Prevalence and Risk Factors of Microalbuminuric in Patients With Diabetes Mellitus and Hypertension in Zhengzhou City, China

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Prevalence and Risk Factors of Microalbuminuric in Patients with Diabetes Mellitus and Hypertension in Zhengzhou city，China

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Abstract

Background: The prevalence of end-stage renal disease (ESRD) is uprising in the paralleled with the increase of chronic kidney disease (CKD) patients. The objective of this study was to assess the value of macroalbuminuric of kidney disease in diabetic and/or hypertensive patients and the risk factors associated with microalbuminuric.

Methods； A total of 3986 patients diagnosed with diabetes and/or hypertension aged 40 years and over was investigated by randomized cluster sampling in the Zhengzhou community and 1453 participants were analyzed in this study. The clinical data were investigated, including the urinary albumin–to-creatinine ratio (ACR), total cholesterol, triglyceride, high density lipoprotein, low density lipoprotein, glycated hemoglobin of HbAlc, fasting plasma glucose, 2-h postprandial plasma, and serum creatinine. The ACR was applied to designate albuminuric. The prevalence of macroalbuminuric was calculated and the risk factors associated with macroalbuminuric were evaluated by stepwise logistic regression.

Results: These comprised 612 males and 841 females and the mean age of all patients was 60.6±9.3 years. The prevalence of microalbuminuric and macroalbuminuric was 12.0%, 1.6%, respectively. The prevalence of microalbuminuric in patients with diabetes, hypertension and both diabetes and hypertension were 8.4%, 9.7% and 17.6%, respectively. In subjects with both diabetes and hypertension, the prevalence of microalbuminuric, macroalbuminuric were significantly higher than those who had diabetes or hypertension only. Logistic regression analysis showed microalbuminuric to be significantly associated with systolic blood pressure (OR: 1.92; 95% CI: 1.36-2.72; $P < 0.001$), diastolic blood pressure (OR: 1.53; 95% CI: 1.02-2.28; $P = 0.038$), HbA1c (OR: 2.31; 95% CI: 1.64-3.26; $P < 0.001$). Fasting plasma glucose (OR: 1.79; 95% CI: 1.18-2.71; $P = 0.006$) and hypertension (OR: 2.45; 95% CI: 1.64-3.65; $P < 0.001$) were the main independent factors for microalbuminuric in diabetic patients with hypertension or not.

Conclusion: The prevalence of microalbuminuric observed in patients diagnosed with

diabetes and/or hypertension aged over 40 reached up to 12.0% in the Zhengzhou community. Microalbuminuric was strongly associated with systolic blood pressure, diastolic blood pressure and HbA1c. Fasting plasma glucose and hypertension were the main independent factors for microalbuminuric in diabetic patients with hypertension or not.

Background

For decades, as the incidence of chronic kidney disease (CKD) has gradually increased, it is now considered a global public health problem [1, 2]. More than 95% of CKD was reported to occur in patients with diabetes and hypertension (HTN) [3]. Early detection and intervention of high-risk groups in order to prevent or delay the progression of CKD and improve patient prognosis [4].

Albuminuric is indicative of renal injury and a component of chronic kidney disease [5]. Urinary albumin excretion is inconvenient and often unavailable [6] and the urinary albumin-to-creatinine ratio (UACR) makes it easy to diagnose and monitor albuminuric in both clinical and research settings [7]. Microalbuminuric (MAU) is an established cardiovascular risk indicator in diabetic, hypertensive patients, and the general population [8]. Diabetes increased the risk for albuminuric significantly. And MAU is the earliest clinically detectable stage of diabetic nephropathy, which is strongly predictive of poor renal outcome in diabetic patients [9]. MAU is also associated with vascular disease, congestive heart failure, diastolic dysfunction, and hypertension [10]. Furthermore, MAU screening of patients with hypertension is a reliable and economical method to assess the risk of cardiovascular events [11]. Increasing evidence suggests that MAU is a strong and independent predictor of increased cardiovascular morbidity and mortality [12-14]. It is crucial to detect early CKD in diabetic and hypertensive patients in order to prevent renal insufficiency. A better understanding of the prevalence of microalbuminuric and the risk factors associated with microalbuminuric was required for in patients with diabetes and/or hypertension.

