

Research Article

Screening of Urinary Albumin-to-Creatinine Ratio: A Real-World Audit in Indian Outpatient Diabetes-Care Settings

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Abstract

Background: To describe the real-world distribution of urinary albumin-to-creatinine ratio (ACR) categories, reported from opportunistic screening of patients with diabetes mellitus (DM), attending outpatient diabetes-care settings across India.

Methods: The analysis represents a cross-sectional audit of urinary ACR screening reports, conducted as a single spot-test, from 11,493 patients with DM across 14 Indian cities during 2024 to 2026. Patients were classified into urinary ACR categories of <30 mg/g, 30 to 300 mg/g, or >300 mg/g. The ACR <30 mg/g category was further sub-classified into <10 mg/g and 10 to 29 mg/g subgroups. Data are summarized descriptively, as counts and percentages.

Results: Of the 11,493 patients screened with a single spot-test, 8,142 (70.8%) were reported with ACR <30 mg/g, 2,182 (19.0%) with ACR 30 to 300 mg/g, and 1,169 (10.2%) with ACR >300 mg/g. Overall, 3,351 patients (29.2%) had urinary ACR at or above the 30 mg/g threshold. Within the ACR <30 mg/g category, 2,382 patients (20.7% of the total) had ACR <10 mg/g while 5,760 (50.1% of the total) fell within the high-normal 10 to 29 mg/g range, making this the single largest subgroup in the cohort.

Conclusions: In this large real-world audit, roughly half of all patients with DM had urinary ACR values

in the high-normal (10 to 29 mg/g) range, and 29.2% had urinary ACR ≥ 30 mg/g. Because low-grade albuminuria within the 'normal' range carries recognized prognostic significance, these descriptive data have relevance for screening and monitoring of early urinary ACR in at-risk patients, in primary and secondary care settings.

Keywords: albumin-to-creatinine ratio; albuminuria; high-normal albuminuria; diabetes mellitus; diabetic kidney disease; real-world audit; KDIGO; cardiovascular risk

Background

The urinary albumin-to-creatinine ratio (ACR) is the guideline-preferred measure for staging albuminuria in patients with diabetes mellitus (DM) [1]. Under the KDIGO 2024 framework, an ACR below 30 mg/g is designated category A1 ('normal to mildly increased'), values of 30 to 300 mg/g define category A2 (moderately increased albuminuria), and values above 300 mg/g define category A3 (severely increased albuminuria) [1]. Diabetic kidney disease (DKD) remains a leading contributor to chronic kidney disease (CKD) and to cardiovascular morbidity in India, and albuminuria is one of its earliest detectable markers [2,3].

Global and regional burden of diabetic kidney disease.

The global burden of DKD is substantial and rising. In 2024, the worldwide adult diabetes population reached an estimated 588.7 million,

with projections indicating an increase to 852.5 million by 2050 [4].

Analysis of the 2021 Global Burden of Disease (GBD) database documented over 107 million prevalent cases of chronic type 2 DKD globally, representing an 85% increase from 58 million cases in 1990 [5]. A separate GBD-based projection estimated that more than 1.3 billion people of all ages will be living with diabetes by 2050 [6]. DKD develops in nearly half of patients with type 2 DM and approximately one-third of those with type 1 DM during their lifetime, and it remains the leading cause of end-stage renal disease worldwide [7]. More than 80% of people with diabetes live in low- and middle-income countries, where the greatest relative increase in prevalence is expected [7]. Worldwide, the prevalence of kidney replacement therapy is projected to more than double to 5.4 million people by 2030, with the most growth anticipated in Asia [7].

India-specific epidemiology. India bears a disproportionate share of this burden. National estimates indicate that approximately 77 million adults are currently living with diabetes [8]. The landmark ICMR-INDIAB study (ICMR-INDIAB-22), a nationally representative survey of 25,408 individuals, reported a significant association between impaired kidney function and diabetes and hypertension across Indian states [9]. A recent meta-analysis estimated the pooled prevalence of DKD among Indian patients with type 2 DM at 44% (95% CI: 31-56%), with regional figures of approximately 45% in southern India [10]. Evidence from the ICMR-INDIAB study and subsequent regional investigations suggests that 34-45% of individuals with type 2 DM in India have evidence of kidney involvement [8]. A recent analysis of CKD epidemiology in India using the GBD 2023 database further highlighted rising incidence, prevalence, and disability-adjusted life years across Indian states, with diabetes as the dominant driver [11]. Despite this burden, CKD in India frequently remains undiagnosed in primary-care settings, underscoring the need for systematic screening [8,12].

