Journal of Associated Medical Sciences 2026; 59(2): 15-23

JAMS
Journal of Associated Medical Sciences

Scopus Indexed & Thai-Journal Citation Index Centre (TCI)

Journal of Associated Medical Sciences

Journal homepage: https://www.tci-thaijo.org/index.php/bulletinAMS/index

Prevalence and risk factors of elevated urinary albumin-to-creatinine ratio in a Thai academic population

Suwatsin Kittikunnathum, Pharisa Nanthawong, Piyawan Bunpo*

Division of Clinical Chemistry, Department of Medical Technology, Faculty of Associated Medical Sciences, Chiang Mai University, Chiang Mai Province, Thailand.

ARTICLE INFO

Article history:
Received 17 September 2025
Accepted as revised 16 December 2025
Available online 9 January 2026

Keywords:
Urinary albumin-to-creatinine ratio, microalbuminuria, obesity, diabetes, systemic lupus erythematosus, chronic kidney disease.

ABSTRACT

Background: The urinary albumin–to–creatinine ratio (UACR) is a key marker for early kidney dysfunction. This study assessed UACR levels and their associations with demographic and clinical factors in a Thai university population.

Materials and methods: A cohort of 158 participants (53 males, 105 females) was recruited from Chiang Mai University between January and May 2024. Urinary albumin and creatinine were measured by turbidimetric immunoassay and creatininase method, respectively, and expressed as UACR (mg/gm creatinine). UACR was categorized as normoalbuminuria (<30 mg/gm creatinine), microalbuminuria (30-299 mg/gm creatinine), or clinical albuminuria (≥300 mg/gm creatinine). Data on body mass index (BMI), blood pressure, fasting blood glucose, physical activity, use of supplements or medications, and the presence of chronic conditions were also collected.

Results: Most participants (94.3%) had normoalbuminuria, whereas microalbuminuria and clinical albuminuria were observed in 4.4% and 1.3% of participants, respectively. Overall, 71.5% were normotensive and 28.5% hypertensive. Based on BMI, 41.1% had normal weight, 18.4% were overweight, and 34.8% were obese. Nearly half reported no regular exercise, and the majority were non–smokers (98.1%) and non–drinkers (83.5%). Regular supplement or medication use was reported by 57.0%, mainly vitamins/minerals and fish oil. Chronic diseases occurred in 37.3%, with hypercholesterolemia (10.8%) and hypertension (8.9%) being most common. Hypercholesterolemia, hypertension, allergy, type II diabetes, lifestyle factors, and supplement or medication use were not associated with albuminuria (Chi-square, $p>0.05$), whereas obesity class II, elevated fasting blood glucose (≥126 mg/dL) and systemic lupus erythematosus (SLE) were significantly associated with increased urinary albumin excretion (Chi-square, $p<0.05$).

Conclusion: Elevated blood glucose, obesity, and SLE were significantly linked to increased UACR, emphasizing the importance of early identification and management of these risk factors to prevent kidney disease progression.

Introduction

Chronic kidney disease (CKD) is a significant global health burden, with its prevalence increasing due to the rising incidence of metabolic disorders such as obesity, diabetes mellitus, and hypertension.[1] Early detection of renal dysfunction is crucial for preventing disease progression, and one of the most widely used markers for early kidney damage is the urinary albumin–to–creatinine ratio (UACR).[2-4] Microalbuminuria,

* **Corresponding contributor.**
Author's Address: *Division of Clinical Chemistry, Department of Medical Technology, Faculty of Associated Medical Sciences, Chiang Mai University, Chiang Mai Province, Thailand.*
E-mail address: piyawan.b@cmu.ac.th
doi: 10.12982/JAMS.2026.033
E-ISSN: 2539-6056

an intermediate stage between normoalbuminuria and clinical albuminuria, serves as an important indicator of endothelial dysfunction and renal impairment, particularly among individuals with metabolic syndrome and cardiovascular risk factors.[5]