Studies of microalbuminuric prevalence and its associated risk factors are still underway among different countries and ethnic groups. China is the world's largest

developing country. Previous studies have indicated that chronic kidney disease has become an important public health problem in China [15, 16], hypertension and diabetes were the independently factors associated with kidney damage [15]. The prevalence of microalbuminuric differs substantially between geographical regions in China [16, 17]. However, few studies on the variability of UACR among patients diagnosed with diabetes, hypertension and diabetes with hypertension in China were performed.

Therefore, our aim was to determine the prevalence and risk factors of microalbuminuric in population with diabetes and/or hypertension aged 40 years and over in the Zhengzhou community, a city of China. Through the understanding of local disease communities, our ultimate goal is to increase the importance of physicians' annual urine albumin screening for patients with diabetes and hypertension through medical education, so as to improve the quality of patient care and formulate China's public health policies.

Methods

Study population

The study was conducted from May 1, 2011, to March 20, 2012. Patients diagnosed with diabetes and/or hypertension aged 40 years and over from the 5 participating community medical centers in Zhengzhou were the target of the survey population. All patients were recruited from primary and secondary care by physicians.Among a total of 3986 patients, 1137 individuals with diabetes, 1521 individuals with hypertension, 1328 individuals with both diabetes and hypertension. Underlying (primary) kidney diseases were excluded as far as possible by means of blood tests and radiology. Out of 1820 randomly selected patients, 57 subjects had acute renal failure or receiving dialysis, 248 didn't complete all measurements or lack of blood or urine samples, 14 were age violation and 48 refused to answer the questionnaires. Finally, 1453 were eligible for enrollment in this study. In detail, among the analyzed population, 475 individuals were diagnosed as diabetes, 477 subjects were diagnosed as hypertension, and another 501 subjects were with diabetes and hypertension. 616 normal individuals aged 40 years and over were randomly selected in this area during the time of the study,

and 514 were eligible for enrollment at last. Diabetes was diagnosed according to the standard set by the American Diabetes Association (ADA) in 1997 [18]. The criteria of diagnosis of hypertension was Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg [19] (WHO 1999). Exclusion criteria were subjects with acute renal failure or receiving dialysis. Informed consent was obtained from each patient. All the protocols were approved by the local ethics committees.

Anthropometric Measurements

Weight and height were measured in light clothing without shoes, and body mass index (BMI, kg/m2) was calculated. Waist circumference was measured at the umbilical level as well as hip circumference at the maximal level over light clothing. Waist to hip ratio was calculated from waist circumference divided by hip circumference. Blood pressure was taken three times using a standard mercury sphygmomanometer and then averaged. Other information such as age, gender, medical history, smoking and alcohol consumption history was also collected by self-administered questionnaires.

Laboratory measurements and definitions

After a fasting venous blood sample was collected, each participant received a 75 g oral glucose tolerance test, except for those with a validated history of diabetes mellitus. Plasma glucose levels were measured using the glucose oxidase method. Glycated haemoglobin (HbA1c) was estimated by high-pressure liquid chromatography using an analyzer (HLC-723G7, Tosoh Corporation, Japan). Serum creatinine and lipid profiles, including measurements of total cholesterol (TCHOL), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C) were measured by standard methods. Urinary albumin levels were measured with the turbid metric immunoassay method using a commercially available kit and urinary creatinine levels were determined by an enzymatic method. The albumin/creatinine ratio was calculated; values < 30 mg/g, 30-299 mg/g and ≥ 300 mg/g in the absence of haematuria were defined as normo, micro and macroalbuminuric, respectively [20].

Statistical analysis

All statistical analyses were performed using SPSS for Windows version 17.0. To assess the difference among groups with regard to quantitative data, a one-way ANOVA

was used. Log transformation was used for variables with significant deviation from normal distribution, assessed by the Kolmogorov–Smirnov test before further analyses. A Kruskal–Wallis H or χ^2 test was used for comparisons of non-normally distributed data. The risk factors associated with microalbuminuric were analyzed by stepwise logistic regression. Continuous variables were expressed as mean ± SD, non-normally distributed variables were presented as medians (P25 and P75), and categorical variables were expressed as numbers (%).Statistically significant level α was set at 0.05.

