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The association between chronic kidney disease and cardiovascular risk factors in patients with type 2 diabetes mellitus

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Objective. *To study the association between chronic kidney disease (CKD) and cardiovascular risk factors in patients with type 2 diabetes mellitus (T2DM).*

Materials and methods. *This clinical epidemiological study included 528 patients with T2DM aged 30–69 years. Social, demographic, behavioral risk factors and life quality were determined using «ARIC» questionnaire. We also assessed the level of glycemia, glycohemoglobin, creatinine, microalbuminuria (MA) and glomerular filtration rate (GFR).*

Results. *Increased creatinine level (p<0,001), high stress level (p=0,006), decreased GFR (p<0,001) were accompanied by 300 mg/gl MA. Patients with albuminuria more often had movement disorders (p=0,015), self-care (p<0,001) or everyday activity (p<0,001) impairment, pain or discomfort (p=0,001). Employment reduced the incidence of albuminuria (p=0.043), low and medium alcohol consumption had antiproteinuric effect (p=0.003), low physical activity was MA predictor (p=0.011). GFR decreased with age (p <0.001), patients with family history of angina pectoris more often had decreased renal function (p=0.031). Most patients with decreased GFR had increased body mass and obesity (p<0,001), most of them had medium or high stress level (p=0,003). Patients with GFR<60 ml/min had high creatininemia and MA (p<0,001); decreased GFR contributed to self-care impairment (p=0,020).*

Conclusion. *7,9 % of patients with T2DM had GFR<60 ml/min, 35,7 % — MA. We assessed general and individual MA and decreased GFR risk factors. Systematic screening will prevent CKD development.*

Key words: *Type 2 diabetes mellitus, chronic kidney disease, microalbuminuria, risk factors.*

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Introduction

Type 2 diabetes mellitus (T2DM) contributes to the development of chronic kidney disease (CKD) [1]. Despite that fact, CKD is rarely timely diagnosed. After 4 years of type 1 diabetes mellitus diagnosis (T1DM) it is recommended to assess microalbuminuria (MA) every year, and, in case of T2DM, regardless of its duration, it is necessary to determine MA immediately, because T2DM is often detected when there are clinical and subclinical complications.

Albuminuria and decreased glomerular filtration rate (GFR) (<60 ml/min) are diagnostic criteria of CKD [2, 3], and MA — initial CKD manifestation [4]. Both these parameters can manifest together and separately [5].

Pathogenesis of CKD include general and specific pathophysiological mechanisms [2, 6, 7]. It is known that endothelial dysfunction and increased kidney vascular permeability lead to MA, and vascular occlusion — to GFR decrease [8]. Various risk factors also contribute to the development of CKD and can act together and separately [4].

Decreased GFR and albuminuria are not only the factors of diabetic nephropathy, but also independent risk factors of cardiovascular events and mortality [9]. Therefore, patients with T2DM and impaired kidney function, including its initial stage, need to underwent risk factors screening [7]. Only in this case it is possible to prevent the development of the disease and its complications, including disability and death, since GFR ⩽30 ml/min indicate the presence of stage 2 diabetic nephropathy.

Patients with T2DM have specific CKD prevalence and risk factors in every region.

Objective

To study the risk factors of CKD, life quality features and laboratory parameters in patients with T2DM among Azerbaijani cohort.

Material and methods

This clinical and epidemiological study included 528 patients (30,5 % — men and 69.5 % — women) with T2DM aged 30–69 years (54,1 ± 0,3 years). All the respondents answered the questions of ARIC questionnaire prepared by World Health Organization experts for clinical and epidemiological studies, that assessed socio-demographic, behavioral risk factors and life quality aspects.

Patients who smoked at least one cigarette per day were considered smokers. Patients who consumed over 7 bottles of beer, and / or over 700 grams of strong wine, and / or over 1 liter of wine, and / or over 300 grams of vodka or other strong drink over 5 times a week were considered alcohol abusers. Patients were considered low- and medium-alcohol drinkers if the number of alcoholic beverages was less than mentioned above values.

If patient didn't move less than for 5 hours per day, walked for at least 30 minutes per day and / or exercised for at least 2 hours per week, physical activity was considered normal. In case of lower activity, we determined physical passivity.