Evidence on UACR prevalence in healthy Thai adults is lacking, as existing studies are limited to clinic–based or high–risk populations. In diabetic cohorts, microalbuminuria prevalence ranged from 26-27% in hospital and multi–center studies.[6,7] Among nondiabetic hypertensive patients, 16.6% had microalbuminuria.[8] A large community hospital review (N=36,172) applying KDIGO criteria reported CKD in 8.2% of adults, with UACR identifying early CKD cases beyond eGFR detection.[9] In community screening of high risk adults, albuminuria or reduced eGFR was found in 20.3% of participants.[10] These findings highlight the absence of data on UACR in healthy Thai populations. In Thailand, based on patient reports from hospitals under the Ministry of Public Health, there were a total of 1,007,251 patients diagnosed with CKD across stages 1 to 5 in 2021.[11] This highlights the urgent need for early detection and intervention to mitigate disease progression and reduce healthcare burdens. In response to this growing concern, the present research was conducted from January to May 2024 at Chiang Mai University's Faculty of Associated Medical Sciences to investigate key metabolic risk factors associated with CKD.

Obesity has been strongly linked to kidney dysfunction, with evidence suggesting that excess adiposity contributes to glomerular hyperfiltration, inflammation, and renal fibrosis.[12] Furthermore, elevated fasting blood sugar levels and type II diabetes mellitus are well–documented risk factors for nephropathy, leading to progressive albuminuria and eventual decline in renal function.[13,14] While hypercholesterolemia is a recognized contributor to cardiovascular disease, its direct impact on renal impairment remains controversial, with some studies failing to establish a significant correlation between dyslipidemia and microalbuminuria.[15]

The present study investigates the relationship between metabolic risk factors and renal dysfunction, as measured by UACR, in a sample population. Specifically, it examines the associations between obesity, diabetes, hypercholesterolemia, and other lifestyle factors with albuminuria status. By identifying key predictors of renal dysfunction, the study aims to provide insight into the early detection and prevention of CKD.

Materials and methods

Study participants

This study, conducted from January to May 2024 at the Faculty of Associated Medical Sciences, Chiang Mai University, included 158 participants (both male and female) aged 20 years and older. The inclusion criteria required participants to be in stable health without any acute illness at the time of enrollment. Prior to participation, all individuals received a comprehensive briefing regarding the study's objectives and methodology. Informed consent was obtained from each participant. Data collection included a range of biometric parameters, such as gender, age, height, weight, body mass index (BMI), blood glucose levels, physical activity, smoking and alcohol consumption habits, medication adherence, blood pressure, and any existing congenital conditions. Participants were instructed to avoid excessive fluid intake within 12 hours before sample collection and to refrain from physical exercise immediately prior to providing urine samples to minimize potential effects on urinary measurements. The urine collection process involved discarding the initial portion of the sample and retaining 10-15 milliliters of the midstream sample for analysis. Samples were stored and analyzed within 1-2 hours of collection.

Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Research Committee from the Faculty of Associated Medical Sciences, Chiang Mai University (AMSEC-66EX-046).

Laboratory measurements

Urinary albumin concentrations were measured using a turbidimetric immunoassay (BA400, BioSystems S.A., Barcelona, Spain). Urinary creatinine was measured using the creatininase method with the BA400 automated system (BioSystems S.A., Spain), and results were expressed as the UACR in mg/gm of creatinine. Microalbuminuria was defined according to the American Diabetes Association and the National Kidney Foundation guidelines, where UACR values ranged from 30 to 299 mg/gm creatinine. Reagents, calibrators, and controls were sourced from BioSystems S.A., Barcelona, Spain.

Statistical analysis

At the end of the study, there were 158 participants. Data were processed using the standard statistical software SPSS 17.0 (SPSS Software, Thailand). Categorical variables were analyzed using the Chi-square test, with statistical significance defined as $p<0.05$. Continuous variables were summarized as means±SD.

Results

Demographic and clinical characteristics of the study population

The study included 158 participants, comprising 53 males (33.5%) and 105 females (66.5%), aged between 20 and 64 years. Most participants were within the age ranges of 25.0-34.9 years (33.5%) and 35.0-44.9 years (32.3%), while smaller proportions were aged

45.0-54.9 years (23.4%), 55.0-64.9 years (9.5%), and 20.0-24.9 years (1.3%). Normotension was observed in 71.5% of individuals, while 28.5% had hypertension (systolic blood pressure >130 mmHg) (Table 1).

Table 1. Demographic and clinical features of the study population (N=158).