Results

Clinical characteristics of the study population

The study analyzed 1453 patients. These comprised 612 males and 841 females, with an average age of 60.6±9.3 years. Of the 1453 patients with hypertension and/or diabetes, the number of known diabetes and newly diagnosed diabetes was 513 and 463, respectively; the number of known hypertension and newly diagnosed hypertension was 570 and 408, respectively. All of patients were classified into three groups based on blood glucose and blood pressure levels: diabetes, hypertension and diabetes with hypertension. Demographic and metabolic characteristics of the subjects are shown in Table 1. The frequencies of subjects who were smokers and alcohol drinker were significantly higher in hypertensive subjects than those in normal, but were similar between diabetic subjects and normal. The cardiovascular disease were much more prevalent in diabetic and/or hypertensive patients than those in normal. The values of age, BMI, waist, circumference, waist-to-hip ratio, systolic blood pressure, triacylglycerol, serum creatinine were significantly higher in diabetic and/or hypertensive patients than those in normal. The diabetic patients had higher HbAlc compared with the hypertensive patients, and the hypertensive patients had higher levels of HDL-cholesterol compared with the diabetic patients. The patients with diabetes and hypertension were older and had higher levels of BMI, waist, serum creatinine, the urinary albumin-to-creatinine ratio compared with the diabetic or hypertensive patients, and the cardiovascular events were much more prevalent in

patients with diabetes and hypertension than those in patients with diabetes or hypertension only. There was no significant difference in smoking, alcohol drinking, total cholesterol and LDL-cholesterol among patients with diabetes and/or hypertension.

Clinical characteristics of the normoalbuminuric, microalbuminuric and macroalbuminuric in diabetes and/or hypertension patients

Table 2 presented the clinical characteristics of the normoalbuminuric, microalbuminuric and macroalbuminuric in diabetic and/or hypertensive patients. Subjects with microalbuminuric and macroalbuminuric were older and had higher prevalence of cardiovascular disease compared with the normoalbuminuric patients. The values of systolic blood pressure, fasting plasma glucose, 2-h postprandial plasma, HbA1c and serum creatinine were significantly higher in microalbuminuric and macroalbuminuric patients than those in normoalbuminuric. Compared with normoalbuminuric patients, the levels of BMI, waist, total cholesterol, triacylglycerol were higher in microalbuminuric patients. The macroalbuminuric patients had higher levels of waist-to-hip ratio, systolic blood pressure, 2-h postprandial plasma, HbA1c and serum creatinine compared with the microalbuminuric patients. The frequencies of subjects who were smokers and alcohol drinker were similar among three groups. There was no significant difference diastolic blood pressure, HDL-cholesterol and LDL-cholesterol among three groups.

Prevalence of albuminuric

Albuminuric was found in 13.6% of the all patients, and the prevalence of microalbuminuric and macroalbuminuric was 12.0%, 1.6%, respectively (Table 3). The prevalence of microalbuminuric in patients diagnosed with diabetes, hypertension and both diabetes and hypertension were 8.4%, 9.7% and 17.6%, respectively. The patients with both diabetes and hypertension had the highest prevalence of albuminuric (22.0%). The prevalence of microalbuminuric was similar between patients with diabetes and hypertension. In patients with both diabetes and hypertension, the prevalence of microalbuminuric, macroalbuminuric were significantly higher than those who had diabetes or hypertension only.

Subjects known to have diabetes (5.9%) had higher prevalence of microalbuminuric

than those newly diagnosed diabetes (2.5%). In patients with both diabetes and hypertension, the prevalence of albuminuric in subjects known both (11.8%) was significantly higher than those who were newly diagnosed both (2.8%). However, there was no significant difference in the prevalence of microalbuminuric between known hypertension and newly diagnosed hypertension.