Although the 30 mg/g threshold is widely used to flag 'abnormal' albuminuria, a substantial body of evidence indicates that risk associated with urinary albumin excretion is continuous rather than dichotomous, extending well below this cut-off [13,14]. In the community-based Framingham Heart Study, low-grade albuminuria, defined as urinary albumin excretion below the microalbuminuria threshold, independently predicted incident cardiovascular disease (CVD) and all-cause mortality even among non-diabetic, non-hypertensive individuals, challenging the notion that an ACR under 30 mg/g reflects uniformly 'normal' excretion [13]. The Heart Outcomes Prevention Evaluation (HOPE) study similarly demonstrated that any degree of albuminuria is a risk factor for cardiovascular events in individuals with or without DM, with risk increasing continuously starting well below the microalbuminuria cutoff [14]. Consistent with a graded relationship, low-grade albuminuria has been associated with higher estimated 10-year cardiovascular risk in hypertensive and diabetic patients in primary care [15], and it is now regarded as an important prognostic marker of cardio-renal risk across non-communicable disease populations [16].

This graded risk is clinically relevant within the defined 'normal' range of urinary ACR levels. Contemporary evidence indicates that, even below 30 mg/g, higher ACR values, in the region of roughly 10 mg/g and above, predict future decline in kidney function and progression of kidney disease in people with DM [17,18]. In the Atherosclerosis Risk In Communities (ARIC) study, high-normal albuminuria (10-29 mg/g) was associated with a 91% increased risk of incident heart failure compared to optimal levels (<5 mg/g), even after adjustment for traditional cardiovascular risk factors [19]. The upper part of the ACR <30 mg/g range, here termed the high-normal range (10 to 29 mg/g), therefore represents a clinically important subgroup: patients labelled 'normal' by a single threshold-based reading who nonetheless carry measurably elevated cardio-renal risk and remain within a potentially modifiable window [16,19].

Distinguishing this high-normal subgroup from truly normal excretion (<10 mg/g) is not routinely done in everyday practice, yet it may materially change how a patient is monitored [20].

Against this background, this report presents descriptive findings from a multi-city, real-world audit that quantified the distribution of ACR categories among patients with DM attending outpatient diabetes-care settings across 14 Indian cities from 2024 to 2026. The objective was to characterize, using routinely collected data, the proportion of patients in each KDIGO risk category, with particular focus on the size of the high-normal (10 to 29 mg/g) subgroup within the ACR <30 mg/g range.

Methods

Study design and population

This was a cross-sectional, real-world audit of routinely collected urinary ACR screening data. The audit comprised 11,493 patients with a documented diagnosis of diabetes mellitus (type 1 or type 2) who attended outpatient diabetes-care settings across 14 Indian cities during the period 2024 to 2026. Inclusion criteria. (i) Adults (≥18 years) with a documented clinical diagnosis of diabetes mellitus; (ii) attending an outpatient diabetes-care or general-medicine consultation at a participating site during the audit period; (iii) having at least one spot urinary ACR result obtained using the specified commercially available point-of-care uACR test kit during the visit.

Exclusion criteria. (i) Patients without a confirmed DM diagnosis; (ii) patients with an intercurrent febrile illness, urinary tract infection, or menstruation at the time of sampling (conditions known to cause transient albuminuria); (iii) duplicate entries – only one ACR result per patient was included; in the event of multiple tests, the first available result was retained; (iv) samples flagged as invalid or indeterminate by the testing device.

Setting and data source. Participating sites were outpatient diabetes-care clinics, general-medicine outpatient departments, and endocrinology practices in 14 cities across India.

We derived data from de-identified, routinely collected screening reports shared by participating clinicians. We performed no additional study-specific visits, investigations, or interventions; all measurements were part of routine clinical care. We included one spot urinary ACR measurement per patient in the analysis.

Urinary ACR measurement and classification

We quantified albuminuria using urinary ACR. All measurements were performed on a single spot urine sample using commercially available point-of-care urinary ACR (uACR) test kits, used according to the manufacturer’s instructions at each participating site. We classified patients into the standard KDIGO 2024 albuminuria categories [1], as shown in Table 1.