Parameter	Frequency	Percentage
Gender		
Male	53	33.5
Female	105	66.5
Age (years)		
20.0-24.9	2	1.3
25.0-34.9	53	33.5
35.0-44.9	51	32.3
45.0-54.9	37	23.4
55.0-64.9	15	9.5
Blood pressure		
Normotension	113	71.5
Hypertension (>130 mmHg systolic)	45	28.5
BMI (kg/m^2)		
Underweight (<18.5)	9	5.7
Normal (18.5-22.9)	65	41.1
Overweight (23.0-24.9)	29	18.4
Obese I (25.0-29.9)	40	25.3
Obese II (≥ 30.0)	15	9.5
Fasting blood sugar (mg/dL)		
<126	76	48.1
≥126	2	1.3
Not Determined	80	50.6
Exercise		
No	78	49.4
1-2 times/week	40	25.3
3-5 times/week	35	22.1
6-7 times/week	5	3.2
Current smoking		
No	155	98.1
Yes	3	1.9
Alcohol consumption		
No	132	83.5
1-2 times/week	18	11.4
3-5 times/week	5	3.2
6-7 times/week	3	1.9

Regarding body mass index (BMI), 5.7% of participants were underweight (<18.5 kg/m^2), 41.1% had normal weight (18.5-22.9 kg/m^2), 18.4% were overweight (23.0-24.9 kg/m^2), 25.3% had obesity class I (25.0-29.9 kg/m^2), and 9.5% had obesity class II (≥30.0 kg/m^2). Among participants, 48.1% had fasting blood glucose levels <126 mg/dL, while 1.3% had levels ≥126 mg/dL. However, 50.6% of participants did not have fasting glucose measurements available, representing a substantial proportion of missing data.

Physical activity levels varied, with 49.4% reporting no exercise, 25.3% exercising 1-2 times per week, 22.1% engaging in physical activity 3-5 times per week, and 3.2% exercising daily. Smoking prevalence was low, with 98.1% being non–smokers. Similarly, alcohol consumption was minimal, with 83.5% reporting no alcohol intake, 11.4% drinking 1-2 times per week, 3.2% consuming alcohol 3-5 times per week, and 1.9% drinking daily.

Medical and supplement use

A total of 57.0% of participants regularly consumed supplements or medications. The most used supplements included vitamins and minerals (35.4%), fish oil (7.0%), and collagen/fiber supplements (3.8%). Other substances, such as anti-hypertensive drugs (7.6%), lipid-reducing medications (2.5%), and diabetes medications (1.3%), were also reported (Table 2).

Table 2. Supplement or regular medicine use among the study population (N=158).

Parameter	Frequency	Percentage
Supplement or regular medicine		
No	68	43.0
Yes	90	57.0
- Vitamin and mineral	56	35.4
- Fish oil	11	7.0
- Collagen and fiber	6	3.8
- L–Carnitine	1	0.6
- Glutathione	1	0.6
- Probiotics and Prebiotics	3	1.9
- Protein supplement	4	2.5
- Glucosamine	2	1.3
- Medicinal plant	8	5.1
- Birth control pill	1	0.6
- Antacids	1	0.6
- Migraine medication	1	0.6
- Anti-inflammatory drug	1	0.6
- Anti-hypertensive drug	11	7.0
- Anti-allergic drug	1	0.6
- Thyroid drug	4	2.5
- Lipid reducing drug	12	7.6
- Uric acid reducing drug	1	0.6
- Anti-viral drug	1	0.6
- Adrenal grand drug	1	0.6
- Steroid drug	2	1.3
- Diabetes medication	1	0.6

Prevalence of chronic diseases

Among the participants, 37.3% had at least one chronic disease, with hypercholesterolemia (10.8%) and hypertension (8.9%) being the most prevalent. Other reported conditions included type II diabetes (2.5%), hyperuricemia (1.9%), hepatitis B virus infection (1.9%), and autoimmune diseases such as systemic lupus erythematosus (SLE) (0.6%) (Table 3).

Table 3. Prevalence of chronic diseases in the study population (N=158).