Risk factors for microalbuminuric

To study the risk factors for microalbuminuric in all patients, we analyzed the contribution of risk factors using the logistic regression. The following categories were taken as independent variables: gender, age, BMI, waist-to-hip ratio, systolic blood pressure, diastolic blood pressure, fasting plasma glucose, 2-h postprandial plasma, HbA1c, total cholesterol, triacylglycerol, HDL-cholesterol, LDL-cholesterol, serum creatinine diabetes, hypertension, smoking and alcohol drinking. Table 4A shows the multivariate Logistic regression analysis of microalbuminuric. Microalbuminuric was significantly associated with systolic blood pressure (OR: 1.92; 95% CI: 1.36-2.72; $P < 0.001$), diastolic blood pressure (OR: 1.53; 95% CI: 1.02-2.28; $P = 0.038$), HbA1c (OR: 2.31; 95% CI: 1.64-3.26; $P < 0.001$).

To explore the risk factors for microalbuminuric in diabetic patients, we analysed the contribution of risk factors such as gender, age, BMI, waist-to-hip ratio, fasting plasma glucose, 2-h postprandial plasma, level of HbA1c, various dyslipidaemia, hypertension in diabetic patients with hypertension or not in our study. As shown in Table 4B, fasting plasma glucose (OR: 1.79; 95% CI: 1.18-2.71; $P = 0.006$) and hypertension (OR: 2.45; 95% CI: 1.64-3.65; $P < 0.001$) were the main independent factors for microalbuminuric in all diabetic patients.

Discussion

In the present study, we documented the prevalence of microalbuminuric, the associated ACR risk factors in diabetic and hypertensive patients aged 40 years and over in the Zhengzhou community. The overall prevalence of albuminuric was 13.6% in patients of our study, and the prevalence of microalbuminuric and macroalbuminuric were 12.0% and 1.6%, respectively. Microalbuminuric was present in 8.4% of patients

with diabetes, 9.7% of patients with hypertension, and 17.6% of patients with both diabetes and hypertension.

Previously-reported values for the prevalence of microalbuminuric are marked variable among patients with diabetes or hypertension. The prevalence of microalbuminuric due to type 2 diabetes among Kuwaiti adults was 27.3% [21]. Among Koreans aged 45–74 years, microalbuminuric was present in 32.7% of the participants with hypertension; 34.1% of the participants with type 2 diabetes; and 44.1% of the participants with both hypertension and type 2 diabetes [13]. Several articles also reported the microalbuminuric prevalence in Asian countries, in a Chinese urban the prevalence of microalbuminuric was 22.8% among the patients diagnosed with type 2 diabetes [16], and a research in Taiwan revealed the prevalence of microalbuminuric was 19.2% [17]. Compared with the recent study, the prevalence of microalbuminuric in diabetes and/or hypertension subjects was lower in the present study. An important reason for this is that nearly half of the diabetes and hypertension cases in our study were newly diagnosed, while most of the cases in other studies were known and probably had severity and a longer duration of diabetes and hypertension. Various studies revealed that several factors contributed to the variations in the prevalence of microalbuminuric among different population, including prevalence of diabetes, hypertension, ethnicity and a genetic predisposition [22, 23]. Other factors such as study design (e.g. Hospital-based study and single-screening design tend to produce higher prevalence estimates), sample number, sample selection (e.g. Nonrandom selection tend to produce higher prevalence estimates), race, the year when a study was conducted, and the age and sex structure of the participants itself might also explain the marked variation in the prevalence of albuminuric.

Jia et al. [16] demonstrated that the subjects with both diabetes and hypertension had a higher prevalence of albuminuric and CKD. It has been reported that the T2DM patients with a history of hypertension were more likely to have microalbuminuric compared with those without hypertension [17]. Although our study showed that the prevalence of microalbuminuric seen in patients with diabetes is similar to that seen in patients with hypertension, albuminuric was found more frequently in patients with

