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Original Article

Prevalence of Diabetic Nephropathy and associated risk factors among type 2 diabetes mellitus patients in Ramallah, Palestine

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ABSTRACT

Aims: Albuminuria is an established marker for endothelial dysfunction and cardiovascular risk in diabetes and prediabetes. So we aimed to explore the prevalence of albuminuria (microalbuminuria and macroalbuminuria) in patients with type2 diabetes mellitus (DM) in the Palestinian community and to determine the association between albuminuria and other health care and biochemical indicators.
Materials and methods: A cross-sectional study was carried out at private health care center. A total of 550 diabetic patients aged 35 years and above with type 2 diabetes mellitus who attended the clinic from May 2017 through February 2018 were included. Socio-demographic, clinical, and laboratory data were obtained from the medical records of patients. Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS, version 23).
Results: Out of the 550 patients recruited, the mean age and duration of diabetes were 57.8 years and 9.5 years, respectively. Approximately 62% were being managed by oral hypoglycemic agents alone, 4.3% by insulin alone, 31.7% were on a combination of oral hypoglycemic agents and insulin and slightly less than 2% were on dietary measures alone. The mean value for HbA1c was 7.71%. The overall prevalence of albuminuria among participants was found to be 34.6%; microalbuminuria (29.3%) and macroalbuminuria (5.3%).
Conclusion: Albuminuria is highly prevalent among Palestinian population with type 2 diabetes. This calls for early and universal screening of urinary albumin. There is also an urgent need for measures that target tight glycemic and optimal blood pressure control and the use of renin-angiotensin system blockade.

1. Introduction

Diabetes mellitus (DM) is a common endocrine disease especially in the Middle East which is known to be one of the highest regions in terms of diabetes mellitus indices. Diabetes cases are expected to rise from 39 million to 67 million in the Middle East and North Africa (MENA) Region by year 2045 with a total expenditure on diabetes that will reach 37.1 billion USD [1,2]. In Palestine there were over 168.800 diabetes cases in 2017 with a diabetes prevalence of 7% in adults and 6.42% in patients aged 18 years and above [2,3].

Type 2 diabetes is known to be a major risk factor for cardiovascular events and it represents the majority of cases with diabetes and these cases are expected to increase in the world to 366 million by year 2030 [4,5]. Type 2 DM symptoms are less marked compared to type 1 and this can lead to late diagnosis several years after onset in which the complications would have already arisen [6]. Diabetes and its complications are ranked as the 6th cause of death and account for around 5.7% of deaths in Palestine [7,8].

One of the complications of diabetes is Diabetic Nephropathy (DN) which is one of the leading causes of renal failure proven to be the major cause of mortality in type 2 diabetic patients [9]. Diabetic nephropathy (DN) is characterized by two biomarkers which are urinary albumin excretion (UAE) and estimated glomerular filtration rate and its progression occurs through several stages starting with Microalbuminuria (MA) then Macroalbuminuria (also called Proteinuria or Albuminuria), renal insufficiency and eventually end-stage renal disease [10].

Microalbuminuria is when the UAE is between 20 and 200 mg/min and/or 30–300 mg/24 h and any excretion rate below this range is considered as normoalbuminuria. It is viewed as the first early clinical sign of diabetes nephropathy and an independent

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marker for cardiovascular diseases as well [11].

Macroalbuminuria is when the urinary albumin excretion is above 300 mg in a 24 h collection and it is the predominant renal risk marker for nephropathy that continues to be the gold standard for diagnosis and staging of DN [12].

According to the American Diabetes Association statistics 20 to 40% of patients with type II diabetes develop nephropathy and according to previous studies it was also observed that MA usually precedes Macroalbuminuria by an interval of five to ten years and a reduction in albuminuria is positively proportional to renal protection [13,14]. Therefore, early detection of MA in type 2 DM is very important as it can reverse or reduce the progression of nephropathy and studies highlighting these complications are required and can play an important role in preventing further complications.