The disturbance of one type of metabolism — carbohydrate, lipid or salt, was considered as mild (1–1.9 points), the presence of two types metabolism disturbances — as moderate (2–2,9 points) and the presence of all three types — as severe (⩾3 points) malnutrition; 0–0,9 points were considered as healthy nutrition.

Symptoms of stress were calculated using hospital scale: 1–1.9 points — severe, 2–2.9 points — moderate, 3–3.9 points — mild stress level, and 0–0.9 points — the absence of stress.

Body mass index (BMI) <25 kg/m^2 was considered normal, ⩾25 kg/m^2 — overweight and obese. According to the report of National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) experts, abdominal obesity (AO) was considered as ⩾102 cm waist circumference in men and ⩾88 cm in women.

Life quality was assessed using the EQ-5D (European Quality of Life İnstrument) questionnaire, that assessed problems with movement, self-care, daily activity, pain, discomfort, anxiety, depression and the dynamics of life quality parameters.

Blood glucose ⩾7 mmol / L measured in ulnar vein on an empty stomach after 9–12 hours of fasting were considered as hyperglycemia, and glycohemoglobin (HbA1c) ⩾7 % was a sign of inadequate diabetes control. Creatinine level was determined by photometric method using STAR FAX apparatus: 53–115 μmol/l in men and 44–90 μmol/l in women were considered normal.

GFR was calculated using the Cockcroft-Gault formula: ⩾90 ml/min/1.73 m^2 was considered as normal or stage 1 CKD, 60–89 — stage 2, 30–59 — stage 3, 15–29 — stage 4, and <15 ml / min / 1.73 m^2 — as the 5th or terminal stage of renal failure.

The level of MA was determined using test strips (Hungary), 30–300 mg / dl was considered pathological. In clinical and epidemiological studies this

method of albuminuria assessment was superior to albumin / creatinine ratio since its simpler to perform [10, 11].

The statistical analysis was carried out using MS EXCEL-2013 and SPSS-20 software and variational (Kruskal-Wallis test), dispersion (Fisher's F-test) and discriminant (Pearson's tetrachoric and polychoric criteria) methods.

Results

The results of the study showed that the frequency of MA was higher in women compared with men, despite the fact that the frequency of 30 and 100 mg/dl MA was 2 times higher and 300 mg/dl — 3 times higher, this difference was statistically insignificant (Table 1). Similar changes were registered in patients with decreased GFR and the highest parameter was registered in patients with 2nd stage CKD.

Average age of patients was over 50 years in both groups despite MA severity and did not differ significantly, patients with GFR <60 ml/min were significantly older.

The level of education did not affect MA and GFR parameters significantly in patients with T2DM. Patients with secondary education had decreased GFR and the highest MA parameters, respondents with secondary professional education most often had 300 mg/dl MA.

Table 1. **The determinants and features of MA and GFR reduction depending on social and demographic factors**

