	100 (46.3)	Ref
Random Blood Glucose (mg/dL)			
80-100	0	4 (5.2)	0.3259
101-120	0	5 (6.5)	0.2729
121-140	0	2 (2.6)	0.4857
141-160	2 (13.3)	8 (10.4)	0.9807
161-200	1 (6.7)	9 (11.7)	0.4635
>200	12 (80)	49 (63.6)	Ref

Continued on next page

Table 2 continued

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

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

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		
Male	1	Ref
Female	1.190 (0.8574 to 1.651)	0.2985
Age		
0-20 years	1	Ref
21-40 years	0.7365 (0.02891 to 18.76)	0.6239
41-60 years	2.103 (0.08505 to 52.02)	0.4031
Above 60 years	4.304 (0.1721 to 107.6)	0.2328
Marital Status		
Unmarried	1	Ref
Married	3.903 (1.125 to 13.54)	0.0211*
Education		
Uneducated	1	Ref
Educated	0.3670 (0.2635 to 0.5112)	<0.0001***
BMI (Kg/m^2)		
<25 Kg/m^2	1	Ref
>/=25 Kg/m^2	1.433 (0.9974 to 2.060)	0.0511
Body Weight (Kg)		
<50	1	Ref
50-70	0.6957 (0.1967 to 2.460)	0.5714
>70	0.7083 (0.2011 to 2.495)	0.5897
Nature of Work		
Not working any where	1	Ref
Private job	0.3480 (0.2035 to 0.5952)	<0.0001***
Govt. job	0.2582 (0.1243 to 0.5363)	0.0002***
Daily labour	0.4732 (0.2483 to 0.9020)	0.0221*
House wife	0.5492 (0.3432 to 0.8789)	0.0120*
Locality		
Rural	1	Ref
Urban	0.3943 (0.2820 to 0.5513)	<0.0001***
Monthly Income		
No income	1	Ref
Below 25000	0.8690 (0.6092 to 1.240)	0.4382
Above 25000	0.2990 (0.1723 to 0.5187)	<0.0001***
Co-morbidities		
No	1	Ref
HTN	4.131 (2.687 to 6.350)	<0.0001***
History of CVDs	17.20 (7.049 to 41.95)	<0.0001***
Endocrine diseases	2.460 (1.433 to 4.224)	0.0009***
Other diseases	4.963 (3.202 to 7.692)	<0.0001***
Systolic Blood Pressure		
<140 mmHg	1	Ref
>140 mmHg	1.522 (1.079 to 2.146)	0.0164*
Diastolic Blood Pressure		
<90mmHg	1	Ref
>90mmHg	0.9051 (0.6088 to 1.346)	0.6219
HbA1C		
<7	1	Ref
7-9	2.488 (1.638 to 3.779)	<0.0001***
>9	3.380 (2.157 to 5.295)	<0.0001***

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Table 4 continued

Fasting Blood Glucose (mg/dL)		
70-80	1	Ref
81-120	2.935 (0.6196 to 13.90)	0.1572
121-160	2.897 (0.6146 to 13.66)	0.1610
161-200	2.887 (0.6028 to 13.83)	0.1678
>200	6.111 (1.283 to 29.10)	0.0113*
Post prandial blood glucose levels (mg/dL)		
90-110	1	Ref
111-130	1.667 (0.1349 to 20.59)	0.6885
131-150	1.091 (0.1032 to 11.53)	0.9423
151-200	1.782 (0.1827 to 17.38)	0.6143
>200	3.261 (0.3331 to 31.92)	0.2834
Random Blood Glucose (mg/dL)		
80-100	2.273 (0.1146 to 45.09)	0.3259
101-120	2.778 (0.1437 to 53.69)	0.2729
121-140	1.263 (0.05689 to 28.02)	0.4857
141-160	0.9796 (0.1837 to 5.222)	0.9807
161-200	2.204 (0.2540 to 19.13)	0.4635
>200	1	Ref
HDL (mg/dL)		
Not available	1	Ref
Normal	0.3610 (0.2310 to 0.5640)	<0.0001***
Low	0.5961 (0.3572 to 0.9947)	0.0470*
High	0.3000 (0.1459 to 0.6168)	0.0008***
Triglycerides (mg/dL)		
Not available	1	Ref
Normal	0.2681 (0.1651 to 0.4354)	<0.0001***
Low	0.1588 (0.03249 to0.7765)	0.0108*
High	0.6077 (0.3878 to 0.9523)	0.0293*
Total Cholesterol (mg/dL)		
Not available	1	Ref
Normal	0.3402 (0.2193 to 0.5277)	<0.0001***
Low	0.1098 (0.01285 to0.9377)	0.0161*
High	0.6281 (0.3852 to 1.024)	0.0617
LDL (mg/dL)		
Not available	1	Ref
Normal	0.3028 (0.1954 to 0.4693)	<0.0001***
Low	0.3089 (0.09070 to 1.052)	0.0496*
High	0.9886 (0.5939 to 1.646)	0.9649
Urea (mg/dL)		
Not available	1	Ref
Normal	0.1692 (0.09703 to 0.2951)	<0.0001***
Low	0.7625 (0.4728 to 1.230)	0.2656
High		
Serum creatinine (mg/dL)		
Not available	1	Ref
Normal	3.689 (1.628 to 8.358)	0.0009***
Low	0.5515 (0.02754 to 11.05)	0.3811
High	154.3 (37.92 to 627.7)	<0.0001***
Duration of T2DM (Years)		

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Table 4 continued

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

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 and Table 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

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)

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

thy 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 edu-

cated (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.

ACKNOWLEDGEMENT

This study was supported by the Siddhartha Academy of General and Technical Education (SAGTE). The authors are grateful to the physicians of Dr. Pinnamaneni Siddhartha Institute of Medical Sciences and Research Foundation, Vijayawada, Andhra Pradesh, for providing the necessary information. The authors thank Dr. Jaidev Sudagani, consultant endocrinologist and diabetologist, Santhi Endocrine, and Diabetes hospital for providing the necessary facilities.

Source of funding

The authors did not receive funds from any other funding sources/agencies for this work.

Conflict of interest

The authors declare that they have no conflict of interest.

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