1.1. Subjects, materials and methods

A cross-sectional study was conducted in health care center in Ramallah district, Palestine. It comprised a systematic sample of 550 type 2 diabetic patients from September 2017 through February 2018. The study was approved by the health and ethics committee of the health center, and all the participants gave their informed consent. Relevant sociodemographic, clinical and laboratory data were obtained from the medical records of the patients.

Anthropometric measurements were taken, including weight and height to estimate body mass index (BMI) [Kg/m2]. 'Overweight' is classified as having a BMI of 25.0–29.9, and obesity as having a BMI of ≥30 as defined by the WHO [15]. Blood pressure was measured using standardized Sphygmomanometers. Fasting blood glucose, serum cholesterol, serum triglyceride, high-density lipoprotein (HDL) and low-density lipoprotein (LDL) were assayed by enzymatic methods. Glycosylated hemoglobin (HbA1c) was analyzed by using a high performance liquid chromatography (HPLC) method (Bio- Rad); HbA1c was considered normal if <7% [16].

Fresh random morning spot urine was examined by the strip test (Combur 9 Test) for leucocytes, nitrites and blood. Patients with positive nitrites, indicative of significant bacteriuria, and patients with erythrocytes and/or leucocytes equal to or above 5 cell counts per microliter, indicative of hematuria or/and pyuria, were excluded from the analyses. Microalbuminuria can be diagnosed when the urinary albumin to creatinine ratio is 30–299 mg/g in at least two of three urine collections in a three-month period.

Whereas to designate a patient as having macroalbuminuria the same ratio is ≥ 300 mg/g 9.

Diabetic retinopathy was detected by direct ophthalmoscopy. The International Clinical DR severity scale, adopted by the American Academy of Ophthalmology (AAO) and the International Council of Ophthalmology (ICO), was used to classify patients into non-proliferative DR (NPDR), and proliferative diabetic retinopathy (PDR) [17,18].

1.2. Statistical analysis

Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS, version 11.5). Chi-square tests and multivariate logistic regression was used to assess the correlation between micro and macroalbuminuria and their risk factors. Separate regression models were used for microalbuminuria and macroalbuminuria

2. Results

2.1. Sociodemographic and anthropometric characteristics

Of the 600 patients recruited 34(0.6%) were excluded due to the presence of urinary tract infections and 16 (0.7%) for the presence of congestive heart failure, leaving 550 for evaluation patients. There were 301 (54.7%) men and 249(46.3%) women. The mean age of the total study population was 58.7 ± 8.3 years and the mean duration of diabetes was 8.9 ± 6.8 years. Of the total sample 15.6% were current smokers while 26.9% were past smokers and 89.5% were obese or over weight. Majority of the patients had their systolic and diastolic blood pressure below the 130/80 mmHg target (Table 1).

2.2. Clinical and biochemical characteristics of the study population

As shown in (Table 2), the majority of the sample population (68.9%) had hypertension. Dyslipidemia was present in 92.5% of the study patients. Hypertriglyceridemia, hypercholesterolemia, high LDL cholesterol,low HDL cholesterol levels among male and low HDL cholesterol levels among female were reported to be 38.9%, 14.5%, 31.6%, 56.5%, 60.7% among these patients, respectively. About 65.8 had HbA1c >7%. Only one third of patients had retinopathy.

2.3. The prevalence of diabetic microalbuminuria and macroalbuminuria according to sociodemographic and anthropometric characteristics

Overall, 38.5% of patients with diabetes had albuminuria (32.7% had microalbuminuria and 5.8% had macroalbuminuria). No significant differences in gender and smoking were noted among patients with micro- and macroalbuminuria. The microalbuminuria patients were older compared with normoalbuminuric group ($p = 0.001$). There was an increase in frequency of microalbuminuria and macroalbuminuria in patients who had diabetes of more than 11 years duration. Mean SBP were significantly higher with micro- and macroalbuminuria compared with normoalbuminuria ($p < 0.0005$). However diastolic blood pressure was higher only in the microalbuminuric patients ($p < 0.0005$). Patients with microalbuminuria were predominantly obese and over weight ($p = 0.02$) (Table 3).