Table 1. KDIGO 2024 albuminuria categories [1].

Catego ry	KDIGO Stage	Descri ption	ACR (mg/g)	ACR (mg/m mol)	Forme r Terms
A1	G1–G5, A1	Norma l to mildly	<30	<3	Normo albumi nuria
A2	G1–G5, A2	Moder ately increa	30– 300	3–30	Microa lbumin uria
A3	G1–G5, A3	Severe ly increa sed	>300	>30	Macro albumi nuria

Adapted from KDIGO 2024 Clinical Practice Guideline [1]. The sub-classification of A1 into <10 mg/g ('truly normal') and 10–29 mg/g ('high-normal') used in this audit is not part of the formal KDIGO staging but is adopted based on evidence of graded cardio-renal risk below 30 mg/g (see Discussion).

To describe the distribution within the ACR <30 mg/g category, it was further partitioned into two subgroups: a truly normal subgroup (<10 mg/g) and a high-normal subgroup (10 to 29 mg/g).

Statistical analysis

We used descriptive statistics for the analysis. Results are reported as counts and percentages of the total audited cohort. Absolute category counts were derived by applying the observed proportions

The total sample is subject to rounding; the two subgroups in the ACR <30 mg/g category are reported separately. We performed no inferential testing, modeling, or imputation.

Results

The audit comprised 11,493 patients with DM, from outpatient settings across 14 Indian cities. Across the total patient cohort, 8,142 patients (70.8%) had urinary ACR <30 mg/g, 2,182 (19.0%) had urinary ACR 30 to 300 mg/g, and 1,169 (10.2%) had urinary ACR >300 mg/g. Overall, 3,351 patients (29.2%) had urinary ACR ≥30 mg/g. Table 2 summarizes the distribution.

Table 2. Albuminuria category distribution in the audited cohort (N = 11,493).

ACR (mg/g)	KDIGO Category	Description	Patients, n (%)
<30	A1	Normal to mildly	8,142 (70.8%)
<10	A1 (truly normal)	Low-normal subgroup	2,382 (20.7%)
10–29	A1 (high-normal)	High-normal subgroup	5,760 (50.1%)
30–300	A2	Moderately increased	2,182 (19.0%)
>300	A3	Severely increased	1,169 (10.2%)
≥30	A2 + A3	Albuminuria present	3,351 (29.2%)

Sub-classifying the ACR <30 mg/g category revealed that the majority of patients occupied the upper part of the sub-30 mg/g range. 2,382 patients (20.7% of the cohort) had ACR <10 mg/g, whereas 5,760 (50.1%) had ACR in the high-normal 10 to 29 mg/g subgroup

Discussion

In this multi-city real-world audit of 11,493 patients with DM, three quantitative observations stand out. First, roughly three in ten patients (29.2%) already had albuminuria at or above the 30 mg/g threshold (A2 + A3). Second, and less commonly appreciated, the high-normal 10 to 29 mg/g subgroup was the single largest group in the entire cohort, accounting for 50.1% of patients, more than the truly normal (<10 mg/g) and the elevated (≥30 mg/g) groups combined. Third, only about one in five patients (20.7%) had genuinely low urinary albumin excretion (<10 mg/g). Taken together, these data indicate that the 'normal' ACR report, when based on a single 30 mg/g cut-off, encompasses a large subgroup whose albumin excretion is measurably above truly normal levels.

Comparison with Indian epidemiological data

The proportion of patients with albuminuria ≥30 mg/g in this audit (29.2%) is broadly consistent with the prevalence of microalbuminuria reported in Indian clinic-based DM cohorts. In a large South Indian diabetes-center study of 1,425 patients, microalbuminuria prevalence was 36.3%, rising with longer diabetes duration and higher blood pressure and glycemia [21]. A cross-sectional study from central India reported a microalbuminuria prevalence of 38.2% among 212 patients with DM [22], and a north Indian study of newly diagnosed DM found nephropathy in 32.9% at the time of diagnosis, underscoring that renal involvement is often present early [23]. The community-based India Microalbuminuria Survey similarly reported microalbuminuria in approximately 31% of hypertensive patients with concomitant DM[24]. The slightly lower A2 + A3 figure in the present audit (29.2%) is plausibly explained by its reliance on a single spot sample and by differences in case mix, but the overall alignment supports the external validity of the audit's albuminuria burden.