Parameter	Frequency	Percentage
Chronic disease		
No	99	62.7
Yes	59	37.3
- Diabetes type II	4	2.5
- Hypertension	14	8.9
- Hypercholesterolemia	17	10.8
- G6PD deficiency	3	1.9
- Allergy	14	8.9
- Kidney tumor	1	0.6
- Hyperuricemia	3	1.9
- Asthma	2	1.3
- Migraine	2	1.3
- Hepatitis B virus infection	3	1.9
- Cervical spondylosis	1	0.6
- Liver fibrosis	1	0.6
- Adrenal grand enlargement	1	0.6
- Systematic lupus erythematosus (SLE)	2	1.3
- Gastric ulcer	1	0.6
- Autoimmune disease	1	0.6
- Tonsillectomy	1	0.6
- Beta-thalassemia trait	1	0.6
- Irritable bowel syndrome	1	0.6

Table 3. Prevalence of chronic diseases in the study population (N=158) (continued).

Parameter	Frequency	Percentage
- Acid reflux	1	0.6
- Hyperthyroidism	1	0.6
- Hypothyroidism	2	1.3

Urinary albumin-to-creatinine ratio and kidney function

Analysis of UACR levels revealed that 94.3% of participants had normoalbuminuria (0.3-28.5 mg/gm creatinine), while 4.4% exhibited microalbuminuria (35.7-190.6 mg/gm creatinine), and 1.3% had clinical albuminuria (576.8-670.0 mg/gm creatinine) (Table 4).

Table 4. Distribution of albuminuria categories based on UACR levels in spot urine samples (N=158).

Category	UACR ratio (mg albumin/gm creatinine)	Mean mg albumin/gm creatinine (range)	Spot urine N (%)
Normoalbuminuria	<30	6 (0.3-28.5)	149 (94.3)
Microalbuminuria	30-299	113 (35.7-190.6)	7 (4.4)
Clinical albuminuria	≥300	623 (576.8-670.0)	2 (1.3)

Comparison of normoalbuminuria and microalbuminuria/ clinical albuminuria groups

Participants with microalbuminuria or clinical albuminuria (N=9, 5.7%) were compared to those with normoalbuminuria (N=149, 94.3%). The mean age was slightly higher in the microalbuminuria/clinical albuminuria group (mean 42.5 years, range 30.2-60.9) compared with the normoalbuminuria group (mean 40.1 years, range 22.8-59.6), however, this difference was not statistically significant (p>0.05) (Table 5).

Table 5. Comparison of demographic and clinical parameters between normoalbuminuria and elevated albuminuria groups (N=158).

Parameter	Normoalbuminuria	Microalbuminuria and Clinical albuminuria	*p* value
Number	149 (94.3)	9 (5.7)	
Age (years) (range)	Mean = 40.1 (22.8-59.6)	Mean = 42.5 (30.2-60.9)	>0.05
Sex			
Male (%)	51 (32.3)	2 (1.3)	>0.05
Female (%)	98 (62.0)	7 (4.4)	>0.05
BMI (kg/m²)			
Underweight (%)	9 (5.7)	0	>0.05
Normal (%)	62 (39.2)	3 (1.9)	>0.05
Overweight (%)	29 (18.4)	0	>0.05
Obese I (%)	37 (23.4)	3 (1.9)	>0.05
Obese II (%)	12 (7.6)	3 (1.9)	<0.05
Blood pressure			
Normotension (%)	107 (67.7)	6 (3.8)	>0.05
Hypertension (%)	42 (26.6)	3 (1.9)	>0.05
Fasting blood sugar (mg/dL)			
<126 (%)	70 (44.3)	6 (3.8)	>0.05
≥126 (%)	1 (0.6)	1 (0.6)	<0.05
Not Determined (%)	78 (49.4)	2 (1.3)	>0.05
Exercise			
No (%)	71 (44.9)	7 (4.4)	>0.05
1-2 times/week (%)	40 (25.3)	0	>0.05
3-5 times/week (%)	33 (20.9)	2 (1.3)	>0.05
6-7 times/week (%)	5 (3.2)	0	>0.05
Current smoking			
No (%)	146 (92.4)	9 (5.7)	>0.05
Yes (%)	3 (1.9)	0	>0.05

Table 5. Comparison of demographic and clinical parameters between normoalbuminuria and elevated albuminuria groups (N=158) (continued).