Parameters	Gradation	MA (mg/dl)				P* (Kruskal-Wallis test)	GFR (ml/min/1.73 м²)			P* (Kruskal-Wallis test)
		0	30	100	300		≥90	89–60	<60	
Sex, n (%)	Men	86 (27.7)	49 (34.3)	9 (33.3)	4 (25.0)	0.508	64 (31.4)	61 (26.9)	12 (32.4)	0.543
	Women	224 (72.3)	94 (65.7)	18 (66.7)	12 (75.0)		140 (68.6)	166 (73.1)	25 (67.6)	
Age, years	n M±м (95 % CI)	310 54.3±0.4 (53.6–55.0)	143 53.9±0.6 (52.7–55.0)	27 55.1±1.4 (52.2–57.9)	16 54.7±1.8 (50.8–58.5)	0.821 p (Fisher's F-test)	204 51.6±0.5 (50.7–52.5)	227 56.0±0.4 (55.2–56.8)	37 58.8±1.0 (56.7–60.8)	<0.001 p (Fisher's F-test)
The level of education, n (%)	No education	4 (1.3)	0	0	0	0.172	2 (1.0)	2 (0.9)	0	0.435
	Higher education	106 (34.2)	34 (23.8)	7 (25.9)	4 (25.0)		54 (26.5)	80 (35.2)	13 (35.1)	
	Professional education	58 (18.7)	35 (24.5)	4 (14.8)	6 (37.5)		50 (24.5)	40 (17.6)	9 (24.3)	
	Secondary education	123 (39.7)	64 (44.8)	13 (48.1)	4 (25.0)		91 (44.6)	83 (36.6)	14 (37.8)	
	Incomplete secindary education	19 (6.1)	10 (7.0)	3 (11.1)	2 (12.5)		7 (3.4)	22 (9.7)	1 (2.2)	
Employment status, n (%)	Employed	190 (61.3)	104 (72.7)	21 (77.8)	12 (75.0)	0.043	136 (66.7)	148 (65.2)	28 (75.7)	0.939
	Unemployed	120 (38.7)	39 (27.3)	6 (22.2)	4 (25.0)		68 (33.3)	79 (34.8)	9 (24.3)	
Family status, n (%)	Not married	7 (2.3)	4 (2.8)	0	2 (12.5)	0.478	5 (2.5)	7 (3.1)	1 (2.7)	0.347
	Married	253 (81.6)	109 (76.2)	21 (77.8)	11 (68.8)		162 (79.4)	181 (79.7)	28 (75.7)	
	Divorsed	7 (2.3)	4 (2.8)	0	1 (6.2)		5 (2.5)	5 (2.2)	1 (2.7)	
	Widow/ widower	43 (13.9)	26 (18.2)	6 (22.2)	2 (12.5)		32 (15.7)	34 (15.0)	7 (18.9)	
Family history of DM, n (%)	No	176 (56.8)	86 (60.1)	12 (44.4)	8 (50.0)	0.453	109 (53.4)	131 (58.1)	27 (73.0)	0.869
	Yes	134 (43.2)	57 (39.9)	15 (55.6)	8 (50.0)		95 (46.6)	95 (41.9)	10 (27.0)	
Family history of CAD, n (%)	No	276 (89.0)	130 (90.9)	25 (92.6)	16 (100.0)	0.485	174 (85.3)	211 (93.0)	33 (89.2)	0.013
	Yes	34 (11.0)	13 (9.1)	2 (7.4)	0		30 (14.7)	16 (7.0)	4 (10.8)	
Family history of MI, n (%)	No	276 (89.0)	132 (92.3)	24 (88.9)	16 (100.0)	0.391	174 (85.3)	213 (93.8)	32 (86.5)	0.031
	Yes	34 (11.0)	11 (7.7)	3 (11.1)	0		30 (14.7)	14 (6.2)	5 (13.5)	

* $p < 0.05$ — the difference between studied parameters.

The severity of MA and CKD in employed patients were 2–3 times lower, however the differences between CKD parameters were not statistically significant.

MA and CKD were registered mostly in married patients; widowers were on the second place.

Patients with family history of DM had higher frequency of 100 mg/dl MA and 1st stage of CKD. The MA severity did not differ significantly in patients with family history of myocardial infarction (MI) and coronary artery disease (CAD), 1/10 of patients had <60 ml/min GFR.

Non-smokers predominated in the studied cohort and the frequency of 100 mg/dl MA as well as the most severe stage of kidney disfunction was higher in smokers (Table 2).

The prevalence of MA and CKD was higher in patients with low and moderate alcohol consumption as well as the frequency of 100 mg/dl MA and 2nd stage of CKD. The only statistically significant difference was the association between MA and alcohol consumption.

Average BMI corresponded stage 1 of obesity in patients with MA, excessive body mass and mild obesity in patients with decreased GFR. Most patients with MA had ≥25 kg/m² BMI, and GFR decrease resulted in statistically significant decrease of this indicator. Respondents with both signs of CKD revealed AO, moreover, this indicator directly correlated with GFR, and AO played significant role in reducing GFR values.

Patients involved in the study had mostly low physical activity. These patients had higher frequency of 100 mg/dl MA and ≥90 ml/min GFR, moreover, only MA changes statistically depended on the level of physical activity.