both hypertension and diabetes. This suggested that it is more important for patients with both hypertension and diabetes to monitor the emergence of microalbuminuric frequently. Fox et al. [24] found that participants with known diabetes at baseline had a two-fold odd of developing CKD. Chiang et al. [17] indicated that longer duration of the diabetes increased the risk of microalbuminuric, and there was a 1.022-fold risk for every 1-year increase in diabetes duration. Our data indicated that subjects known to have diabetes had higher prevalence of microalbuminuric than those newly diagnosed diabetes. Therefore, a policy of yearly screening of microalbuminuric is recommended once the diagnosis of diabetes is made. Microalbuminuric is reported to be present in approximately 30–40% of patients with hypertension and appears to correlate with both the severity and duration of hypertension [25, 26]. However, our study showed that there was no significant difference in the prevalence of microalbuminuric between known hypertension and newly diagnosed hypertension. Several reasons for this may be that the small sample size, antihypertensive therapy and the age, severity and duration of the hypertension subjects itself in our study.

Microalbuminuric can be used to assess cardiovascular and renal risks in patients with diabetes and hypertension. In order to interrupt the prevalence of microalbuminuric, it is critical to analyse the contribution of risk factors. Jia et al. [16] revealed that diabetes, hypertension, cardiovascular disease and HbA1c increased the risk for microalbuminuric significantly. A research in Taiwan indicated that microalbuminuric was strongly associated with metabolic syndrome and its components in the Chinese population [27]. Our study showed that microalbuminuric was strongly associated with systolic blood pressure, diastolic blood pressure and HbA1c in patients diagnosed with diabetes and hypertension. The findings of this study indicated that factors associated with microalbuminuric are similar to those reported in other studies. However, the impact of these factors on the prevalence of microalbuminuric probably varies among different population. Lu et al. [28] demonstrated that microalbuminuric was significantly associated with systolic blood pressure, gender and waist circumference in patients diagnosed with type 2 diabetes in the Shanghai downtown. A recent study by Afaf [21] reported that hypertension was the

most significant independent factor associated with diabetic microalbuminuric. Similarly, we also found that hypertension were the main independent factors for microalbuminuric in all diabetic patients. In addition, we found fasting plasma glucose also another considerable factor. Therefore, early recognition and treatment of hypertension and tight glucosecontrol are the important strategies to prevent or delay diabetic nephropathy. As concluded by these studies, to reduce the prevalence of microalbuminuric, it is very important to control the prevalence of diabetes and hypertension. Considering that microalbuminuric can be reversed with appropriate treatment or physical exercise, subjects with microalbuminuric or related conditions (diabetes, hypertension or obesity) should be encouraged to seek appropriate treatment, including regular exercise and medication [29].

In conclusion, the prevalence of microalbuminuric was high in population with diabetes and hypertension in the Zhengzhou community. Systolic blood pressure, diastolic blood pressure and HbA1c were the main risk factors for microalbuminuric. Treatment of hypertension and tight control of blood glucose are the important strategies to prevent microalbuminuric in patients with diabetes. Screening for microalbuminuric is highly recommended for patients with diabetes and hypertension to prevent end stage kidney disease, especially for patients with both diseases.

Conclusions

The prevalence of microalbuminuric observed in patients diagnosed with diabetes and/or hypertension aged over 40 reached up to 12.0% in the Zhengzhou community. Microalbuminuric was strongly associated with systolic blood pressure, diastolic blood pressure and HbA1c. Fasting plasma glucose and hypertension were the main independent factors for microalbuminuric in diabetic patients with hypertension or not.

Abbreviation

abbreviation	full names
ADA	the American Diabetes Association
BMI	body mass index
CKD	chronic kidney disease
ESRD	end-stage renal disease

HTN	hypertension
HbA1c	Glycated haemoglobin
HDL-C)	high-density lipoprotein cholesterol
LDL-C	low-density lipoprotein cholesterol
MAU	Microalbuminuric
TCHOL	total cholesterol
TG	triglyceride
UACR	urinary albumin-to-creatinine ratio

Declarations

Ethics approval and consent to participate

Research involving human participants and human data performed in accordance with the Declaration of Helsinki and were reviewed and approved by Ethics Committee of the First Affiliated Hospital of Zhengzhou University. The patients/participants provided their written informed consent to participate in this study.

The Availability of data and materials

All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests

No conflict of interest exits in the submission of this manuscript, and manuscript is approved by all authors for publication.