Parameter	Normoalbuminuria	Microalbuminuria and Clinical albuminuria	*p* value
Alcohol consumption			
No (%)	124 (78.5)	8 (5.1)	>0.05
1-2 times/week (%)	18 (11.4)	0	>0.05
3-5 times/week (%)	4 (2.5)	1 (0.6)	>0.05
6-7 times/week (%)	3 (1.9)	0	>0.05
Supplement or regular medicine			
No (%)	64 (40.5)	4 (2.5)	>0.05
Yes (%)	85 (53.8)	5 (3.2)	>0.05
Chronic disease			
No (%)	94 (59.5)	5 (3.2)	>0.05
Yes (%)	55 (34.8)	4 (2.5)	<0.05
- Diabetes type II (%)	3 (1.9)	1 (0.6)	>0.05
- Hypercholesterolemia (%)	16 (10.1)	1 (0.6)	>0.05
- Allergy (%)	13 (8.2)	1 (0.6)	>0.05
- SLE (%)	2 (1.3)	1 (0.6)	<0.05

Sex distribution did not differ significantly between the groups (p>0.05). However, a significantly higher proportion of individuals with microalbuminuria/clinical albuminuria were classified as obese class II (p<0.05). No significant associations were found between hypertension, smoking, alcohol consumption, or physical activity and albuminuria status (p>0.05). Participants with fasting blood glucose ≥126 mg/dL were significantly more likely to present with microalbuminuria or clinical albuminuria compared to those with lower glucose levels (p<0.05).

Participants with chronic diseases such as hypercholesterolemia, type II diabetes, allergy, and other conditions showed no significant association with albuminuria (p>0.05). In contrast, systemic lupus erythematosus (SLE) was significantly associated with increased urinary albumin excretion (p<0.05).

Discussion

The findings of this study provide important insights into urinary albumin excretion patterns within a cohort of 158 participants from the Faculty of Associated Medical Sciences, Chiang Mai University. The measurement of UACR serves as a key biomarker in assessing kidney function and detecting early signs of kidney damage, particularly in individuals with risk factors for chronic kidney disease.[2-4] The findings revealed that most participants (94.3%) had normoalbuminuria, with a mean age of 40.1 years (range 22.8-59.6), indicating preserved renal function in most of this cohort. In contrast, a small proportion (5.7%) exhibited microalbuminuria or clinical albuminuria, with a mean age of 42.5 years (range 30.2-60.9), suggesting early kidney dysfunction that may require closer clinical monitoring to prevent further progression.

Microalbuminuria, defined as UACR levels between 30 and 299 mg albumin/g creatinine, is a recognized marker for renal injury and an early indicator of CKD. Evidence on UACR prevalence in healthy Thai adults is limited, as most studies focus on clinic-based or high risk populations. Microalbuminuria was reported in 26-27% of diabetic.[6,7] and 16.6% of hypertensive patients.[8] A community hospital review found CKD in 8.2% of adults, and high risk community screening detected albuminuria or reduced eGFR in 20.3%.[10] These findings emphasize the lack of representative data on UACR in healthy Thais. In U.S. adults without diabetes (NHANES 1999-2020), the prevalence of albuminuria was 9.7%,[16] whereas the present study observed a lower prevalence of 4.4%, consistent with findings in lower-risk populations compared to those with diabetes or hypertension.[17] Clinical albuminuria (UACR ≥300 mg albumin/g creatinine), indicative of more advanced kidney damage, was observed in 1.3% of participants. This finding highlights the importance of early detection and intervention to prevent progression to more severe forms of CKD.

In terms of factors associated with albuminuria, the study did not find significant correlations between hypertension, smoking, alcohol consumption, or physical activity and the presence of microalbuminuria or clinical albuminuria. The lack of association with hypertension, smoking, and physical inactivity was unexpected given their known impact on kidney disease. This may be explained by the relatively young age of participants, the high proportion of normotensive individuals (71.5%), and the low prevalence of smoking (1.9%) and alcohol consumption (16.5%), which likely reduced statistical power and exposure variability to detect significant associations.[18,19]

Interestingly, a significant association was observed between elevated fasting blood glucose levels (≥126 mg/dL) and the presence of microalbuminuria/ clinical albuminuria. Elevated blood glucose is a well-established risk factor for the development of diabetic nephropathy, a leading cause of CKD globally.[20] Impaired fasting glucose (IFG) was independently associated with the development of albuminuria in a Chinese community–based population. The risk of albuminuria increased progressively with higher fasting blood glucose levels, suggesting that individuals with IFG should be prioritized for albuminuria screening to enable early detection and intervention.[21] The association between hyperglycemia and increased urinary albumin excretion emphasizes the need for diligent management of blood glucose levels in preventing kidney damage, especially in individuals at risk of diabetes or those already diagnosed with the condition.