Table 1
Sociodemographic and anthropometric characteristics of 550 patients with Diabetes Mellitus attending the diabetes clinic.

(%)	Variable	n
Gender		
Males	301	(54.7)
Females	249	(46.3)
Age (year)	Mean(SD) = 58.7 (8.3)	
<45	54	(9.8)
45–55	164	(29.8)
56–65	228	(41.5)
>65	104	(18.9)
Duration of D.M(year)	Mean(SD) = 8.9 (6.8)	
≤5	183	(33.3)
6–10	195	(35.4)
≥11	172	(31.3)
Smoking		
Non	316	(57.5)
Current	86	(15.6)
Past	148	(26.9)
Body Mass Index(Kg/m^2)	Mean(SD) = 30.9 (6.1)	
<25	58	(10.5)
25–29.9	144	(26.2)
≥30	348	(63.3)
Systolic Blood Pressure(mmHg)	Mean(SD) = 126 (10.1)	
<130	341	(62.0)
≥130	209	(38.0)
Diastolic Blood Pressure(mmHg)	Mean(SD) = 77.2 (6.2)	
<80	392	(71.3)
≥80	158	(28.7)

Table 2
Clinical and biochemical characteristics of the participants.

%	Variable	n
Hypertension		
Yes	379	(68.9)
No	171	(31.1)
Dyslipidemia		
Yes	509	(92.5)
No	41	(7.5)
Diabetes retinopathy(DR)		
Yes	164	(29.8)
No	386	(65.8)
Glycated hemoglobin	Mean(SD) = 8.106 (2.3)	
<7.0%	188	(34.2)
≥7.0%	362	(65.8)
Cholesterol(mg/dl)	Mean(SD) = 173.1 (24.6)	
<200	470	(85.4)
≥200	80	(14.5)
Low density lipoprotein	Mean(SD) = 99.6 (21.3)	
<100	376	(68.4)
≥100	174	(31.6)
High density lipoprotein male	Mean(SD) = 41.2 (9.6)	
<40	170	(56.5)
≥40	131	(43.5)
High density lipoprotein female	Mean(SD) = 49.1 (11.2)	
<50	151	(60.7)
≥50	98	(39.3)
Triglyceride(mg/dl)	Mean(SD) = 151.3 (32.6)	
<150	336	(61.1)
≥150	214	(38.9)

2.4. The prevalence of diabetic microalbuminuria and macroalbuminuria according to clinical and biochemical characteristics

The presence of hypertension, hypertriglyceridaemia and hypercholesterolemia were significantly higher with both micro- and macroalbuminuric groups. HbA1c levels were significantly higher in all groups with abnormal albumin. The prevalence of diabetic retinopathy was significantly higher in micro- and macroalbuminuric patients compared with those with normoalbuminuria ($p < 0.0005$) see (Table 4).

2.5. Multivariate analysis of factors associated with diabetic microalbuminuria after adjusting for other factors

In the bivariate analysis, microalbuminuria significantly associated with age, BMI, duration of diabetes, diabetes retinopathy, HbA1c, hypercholesterolemia, hypertriglyceridemia, SBP, and DBP. After stepwise logistic regression analysis use, the only variables remained associated significantly with Microalbuminuria were mean HbA1c, mean SBP and the presence of retinopathy. For each 1% increase in HbA1c, the odds of having microalbuminuria increased by 79%. Patients with mean SBP ≥130 mmHg were found to be 1.92 times more likely to have microalbuminuria than those with SBP <130 mmHg.Patients with mean DBP ≥80 mmHg were found to be 1.61 times more likely to have microalbuminuria than those with DBP <80 mmHg. The odds of having microalbuminuria for those who had diabetic retinopathy are 1.76 times more than those who did not have diabetic retinopathy (Table 5).