Table 2. **The features of the association between CKD indicators and behavioral risk factors**

Parameters	Gradation	MA (mg/dl)				p* (Kruskal-Wallis test)	GFR (ml/min/l/1.73 m²)			p* (Kruskal-Wallis test)
		0	30	100	300		≥90	89–60	<60	
Smoking, n (%)	Non-smoker	276 (89.0)	123 (86.0)	21 (77.8)	15 (93.8)	0.274	184 (90.2)	200 (88.1)	32 (86.5)	0.889
	Smoker	34 (11.0)	20 (14.0)	6 (22.2)	1 (6.2)		20 (9.8)	27 (11.9)	5 (13.5)	
Alcohol, n (%)	No alcohol consumotion	47 (15.2)	47 (32.9)	8 (29.6)	8 (50.0)	0.003	53 (26.0)	43 (18.9)	9 (24.3)	0.478
	Low and moderate alcohol consumption	225 (72.6)	74 (51.7)	16 (59.3)	7 (43.8)		122 (59.8)	157 (69.2)	25 (67.6)	
	Alcohol abuser	38 (12.3)	22 (15.4)	3 (11.1)	1 (6.3)		29 (14.2)	27 (11.9)	3 (8.1)	
BMI, kg/m²	n M±m (95% CI)	310 32.9±0.3 (32.3–33.6)	143 32.1±0.5 (31.2–33.0)	27 32.2±0.9 (30.3–34.1)	16 30.8±1.5 (27.6–34.0)	0.298 p (Fisher's F-test)	204 34.3±0.4 (33.6–35.0)	227 31.5±0.4 (30.8–32.2)	37 29.6±0.8 (28.1–31.2)	<0.001 p (Fisher's F-test)
BMI, n (%)	<25 kg/m²	18 (5.8)	10 (7.0)	1 (3.7)	3 (18.8)	0.298	5 (2.5)	19 (8.4)	5 (13.5)	<0.001 p (Fisher's F-test))
	≥25 kg/m²	292 (94.2)	133 (93.0)	26 (96.3)	13 (81.3)		199 (97.5)	208 (91.6)	32 (86.5)	
Waist circumflex (ATP III), sm	n M±m (95% CI)	310 106.0±0.7 (104.7–107.4)	143 105.7±1.0 (103.6–107.8)	27 107.2±2.0 (103.0–111.4)	16 103.7±4.3 (94.5–112.9)	0.821 p (Fisher's F-test)	204 109.4±0.7 (107.9–110.9)	227 103.9±0.8 (102.2–105.5)	37 99.9±2.0 (95.9–103.9)	<0.001 p (Fisher's F-test)
Low physical activity, n (%)	No	156 (50.3)	65 (45.5)	6 (22.2)	4 (25.0)	0.011	87 (42.6)	122 (53.7)	16 (43.2)	0.235
	Yes	154 (49.7)	78 (54.5)	21 (77.8)	12 (75.0)		117 (57.4)	105 (46.3)	21 (56.8)	
Malnutrition, n (%)	No	84 (27.1)	33 (23.1)	9 (33.3)	3 (18.8)	0.639	38 (18.6)	70 (30.8)	13 (35.1)	0.204
	Mild	116 (37.4)	59 (41.3)	11 (40.7)	7 (43.8)		79 (38.7)	95 (41.9)	10 (27.0)	
	Moderate	93 (30.0)	44 (30.8)	6 (22.2)	5 (31.2)		71 (34.8)	54 (23.8)	11 (29.7)	
	Severe	17 (5.5)	7 (4.9)	1 (3.7)	1 (6.2)		16 (7.8)	8 (3.5)	3 (8.1)	
Stress, points	n M±m (95% CI)	310 2.03±0.03 (2.0–2.1)	143 1.86±0.04 (1.8–1.9)	27 1.87±0.11 (1.6–2.1)	16 1.83±0.11 (1.6–2.1)	0.006 p (Fisher's F-test)	204 1.88±0.03 (1.8–1.9)	227 2.04±0.04 (2.0–2.1)	37 2.07±0.11 (1.9–2.3)	0.003 p (Fisher's F-test)

* p < 0,05 — the difference between studied parameters.

Our study revealed inverse correlation between malnutrition and the severity of GFR and MA. Thus, the frequency of albuminuria and CKD was higher in patients with mild malnitrition, mostly with 300 mg/dl MA and 89–60 ml/min GFR.

Patients with 300 mg/dl MA had high average stress level, patients with <60 ml/min GFR — moderate level. It is also remarkable that stress indicator played important role in the developement of both CKD parameters.

Most patients involved in the study noted certain movement problems (Table 3). The severy of MA correlated with movement impairment.

Patients with MA had more problems with self-care compared with patients with decreased GFR, ⅓ of patients with 300 mg/dl MA and 1/12 patients with GFR < 60 ml/min were unable to wash and put on their cloth on their own.