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Authors' contributions

AS: conceived and designed the experiments. LW 、XM and LZ: analyzed the data. NJ、XD and MP: collected sample. LZ: helped perform the analysis with constructive discussions. GQ and YZ: revised the manuscript. All authors have read and approved the manuscript.

Consent for publication

Not Applicable

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Table 1. Clinical characteristics of study population by group of normal, diabetes, hypertension and both diabetes and hypertension

	Normal N=514	Diabetes N=475	Hypertension N=477	Both Diabetes and Hypertension N=501
Age (years)	54.3±8.8	58.6±9.7*	59.9±8.9*	62.9±8.6*#▲
Sex (men/women)	123/391	177/298	165/312	270/231
Smoking	49 (9.5%)	62 (13.1%)	66 (13.8%)■	41 (8.2%)
Alcohol drinking	22 (4.3%)	25 (5.3%)	40 (8.4%)■	29 (5.8%)
Cardiovascular events	30 (5.8%)	59 (12.4%)*	69 (14.5%)*	125 (24.9%)*#▲
BMI (kg/m^2)	24.7±3.1	26.3±4.2*	26.5±3.6*	27.2±3.7*#◇
Waist (cm)	84.0±8.8	89.6±10.1*	89.7±9.4*	92.1±9.7*#▲
Waist-to-hip ratio	0.88±0.06	0.91±0.07*	0.90±0.06*	0.92±0.06*▲
SBP(mmHg)	117.7±11.3	121.3±10.6*	144.5±16.4*#	145.4±16.1*#
DBP (mmHg)	73.4±7.5	74.3±7.3	85.2±10.2*#	81.2±10.4*#▲
FPG (mmol/L)	5.4±0.4	7.9±2.4*	5.4±0.4#	7.9±2.6*▲
2hPG (mmol/L)	6.2±1.0	13.6±4.2*	6.2±1.0#	13.8±3.8*▲
HbAlc (%)	5.7±0.4	7.4±1.5*	5.8±0.4#	7.6±1.4*▲
Total cholesterol (mmol/L)	4.54±1.16	4.74±1.30	4.76±1.16■	4.88±1.29*
Triacylglycerol (mmol/L)	1.43±0.98	2.05±2.08*	1.73±1.15■§	2.21±1.76*▲
HDL-cholesterol (mmol/L)	1.19±0.31	1.12±0.34■	1.19±0.32§	1.09±0.28*▲
LDL-cholesterol (mmol/L)	2.61±0.82	2.70±0.88	2.73±0.86	2.79±0.93■
Creatinine (μmol/L)	60.3±11.2	64.4±12.6*	64.8±16.0*	68.6±20.5*#▲
Urine ACR (mg/g)	9.4(6.0-16.0)	11.5(7.1-19.7)*	12.1(7.7-	17.2(9.8-29.9)*#▲

			21.4)*

Categorical variables were expressed as numbers (%). Continuous variables were expressed as mean ± SD or median (25% and 75% quartile) for non-normally distributed variables. BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FPG, fasting plasma glucose; 2hPG, 2-h postprandial plasma glucose; HDL, high density lipoprotein; LDL, low-density lipoprotein; ACR, albumin-to-creatinine ratio. *vs*. normal group, $^{*}P < 0.01$, $^{■}P < 0.05$; *vs*. diabetes group, $^{\#}P < 0.01$, $^{\S}P < 0.05$; *vs*. hypertension group, $^{▲}P < 0.01$, $^{◇}P < 0.05$.

Table 2. Clinical characteristics among the normoalbuminuric, microalbuminuric and macroalbuminuric patients by groups of diabetes, hypertension and both diabetes and hypertension