2.6. Multivariate analysis of factors associated with diabetic macroalbuminuria after adjusting for other factors

In the bivariate analysis (Table 6), macroalbuminuria significantly associated with duration of diabetes, diabetes retinopathy, HbA1c, hypercholesterolemia, SBP and DBP. After using stepwise logistic regression analysis, the only variables remained significantly associated with macroalbuminuria were mean SBP, male sex and the presence of diabetic retinopathy. Patients with mean SBP

Table 3
Prevalence of diabetic microalbuminuria and macroalbuminuria among diabetics according to sociodemographic and anthropometric characteristics.

Variable	Normoalbuminuria n% = 338(61.5)	Microalbuminuria n% = 180(32.7)	Macroalbuminurin% = 32(5.8)
Gender			
Men	186 (61.8)	95(35.6)	20 (6.6)
Women	152 (61.0)	85 (34.1)	12 (4.8)
P-value	–	0.689	0.058
Age (years)			
<45	35 (64.8)	16 (29.6)	3 (5.5)
45-55	111(67.7)	48 (29.3)	5 (3.0)
56-65	154(67.5)	64 (28.1)	10 (4.4)
>65	38 (36.5)	52 (75.0)	14 (13.5)
P-value	–	**0.001**	0.321
Body mass index			
<25	41 (70.7)	15 (25.9)	2 (3.4)
25–29.9	85 (59.0)	51 (35.4)	8(5.6)
≥30	212 (60.1)	114 (32.8)	22 (6.3)
P-value	–	**0.013**	0.352
Duration of DM (years)			
≤5	126 (68.9)	50 (27.3)	7 (3.8)
6-10	111 (57.5)	69 (35.8)	13 (6.7)
≥11	101 (58.0)	61 (35.5)	12 (6.9)
P-value	–	**0.002**	**0.005**
Smoking			
Non	201 (63.6)	97 (30.7)	18 (5.7)
Current	52 (60.5)	30 (34.9)	4 (4.7)
Past	85 (57.4)	53 (35.8)	10 (6.8)
P-value	–	0.137	0.316
SBP(mmHg)			
<130	239 (70.1)	92 (26.9)	10 (2.9)
≥130	99 (47.4)	88 (42.1)	22 (10.5)
P-value	–	< **0.0004**	< **0.0005**
DBP(mmHg)			
<80	268 (68.4)	106 (27.0)	18 (4.6)
≥80	70 (44.3)	74 (46.8)	14 (8.9)
P-value	–	< **0.0004**	**0.003**

Table 4
Prevalence of diabetic microalbuminuria and macroalbuminuria among diabetics according to clinical and biochemical characteristics.

Variable	Normoalbuminuria n (%) = 338(61.5)	Microalbuminuria n (%) = 180(32.7)	Macroalbuminuria n (%) = 32(5.8)
Hypertension			
Yes	216 (56.9)	137 (36.1)	26 (6.9)
No	122 (71.4)	43 (25.2)	6 (3.5)
P-value	–	< **0.0005**	**0.020**
Dyslipidemia			
Yes	232 (63.5)	156 (30.6)	30 (5.9)
No	15 (36.0)	24 (58.5)	2 (4.9)
P-value	–	0.602	0.246
Diabetes retinopathy (DR)			
Yes	78 (47.5)	68(41.5)	18 (11.0)
No	260 (67.4)	112(29.0)	14 (3.6)
P-value		< **0.0005**	< **0.0005**
Glycated hemoglobin (HbA1c %)			
<7%	133 (70.0)	49 (26.1)	6 (3.2)
≥7%	205 (56.7)	131 (36.2)	26 (7.2)
P-value	–	< **0.0004**	**0.005**
Cholesterol (mg/dl)			
<200	305 (64.9)	141(30.0)	24 (5.5)
≥200	33 (41.2)	39 (48.8)	8 (10.0)
P-value	–	**0.017**	**0.016**
Low density lipoprotein (LDL)			
<100	238 (63.3)	116 (30.9)	22 (5.9)
≥100	100 (57.5)	64 (36.8)	10 (5.7)
P-value	–	0.136	0.682
High density lipoprotein (HDL) male			
<40	95 (55.9)	66 (38.8)	9 (5.3)
≥40	89 (67.9)	34 (29.9)	8 6.1)
P-value	–	0.072	0.149
High density lipoprotein (HDL) female			
<50	95 (62.9)	48 (31.8)	8 (5.3)
≥50	59 (60.2)	32(32.7)	7 (7.1)
P-value	–	0.762	0.121
Triglyceride (mg/dl)			
<150	218 (64.9)	105 (31.3)	13 (3.9)
≥150	120(56.1)	75 (35.0)	19 (8.9)
P-value	–	**0.004**	**0.005**