Clinical significance of the high-normal (10 to 29 mg/g) subgroup

The dominant high-normal subgroup is the audit's most clinically salient finding. A single-threshold interpretation would classify all 8,142 (70.8%) patients with ACR <30 mg/g as 'normal'; yet the evidence base indicates that risk is graded across the <30 mg/g range.

Cardiovascular Risk: Cardiovascular risk. In the Framingham Heart Study, urinary albumin excretion below the microalbuminuria threshold predicted incident CVD and death in non-diabetic, non-hypertensive individuals, prompting the conclusion that an ACR under 30 mg/g should not be regarded as uniformly benign [13]. The HOPE study established that albuminuria is a continuous risk factor for cardiovascular events; for every 1 mg/mmol rise in ACR, even below the level of microalbuminuria, the adjusted hazard of the primary composite outcome MI, stroke, CVD death)

Increased by approximately 15% [14,25]. In a post-hoc analysis of the ACCORD trial involving patients with type 2 DM, even elevations in uACR within the normal range (<30 mg/g) were significantly associated with increased risk of major adverse cardiovascular events and total mortality [26]. In the ARIC study, comprising more than 10,000 community-dwelling participants, high-normal albuminuria (10–29 mg/g) was associated with a hazard ratio of 1.91 (95% CI: 1.38–2.66) for incident heart failure compared to optimal albuminuria (<5 mg/g), after adjustment for traditional cardiovascular risk factors [19]. A study of elderly men similarly showed that low-grade albuminuria independently predicted incident heart failure in a community-based cohort [27]. A recent multicenter retrospective study of 5,960 patients with coronary artery disease showed that even a low-level elevation in uACR (10–30 mg/g) was associated with significantly increased cardiovascular and all-cause mortality compared with patients with uACR <10 mg/g, regardless of diabetes status [28]. An American Heart Association (AHA) state-of-the-art review has described albuminuria as an underappreciated risk factor for CVD, reinforcing that screening should move beyond the single 30 mg/g threshold [16]. A 2025 state-of-the-art review in *Circulation* further synthesized evidence that albuminuria across the full continuum is a robust, independent predictor of cardiovascular, kidney, and metabolic outcomes [29].

Kidney disease progression: Low-grade albuminuria has likewise been associated with higher estimated 10-year cardiovascular risk in hypertensive and diabetic patients in primary care [15], and contemporary evidence suggests that ACR values above roughly 8 to 10 mg/g, still within the ‘normal’ range, predict progression of kidney disease in DM [17,18]. A Taiwanese study of 4,821 patients with type 2 DM and normoalbuminuria identified a UACR of approximately 15 mg/g as the optimal cut-off for predicting CKD progression [17]. The LEADER trial post-hoc analysis further demonstrated that a >30% reduction in albuminuria from baseline was

Associated with a lower risk of both major adverse cardiovascular events and a composite nephropathy outcome [30].

Conversely, a >30% rise in ACR was associated with higher risk of mortality, cardiovascular events, and CKD progression, supporting serial ACR monitoring as a modifiable target [18]. The ADA Standards of Care in Diabetes (2025) now recommend annual uACR screening in all patients with type 2 DM and integrated interpretation alongside eGFR [12].

In this audit, more than half of all patients fall into precisely this prognostically meaningful zone, representing a large group in whom a ‘normal’ result may provide false reassurance.

Implications for general medicine, internal medicine, and endocrinology

These descriptive findings translate into several practical implications for clinicians managing DM in India:

Adopt quantitative ACR as the routine screening test. Because the high-normal subgroup cannot be distinguished from truly normal excretion by qualitative dipstick methods, quantitative spot ACR, ideally on a first-morning sample, should be the default screening test, performed at diagnosis and at least annually in every patient with DM [1,12].

Treat 10 to 29 mg/g as an actionable ‘watch’ zone, not a normal result. For the ~50% of patients in this subgroup, a result below 30 mg/g should prompt reinforcement of glycaemic, blood-pressure, lipid, and lifestyle targets and closer surveillance, rather than discharge from renal monitoring [1,16,20].