Almost half of patients with MA, mostly with 100 mg/dl MA, and decreased GFR had some problems with everyday activity. Everyday activity impairment correlated with MA severity in patients with <60 ml/min GFR, ⅓ of them had 300 mg/dl MA.

Questioning revealed that patients with decreased GFR had more frequent pain and discomfort compared with patients with MA. The MA severy correlated with pain and discomfort frequency and ⅗ of patients with the most severe stage of MA had these symptoms.

Patients with both signs of CKD had relatively high frequency of anxiety and depression. We noted the direct correlation between the prevalence of unsignificant and serious anxiety and depression with MA severity. Over half of patients with 300 mg/dl MA underwent some anxiety or depression and only 1/10 of patients had severe clinical manifestations of these

Table 3. **Life quality indicators in patients with MA and decreased GFR**

Parameters	Gradation	MA (mg/dl)				p* (Kruskal-Wallis test)	GFR (ml/min/l/1.73 m²)			p* (Kruskal-Wallis test)
		0	30	100	300		≥90	89–60	<60	
Movement, n (%)	No problems	85 (27.4)	26 (18.2)	4 (14.8)	1 (6.2)	0.015	44 (21.6)	61 (26.9)	9 (24.3)	0.143
	Some problems	224 (72.3)	115 (80.4)	23 (85.2)	14 (87.5)		158 (77.5)	166 (73.1)	26 (70.3)	
	Bed-patient	1 (0.3)	2 (1.4)	0	1 (6.2)		2 (1.0)	0	2 (5.4)	
Self-care, n (%)	No problems	219 (70.6)	65 (45.5)	10 (37.0)	3 (18.8)	<0.001	85 (41.7)	152 (67.0)	19 (51.4)	0.020
	Some problems	89 (28.7)	69 (48.3)	17 (63.0)	8 (50.0)		103 (50.5)	69 (30.4)	15 (40.5)	
	Disable to wash and put on cloth on their own	2 (0.6)	9 (6.3)	0	5 (31.2)		16 (7.8)	6 (2.6)	3 (8.1)	
Daily activity, n (%)	No problems	162 (52.3)	50 (35.0)	6 (22.2)	2 (12.5)	<0.001	85 (41.7)	114 (50.2)	16 (43.2)	0.177
	Some problems	135 (43.5)	78 (54.5)	18 (66.7)	8 (50.0)		103 (50.5)	101 (44.5)	16 (43.2)	
	Disable to perform daily activity	13 (4.2)	15 (10.5)	3 (11.1)	6 (37.5)		16 (7.8)	12 (5.3)	5 (13.5)	
Pain, discomfort, n (%)	Absent	52 (16.8)	18 (12.6)	2 (7.4)	1 (6.2)	0.004	34 (16.7)	33 (14.5)	3 (8.1)	0.282
	Some pain and discomfort	173 (55.8)	75 (52.4)	12 (44.4)	5 (31.2)		99 (48.5)	127 (55.9)	23 (62.2)	
	Severe pain and discomfort	85 (27.4)	50 (35.0)	13 (48.1)	10 (62.5)		71 (34.8)	67 (29.5)	11 (29.7)	
Anxiety, depression n (%)	Absent	174 (56.1)	77 (53.8)	9 (33.3)	5 (31.2)	0.059	105 (51.5)	125 (55.1)	22 (59.5)	0.733
	Some anxiety and depression	109 (35.2)	53 (37.1)	15 (55.6)	9 (56.2)		78 (38.2)	82 (36.1)	11 (29.7)	
	Severe anxiety and depression	27 (8.7)	13 (9.1)	3 (11.1)	2 (12.5)		21 (10.3)	20 (8.8)	4 (10.8)	
Life quality, n (%)	Improved	40 (12.9)	18 (12.6)	3 (11.1)	2 (12.5)	0.547	23 (11.3)	35 (15.4)	5 (13.5)	0.571
	Did not change	61 (19.7)	25 (17.5)	2 (7.4)	2 (12.5)		36 (17.6)	42 (18.5)	8 (21.6)	
	Worsened	209 (67.4)	100 (69.9)	22 (81.5)	12 (75.0)		143 (71.1)	150 (66.1)	24 (64.9)	

* p < 0,05 — the difference between studied parameters.