≥130 mmHg were found to be 2.61 times more likely to have macroalbuminuria than those with SBP <130 mmHg. Males were found to be 2.44 times more likely to have macroalbuminuria than females. Patients with diabetic retinopathy were found to be 5.31 times more likely to have macroalbuminuria than those without diabetic retinopathy.

3. Discussion

This study measures the prevalence of the different stages of albuminuria in type 2 diabetes among patients attending private clinic, patients are from different urban areas of Ramallah district. Numerous studies carried out to determine the prevalence of albuminuria in patients with type 2 diabetes. These studies yielded different rates between (17%–58.6) for albuminuria [19,20]. This study showed the prevalence rate of 38.5% that lies within the range. The high degree of variation in the rate can be attributed to sample selection, study design, urine collection method,-age,sex,race and population structure [21]. The prevalence of microalbuminuria and macroalbuminuria in the present study was 32.7% and 5.8% respectively. The prevalence of microalbuminuria in this study is consistent with the Iranian study [22]. Which showed close prevalence (27.5%), but considerably higher prevalence of macroalbuminuria 32.7% vs. 5.8% in this study.

In Finland a study conducted by Wirta et al. in a recent onset diabetic patients, showed almost the similar prevalence as in this study;microalbuminuria and macroalbuminuria prevalence value of (29%,4%) vs. (32.7%,5.8%) among the present patients [23]. However a study carried out in United Kingdom on type 2 diabetes patients showed a lower prevalence of albuminuria (19%) [24,25].

Concerning Arab countries, studies in the Kingdom of Saudi Arabia [51] and United Arab Emirates [26], showed a relatively higher rate of microalbuminuria (41.3%, 61%) respectively than that observed in the present results. On the other hand, a study in Sultanate of Oman [20], and Jordan showed nearly similar rate (27%,

Table 5
Logistic regression analysis of factors associated with microalbuminuria.

Variables	OR (95% confidence interval)	P-value
Mean HbA1c (Uncontrolled vs. control)	2.01(1.21, 2.32)	**0.001**
Mean SBP (Uncontrolled vs. control)	1.92(1.43, 2.93)	**0.002**
Mean DBP (Uncontrolled vs. control)	1.61(1.04, 2.08)	**0.031**
Diabetes retinopathy (Yes vs. no)	1.76(1.08, 2.12)	**0.008**

OR: Odds ratio, HbA1c: Glycated hemoglobin, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure.

Table 6
Logistic regression analysis of factors associated with macroalbuminuria.

Variables	Odd ratio (95% confidence interval)	P-value
Mean Systolic blood pressure (Uncontrolled vs. control)	2.61(1.21, 3.92)	**0.004**
Gender (Male vs. female)	2.44(1.10, 4.13)	**0.016**
Diabetes retinopathy (Yes vs. no)	5.31(2.16, 7.31)	**0.002**

29%) respectively [20].