In this study, among chronic diseases, only SLE was significantly associated with increased urinary albumin excretion. This finding aligns with previous literature demonstrating that SLE predisposes individuals to kidney damage. Although diabetes mellitus (DM) is known to cause renal injury through mechanisms such as hyperglycemia-induced glomerular hypertension,[20] no significant association with albuminuria was observed in this cohort. This may be due to the fact that two participants with type 2 DM had normal blood glucose levels (data not shown), one had a glucose level of 127 mg/dL (data not shown), and all three exhibited normoalbuminuria, whereas the single participant with type 2 DM and clinical albuminuria had a fasting blood glucose level of 300 mg/dL (data not shown). These findings suggest that individuals with type 2 DM who maintain good glycemic control may have a lower risk of developing albuminuria. In contrast, SLE, an autoimmune disorder that frequently affects the kidneys and can lead to glomerulonephritis,[22] remains a strong determinant of albuminuria. The finding underscores the importance of monitoring kidney function in individuals with SLE to prevent further renal deterioration. A nationwide study (2017-2020) reported an SLE prevalence of 85.8 per 100,000 persons in Thailand, with a female-to-male ratio of 9.6:1 and the highest rates in adults aged 40-49 years and in the southern region (178.5/100,000).[23] Thai lupus nephritis studies consistently show high rates of proteinuria, typically assessed by 24-hour urine protein or urine protein creatinine ratio, while UACR measurements are rarely reported in published Thai cohorts.[24,25]

Moreover, while obesity is a known risk factor for the development of kidney disease,[26] a significantly higher proportion of participants with microalbuminuria or clinical albuminuria were classified as obese class II. This is an important observation, as the relationship between obesity and kidney function is well established. Obesity can lead to glomerular hyperfiltration, increased intraglomerular pressure, and ultimately kidney damage over time.[27] These results highlight those higher degrees of obesity, particularly class II obesity, may exert an independent and measurable effect on early kidney dysfunction, reinforcing the need for targeted weight management strategies.

Limitations

Several limitations should be noted. First, the study was conducted at a single academic institution with a relatively small sample size (N=158), which may limit the generalizability of the findings to the broader Thai population. A second limitation was the absence of fasting glucose data in 80 participants, of whom only two had albuminuria; this missing information may have introduced bias. Third, the small number of individuals with elevated UACR (N=9) limited the statistical power to detect associations with some risk factors. Finally, only univariate analyses were performed; future studies should employ multivariate models to adjust for potential confounding variables.

Conclusion

In conclusion, the findings highlight the significance of urinary albumin as an indicator of early kidney dysfunction and reinforce the need for regular monitoring, especially among individuals with risk factors such as elevated blood glucose, obesity, and SLE. Although the overall prevalence of albuminuria was low in this cohort, the associations observed with certain demographic and clinical factors suggest that targeted interventions could help mitigate the risk of progression to more severe kidney disease. Further research is needed to explore the long–term implications of these early signs of kidney dysfunction and to identify effective strategies for prevention and management.

Ethical approval

This study was reviewed and approved by the Ethics Research Committee from Faculty of Associated Medical Sciences, Chiang Mai University, (AMSEC-66EX-046).

Conflict of interests

The authors declare no conflict of interest.

CRediT authorship contribution statement

Piyawan Bunpo: conceived and designed the study, carried out all the experimental work and statistical analysis, interpreted and prepared the manuscript; **Suwatsin Kittikunnathum**: carried out all the experimental work and statistical analysis, interpreted and prepared the manuscript; **Pharisa Nanthawong**: carried out all the experimental work and statistical analysis. All authors read and approved the final manuscript.

Acknowledgements

This work was supported by the Faculty of Associated Medical Sciences, Chiang Mai University. The funders had no role in study design, data collection and analysis, interpretation of data and preparation of the manuscript.

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