Table 4. **Features of laboratory parameters in patients with various CKD stages**

Parameters	Gradation	MA (mg/dl)				p* (Fisher's F-test)	GFR (ml/min/1.73 m²)			p* (Fisher's F-test)
		0	30	100	300		≥90	89–60	<60	
Glucose, mmol/l	n M±m (95% CI)	293 11.8±0.3 (11.3–12.3)	130 10.8±0.4 (10.1–11.5)	26 11.4±1.0 (9.4–13.3)	14 11.4±1.7 (7.8–15.0)	0.220	204 11.3±0.3 (10.7–11.9)	226 11.6±0.3 (11.1–12.2)	37 11.1±1.0 (9.1–13.1)	0.691
HbA1c, %	n M±m (95% CI)	96 8.9±0.2 (8.5–9.4)	35 8.5±0.4 (7.7–9.2)	4 7.9±0.6 (6.0–9.8)	3 8.4±0.8 (5.1–11.6)	0.564	47 9.09±0.31 (8.47–9.7)	81 8.73±0.24 (8.26–9.2)	9 8.1±0.82 (6.21–9.99)	0.393
Creatinine, μmol / l	n M±m (95% CI)	293 83.2±1.1 (81.0–85.5)	131 81.8±1.7 (78.4–85.2)	26 92.0±6.7 (78.3–105.8)	14 165.9±32.9 (94.8–236.9)	<0.001	204 70.9±0.7 (69.5–72.4)	227 87.9±0.9 (86.1–89.7)	37 153.4±12.4 (128.3–178.4)	<0.001
MA, mg/dl	n M±m (95% CI)	—	—	—	—		198 22.3±4.6 (13.2–31.3)	225 17.4±3.4 (10.7–24.2)	37 138.9±34.5 (69.0–208.8)	<0.001
GFR (ml/min/1.73 m²)	n M±m (95% CI)	291 87.9±1.2 (85.5–90.2)	129 88.8±1.8 (85.1–92.4)	26 83.7±4.9 (73.6–93.7)	14 56.4±7.4 (40.5–72.4)	<0.001	—	—	—	

* p < 0,05 — the difference between studied parameters.

disorders. ⅓ of patients with <60 ml/min GFR had some anxiety and depression, 1/10 — serious anxiety and depression disorders.

11,1–15,4 % of patients with MA and decreased GFR had impovenet and 7.4–21.6 % — no changes and 66.1–81.5 % — worsening of clinical condition. Patients with 100 mg/dl MA and ≥90 ml/min GFR mostly had worse clinical condition compared with last year.

Table 4 shows that both groups had high average glycemia level, blood glucose was lower in other groups compared with patients without albuminuria, patients with <60 ml/min GFR had the lowest glycemia level.

The average level of HbA1c was high in all gradations and, moreover, it directly correlated with GFR.

Albuminuria increase and GFR decrease were accompanied by statistically significant increase of blood creatinine. Average MA values inversely correlated with GFR; thus, we estimated the lowest GFR value in patients with 300 mg/dl MA and the highest albuminuria in patients with <60 ml/dl GFR.

Results and discussion

Total MA prevalence in the population was 35.7 %, that almost corresponded to the value obtained by other researchers (36 %) [12]. In both studies, one of the most important reasons for the high incidence of MA was inadequate glycemic control.

56.4 % of patients had <90 ml/min GFR, 48.5 % had 2nd stage, 7.5 % — 3d stage, 0.2 % — 4th, and 0.2 % — terminal stage of CKD (7.9 % of patients had <60 ml/min GFR). The ONTARGET study showed that 31 % of patients had <60 ml / min GFR [13] that was 3 times higher compared with our data.

According to Fink H.A. et al. there are gender differences in the prevalence of CKD — the incidence of CKD among women was higher (12.6 %) compared with men (9.7 %) [14]. Similar results were obtained in our study — 32.2 % of men had <90 ml/min GFR, and in women this indicator was two times higher.

It was proved that the rate of CKD development increases with age, and GFR decreases by 1–> 10 ml/min/year with age in patients with DM [15]. We also showed that CKD progression was associated with age, at the same time, average age of patients with 100 and 300 mg/dl MA was higher compared with patients without or with mild albuminuria.