Several studies clearly demonstrated the benefits of improving glycaemic control and decreasing HbA1c concentration in decreasing the complication rate [25,27]. In the present study,-HbA1c showed a high significance with microalbuminuria and macroalbuminura. This finding is consistent with the results obtained by others [25,28], but results must be considered with caution because of the cross-sectional design of the study.

The systolic blood pressure showed a significant association with both microalbuminuria and macroalbuminuria as it has been identified as strong risk factor in many studies [16,21,29].

This study revealed no significance in association of duration of diabetes,smoking, body mass index and age with microalbuminuria or macroalbuminuria to be as major risk factors.

Many previous studies have reported both significant and non-significant correlation between albuminuria excretion and diabetes duration smoking, body mass index and age [25,30–32]. Vijay et al. have reported duration of diabetes, systolic and diastolic BP age and serum creatinine levels to be associated with proteinuria while HbA1C was reported to be the risk factor by Gupta et al. [33,34]. In a study by John et al., male sex, age, longer duration of diabetes, poor glycemic control and raised blood pressure was associated with microalbuminuria [25]. Yet in another study by Verghese et al. age, duration of diabetes, diastolic blood pressure, HbA1C, and fasting plasma glucose were reported to be the risk factors [30].

When the gender was tested micro-and macroalbuminuria did not show any statistical difference, whereas male gender showed significant correlation of with macroalbuminuria in the final regression model. That is in agreement with the other findings that revealed the male to be positively associated with microalbuminuria with diabetic males compared with diabetic females [25,35]. While, other study has found that female sex was positively associated with microalbuminuria [25].

The logistic regression analysis did not show significant association between the Body Mass Index and the prevalence of microalbuminuria. These results are in agreement with previously published data [21,28,36].

According to serum lipid, the present study showed no association between serum lipid —including all its types- and either microalbuminuria, or macroalbuminuria and it is consistent with a number of other studies [26,33].

The present study revealed that patients with microalbuminuria and macroalbuminuria were statistically significant with the presence of retinopathy. This finding were supported by other studies [26]. Besides, the present results revealed that the prevalence of diabetic retinopathy in microalbuminuria patients was higher than that in macroalbuminuria patients (41.5% vs.11.0%), so that even patients who have microalbuminuria were at high risk of developing retinopathy [37]. It was surprisingly, however, that in the 35 patients with macroalbuminuria,18(51%) of them had DR, In different study, analysis of type 2 diabetes with proteinuria found that approximately 30% did not have diabetes nephropathy on renal biopsy among those without retinopathy [17]. Type 2 diabetics with marked proteinuria and retinopathy are most likely to have DNP, whereas those without retinopathy may be caused by disease other than diabetic glomerulopathy (hypertension, atherosclerosis, chronic glomerulonephritis, chronic pylonephritis) [22,38].

4. Conclusion

This is a cross sectional study to estimate the prevalence of albuminuria in patients attending a private health care center with referrals from all over Jordan. The present study showed:

- The high prevalence of albuminuria (macroalbuminuria and macroalbuminuria) observed in Palestinian patients diagnosed with type 2.
- Microalbuminuria is significantly associated with HbA1c, SBP, and presence of retinopathy and male sex.
- Macroalbuminuria is significantly associated with SBP, presence of diabetic retinopathy, and male sex.

The high prevalence of micro and macroalbuminuria obtained in the study supports the need to promote and implement the utilization of albuminuria screening at the national level.

Conflicts of interest statement

Authors declare no conflict of interest.