	Normoalbuminuric N=1256	Microalbuminuric N=174	Macroalbuminuric N=23
Age (years)	60.3±9.3	62.0±9.1■	64.7±9.2■
Sex (men/women)	517/739	78/96	17/6
Smoking	150(11.9%)	16(9.2%)	3(13.0%)
Alcohol drinking	85(6.8%)	8(4.6%)	1(4.3%)
Cardiovascular events	202(16.1%)	41(23.6%)■	10(43.5%)*
BMI (kg/m^2)	26.6±3.8	27.3±4.5■	26.4±3.4
Waist (cm)	90.2±9.6	91.9±11.1■	93.5±7.9
Waist-to-hip ratio	0.91±0.06	0.91±0.07	0.95±0.06*§
SBP (mmHg)	136.0±17.9	144.0±19.6*	152.9±18.0*§
DBP (mmHg)	80.1±10.3	81.2±11.5	78.4±10.4
FPG (mmol/L)	6.9±2.2	7.9±3.0*	8.7±2.8*
2hPG (mmol/L)	11.0±4.7	12.4±5.5*	14.8±5.0*§
HbAlc (%)	6.8±1.4	7.4±1.7*	8.3±2.0*§
Total cholesterol (mmol/L)	4.76±1.25	4.98±1.24■	5.08±1.63
Triacylglycerol	1.95±1.70	2.31±1.83■	2.29±1.65

(mmol/L)			
HDL-cholesterol (mmol/L)	1.14±0.32	1.14±0.31	1.13±0.37
LDL-cholesterol (mmol/L)	2.73±0.89	2.80±0.88	2.80±1.19
Serum creatinine (μmol/L)	64.76±14.16	69.46±16.95*	105.40±57.61*#

Categorical variables were expressed as numbers (%). BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; FPG, fasting plasma glucose; 2hPG, 2-h postprandial plasma glucose; HDL, high density lipoprotein; LDL, low-density lipoprotein. *vs*. Normoalbuminuric group, *$P < 0.01$, ■$P < 0.05$; *vs*. Microalbuminuric group, #$P < 0.01$, §$P < 0.05$.

Table 3. Prevalence of albuminuric by a subgroup of diabetes, hypertension and both diabetes and hypertension.

	Albuminuric		
	Total (%)	Microalbuminuric (%)	Macroalbuminuric (%)
Diabetes (n=475)	40 (8.4%)*	40 (8.4%)*	0
Known	28 (5.9%)	28 (5.9%)■	0
Newly diagnosed	12 (2.5%)	12 (2.5%)	0
Hypertension (n=477)	47 (9.9%)*	46 (9.7%)*	1
Known	31 (6.5%)	30 (6.3%)	1
Newly diagnosed	16 (3.4%)	16 (3.4%)	0
Diabetes and hypertension (n=501)	110 (22.0%)*#▲	88 (17.6%)*#▲	22 (4.4%)*#▲
Known (diabetes)	59 (11.8%) §	44 (8.8%) §	15 (3.0%)
Newly diagnosed (both)	14 (2.8%)	12 (2.4%)	2
Known (diabetes) and Newly diagnosed (hypertension)	15 (3.0%)	13 (2.6%)	2
Known (hypertension) and Newly diagnosed (diabetes)	22 (4.4%)	19 (3.8%)	3

Total (n=1453)	197 (13.6%)	174 (12.0%)	23 (1.6%)

Data were expressed as number (%). For categories with absolute count of subjects <5, prevalence or percentage was not provided. *vs*. normal group, *$P < 0.01$; *vs*. diabetes group, #$P < 0.01$; *vs*. hypertension group, ▲$P < 0.01$; §$P < 0.01$, known diabetes and hypertension versus newly diagnosed diabetes and hypertension. ■$P < 0.05$, known diabetes versus newly diagnosed diabetes.

Table 4.

A. Multiple logistic regression analysis the risk factors for microalbuminuric in overall patients

Varibles	β	S.E.	Wald χ^2	*P*	*OR* (95% CI)
SBP	0.652	0.177	13.569	< 0.001	1.92 (1.36-2.72)
DBP	0.424	0.204	4.316	0.038	1.53 (1.02-2.28)
HbAlc	0.839	0.176	22.788	< 0.001	2.31 (1.64-3.26)

B. Risk factors for microalbuminuric in diabetic subjects with hypertension or not

Varibles	β	S.E.	Wald χ^2	*P*	*OR* (95% CI)
FBG	0.582	0.211	7.621	0.006	1.79 (1.18-2.71)
Hypertension	0.896	0.204	19.324	< 0.001	2.45 (1.64-3.65)