Confirm and then track the ACR trajectory. Confirm a single elevated value (two of three samples over 3 to 6 months) to establish persistence; thereafter, the direction of change matters [1,18]. In patients with DM and CKD, a >30% reduction in ACR has been associated with lower risks of mortality, cardiovascular events, and CKD progression, whereas a >30% rise carries higher risk [18,30], supporting serial ACR monitoring as a modifiable target.

Integrate ACR with eGFR and global risk. ACR should be interpreted alongside eGFR and cardiovascular risk factors so that patients in the high-normal subgroup who also have hypertension, poor glycaemic control, or reduced eGFR are prioritised for intensified, guideline-directed cardio-renal protection [1,12].

Operational relevance to Indian practice. Given the large diabetes burden and frequently early renal involvement documented in Indian cohorts [9,10], embedding structured, quantitative ACR screening and recall systems into routine diabetes review is a low-cost, high-yield step for general physicians, internists, and endocrinologists alike.

These practice implications are drawn from the audit's descriptive distribution and the external evidence base; the audit did not evaluate any intervention and cannot establish treatment effects.

Limitations

Single-spot ACR per patient. Albuminuria status was based on one opportunistic spot urine ACR; persistence was not confirmed by repeat testing, so category assignment reflects a single time-point measurement rather than established chronicity [1].

Cross-sectional data. No longitudinal follow-up was available; the audit describes a point-in-time distribution and cannot characterize progression or outcomes.

Derived counts. Absolute category numbers were reconstructed from reported proportions and are subject to rounding.

Uneven site contribution and sampling. Patient numbers varied substantially across sites (42 to 1,706), and participants attending outpatient diabetes care may not represent the wider DM population.

Limited covariates. We did not include concurrent eGFR and clinical/demographic covariates (age, diabetes duration, glycaemic control, blood pressure, medications), precluding combined GFR and albuminuria staging, risk adjustment, or subgroup analysis.

Conclusions

In this multi-city real-world audit of 11,493 patients with DM, 70.8% were classified as ACR <30 mg/g (A1), 19.0% as ACR 30 to 300 mg/g (A2), and 10.2% as ACR >300 mg/g (A3), with 29.2% having albuminuria at or above the 30 mg/g threshold. Most strikingly, the high-normal 10 to 29 mg/g subgroup alone accounted for 50.1% of the cohort, the largest single subgroup. Because low-grade albuminuria within the 'normal' range is prognostically important for both cardiovascular and kidney outcomes [13,14,16,17,19], these descriptive data support routine quantitative ACR screening, careful attention to the high-normal subgroup, and serial ACR monitoring as part of everyday diabetes care in general medicine, internal medicine, and endocrinology.

Declarations

Ethics approval and consent to participate: This audit used routinely collected, de-identified urinary ACR screening reports; [state name of ethics committee / IRB and approval reference number, or the basis on which formal ethics review was waived for this retrospective audit of de-identified data – to be completed by the corresponding author].

Consent for publication: Not applicable (this manuscript presents no person's data, images, or identifiable information).

Availability of data and materials: The de-identified dataset analyzed in the current study was generated from routinely collected screening reports compiled by NeoDocs Healthcare Pvt Ltd. The dataset is proprietary and is not publicly available due to commercial confidentiality and third-party data-sharing restrictions. Reasonable requests for access to the aggregated, de-identified dataset may be directed to NeoDocs Healthcare Pvt Ltd. They will be considered subject to execution of a data-sharing agreement and any applicable ethics and regulatory requirements.

Competing interests: "The authors declare that they have no competing interests" or disclose any relationship with NeoDocs.

Funding: NeoDocs Healthcare Pvt Ltd. supported this work.

Authors' contributions: "AS conceived and designed the audit, interpreted the data, and drafted and revised the manuscript. All authors read and approved the final manuscript."

Acknowledgments: Not applicable.

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• *COI: Authors declare no conflict of interest.*

• *DOI: <https://doi.org/10.62996/daj.89052026>.*

*Cite this Article: Ashok Sarin. Screening of Urinary Albumin-to-Creatinine Ratio: A Real-World Audit in Indian Outpatient Diabetes-Care Settings. *Diabetes Asia Journal.* 2026;3 (3):01-09 <https://doi.org/10.62996/daj.89052026>*