References

[1] United Nations. World population prospects, the 2015 revision. New york: united nations.
[2] International Diabetes Federation. https://www.idf.org/our-network/regions-members/middle-east-and-north-africa/members/44-palestine.html.
[3] International Diabetes Federation Diabetes Atlas. Country summary table age18 to 99 years. 2017. http://diabetesatlas.org/resources/2017-atlas.html.
[4] World Health Organization. Diabetes program. 2004. http://www.who.int/diabetes/en.
[5] Sheikh SA, Baig JA, Iqbal T, Kazmi T, Baig M, Husain SS. Prevalence of microalbuminuria with relation to glycemic control in type-2 diabetic patients in Karachi. J Ayub Med Coll Abbottabad 2009;21(3):83–6.
[6] WHO key facts. Diabetes. 2018. https://www.who.int/news-room/fact-sheets/detail/diabetes.
[7] El sharif N, Samara I, Titi I, Awartani A. Compliance with and knowledge about diabetes guidelines among physicians and nurses in Palestine. EMHJ 2015;21:791–802.
[8] Palestinian Health Information Center. Health status in Palestine. Ramallah: Palestinian Ministry of Health. http://www.moh.ps.
[9] Kassab A, Ajmi T, Issaoui M, Chaeib L, Miled A, Hammami M. Homocysteine enhances LDL fatty acid peroxidation, promoting microalbuminuria in type 2 diabetes. Ann Clin Biochem 2008;45:476–80.
[10] Ayodele OE, Alebiosu CO, Salako BL. Diabetic nephropathy – a review of the natural history, burden, risk factors and treatment. J Natl Med Assoc 2004;96:1445–54.
[11] Bouhanick B, Berrut G, Chameau AM, Hallar M, Bled F, Chevet B, et al. Predictive value of testing random urine sample to detect microalbuminuria in diabetic patients on outpatient basis. Diabete Metab 1992;18:54–8.
[12] Cohen-Bucay A, Viswanathan G. Urinary markers of glomerular injury in diabetic nephropathy. Internet J Nephrol 2012;2012:146987.
[13] American Diabetes Association. Standards of medical care in diabetes. Diabetes Care 2012;35:11–63.
[14] Jerums G, MacIsaac RJ. Treatment of microalbuminuria in patients with type 2 diabetes mellitus. Treat Endocrinol 2002;1(3):163–73.
[15] Gerstein HC, Mann JF, Yi Q, Zinman B, Dinneen SF, Hoogwerf B, et al. Albuminuria and risk of cardiovascular events, death, and heart failure in diabetic and nondiabetic individuals. J Am Med Assoc 2001;286:421–6.
[16] Lu B, Wena J, Song XY, Dong XH, Yang YH, Zhang ZY, et al. High prevalence of albuminuria in population-based patients diagnosed with type 2 diabetes in the Shanghai downtown. Diabetes Res Clin Pract 2007;75:184–92.
[17] Christensen PK, Larsen S, Horn T, Oslen S, Parving HH. Causes of albuminuria in patients with type 2 diabetes without diabetic retinopathy. Kidney Int 2000;58:1719–31.
[18] Hovind P, Rossing P, Tornow L, Smidt U, Parving H. Progression of diabetic nephropathy. Kidney Int 2001;59:702–9.
[19] Unnikrishnan R, Rema M, Pradeepa R, Deepa M, Shanthirani CS, Deepa R, et al. Prevalence and risk factors of diabetic nephropathy in an urban south Indian population: the Chennai urban rural epidemiology study (CURES 45). Diabetes Care 2007;30:2019–24.
[20] Al-Futaisi A, Al-Zakwani I, Almahrezi A, Al-Hajri R, Al-Hashmi L, Al-Muniri A. Prevalence and predictors of microalbuminuria in patients with type 2 diabetes mellitus: a cross-sectional observational study in Oman. Diabetes Res Clin Pract 2006;72:212–5.
[21] Lutale JJ, Thordarson H, Abbas ZG, Vetvik K. Microalbuminuria among type 1 and type 2 diabetic patients of african origin in dar Es salaam, Tanzania. BMC Nephrol 2007;8:1–8.
[22] Malek MA, Reyhaneh S, Mohammad KL. Risk factors of microalbuminuria and macroalbuminuria in type 2 diabetic patients in north of Iran – rasht. Nephro-Urol Mon 2017;9(1):40031.
[23] Wirta OR, Pasternak AI, Oksa HH, Mustonen JT, Koivula TA, Helin HJ, et al. Occurrence of late specific complications in type II (Non-Insulin-Dependent) diabetes mellitus. J Diabetes Complicat 1995;9:177–85.