The level of education did not affect GFR and MA. The presence of MA and GFR decrease were noted mostly in patients with secondary professional and higher education. The ONTARGET study showed that increased level of education inversely correlated with CKD development [13]. These results can be explained by the fact that patient adherence to treatment increases with education level that contributes to the decrease of renal dysfunction progression. It can be concluded that it is necessary to improve measures on treatment and prevention of T2DM, especially in educated patients.

In our study the frequency of MA was significantly higher in unemployed patients compared with employed patients in contrast with Dunkler D. et al. [13] results. There results can be explained by the nephroprotective effect of physical activity in working patients that slowed MA progression.

It is known that genetic predisposition and family history of cardiovascular diseases (CVD), which are independent risk factors for kidney damage develop-

ment, contribute to the development of diabetic nephropathy [16]. Our data are similar to the results of Abdelhafiz A.H. et al. — 1/10 of patients with DM and family history of MI had < 60 ml / min GFR.

It was found that moderate alcohol consumption significantly reduced the risk of CKD development [13]. Our study obtained similar results — the majority of patients without albuminuria (about 3/4) and low rate of 300 mg / dl MA had low or moderate alcohol consumption. Patients who did not consume alcohol had higher incidence of MA. Thus, low and moderate amounts of alcohol had anti-albuminuric effect, but alcoholic beverages did not affect GFR significantly.

Obesity is also a serious CVD and kidney damage risk factor [5,8]. In our study most patients were overweight and had obesity. Despite the fact that this parameter did significantly contribute to the development of MA, patients with <60 ml / min GFR had excessed body mass and obesity significantly less common compared with patients with stages 1 and 2 of CKD. CKD decompensation led to body mass decrease, which was an indicator of uremic intoxication and unfavorable prognostic marker.

A significant CKD risk reduction was associated with regular physical activity in several studies [13]. Similarly, in our study patients with low physical activity had higher incidence of MA, but this risk factor did not reduce GFR significantly.

According to the results of the ONTARGET study [13], stress did not significantly affect the development of CKD; on the contrary, in our study, moderate and high stress levels prevailed in patients with severe MA and <60 ml/min GFR.

It is well known that adequate glycemic control plays an important role in preventing kidney damage [7]. As a result of inadequate diabetes management, albuminuria develops after 4 years [17], and the annual rate of MA to macroalbuminuria transition ranges from 2.8 to 9 % [18]. Chronic hyperglycemia leads to glomerular hyperfiltration, that is considered as the main diabetic nephropathy sign and, therefore, GFR gradually reduces [19]. Our patients did not have adequate glycemic status control. Patients with MA had high HbA1c level, and low glycemia in patients with <60 ml / min GFR may be associated with Zabrodi phenomenon, that is an unfavorable prognostic marker. Average values of HbA1c decreased with kidney filtration rate. This fact may be associated with discomfort and worsening of life quality in patients with CKD progression, that may lead to glycemic status control improvement.

Giordano Imbroll M. et al. determined that the increase of creatinine blood level was associated with albuminuria progression and GFR decrease [20]. In our study, this indicator also directly correlated with MA and inversely — with GFR.

At the same time, albuminuria was the most significant predictor of GFR decrease during the following year [21]. Similar results were obtained in our study, for example, increased severity of MA was associated with decreased GFR, and vice versa.

Thus, in the Azerbaijani cohort of patients with T2DM, it is necessary to perform monitoring of CKD prevalence, socio-demographic, and behavioral risk factors, as well as correct glycemic status adequately. Only in this case is it possible to slow down the development and progression of serious renal dysfunction and protect patients from life-threatening cardiovascular complications.

Conclusion

7,9 % of patients with T2DM had GFR < 60 ml/min, 35,7 % — MA. We assessed general and individual MA and decreased GFR risk factors.

Increased creatinine level, high stress level, and GFR decrease were associated increased level of MA. MA was often accompanied by movement restriction, self-care and daily activity impairment, as well as pain and discomfort. Employment reduced the incidence of albuminuria, low and moderate alcohol consumption had an antiproteinuric effect, and low physical activity was albuminuria predictor.

Patients with CKD had mainly moderate and high stress levels, family history of CAD was associated with GFR decrease, glycemia directly correlated with GFR and inversely — with age, creatinine blood level and MA. The incidence of renal dysfunction was higher in overweight patients with obesity and limited self-care.

Conflict of interest: None declared.

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