[24] Neil A, Hawkins M, Potok M, Thorogood M, Cohen D, Mann J. A prospective population based study of Microalbuminuria as a predictor of mortality in NIDDM. Diabetes Care 1993;16:996–1003.
[25] Mane M, Chandra V. Prevalence and risk factors of microalbuminuria in type 2 diabetes mellitus. Int J Adv Med 2015;2(4):383–6.
[26] Al-Maskari F, El-Sadig M, Obineche E. Prevalence and determinants of microalbuminuria among diabetic patients in the United Arab Emirates. BMC Nephrol 2008;9:1–25.
[27] United Kingdom Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet 1998;352:837–53.
[28] De Pablos PL, Martinez J, Martinez MP, Doreste JA. Prevalence of macro-and macroalbuminuria in a Canarian population of type 2 diabetic patients. Relationship with blood pressure, lipid profile, obesity and metabolic control. Diabetes Metab 1998;24:337–43.
[29] Ufuoma C, Ngozi JC, Kester AD, Godwin YD. Prevalence and risk factors of microalbuminuria among type 2 diabetes mellitus: a hospital based study from, Warri, Nigeria. Sahel Med J 2016;19:16–20.
[30] Gall M, Honngaard P, Borch-Johnsenk, Parving HH. Risk factors for development of incipient and overt diabetic nephropathy in patients with non-insulin dependent diabetes mellitus: prospective, observational study. BMJ 1997;314:783.
[31] Adler AI, Stevens RJ, Manley SE, Bilous RW, Cull CA, Holman RR. Development and progression of nephropathy in type 2 diabetes: the United Kingdom Prospective Diabetes Study (UKPDS 64). Kidney Int 2003;63:225–32.
[32] Ali D, Abduelkarem AR, Shahwan M. Evaluation of factors associated with inadequate glycemic control and some other health care indicators among patients with type 2 diabetes in Ramallah, Palestine. Res J Pharmaceut Biol Chem Sci 2013;4:445–51.
[33] Varghese A, Deepa R, Rema M, Mohan V. Prevalence of microalbuminuria in type 2 diabetes mellitus at a diabetes center in southern India. Postgrad Med 2001;77:399–402.
[34] Gupta DK, Verma LK, Khosla PK, Dash SC. The prevalence of microalbuminuria in diabetes: a study from north India. Diabetes Res Clin Pract 1991;12:125–8.
[35] Rossi MCE, Nicolucci A, Pellegrini F, Commaschi Ceriello A, Cucinotta D, et al. Identifying patients with type 2 diabetes at higher risk of microalbuminuria: result of DEMAND study. Nephrol Dial Transplant 2007;0:1–7.
[36] Wu AY, Kong NC, de Leon FA, Pan CY, Tai TY, nYeung Vt, et al. An alarmingly high prevalence of diabetic Nephropathy in Asian type 2 diabetes patients: the Microalbuminuria Prevalence (MAP) Study. Diabetologia 2005;48:17–26.
[37] Ahmedani MY, Hydrie MZ, Iqbal A, Gul A, Mirza WB, Basit A. Prevalence of microalbuminuria in type 2 diabetic patients in Karahi: Pakistan: a multicenter study. Pak Med Assoc J 2005;55:382–6.
[38] Shahwan Moayad, Hassan Nageeb, Noshi Adel, Banu Naheed. Prevalence and risk factors of vitamin B12 deficiency among patients with type 2 diabetes on metformin: a study from northern region of United Arab Emirates. Asian J Pharmaceut Clin Res 2018;11(8):225–9.