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Original Article

Clinical Profile and Outcomes of Patients with the Most Common Hereditary Kidney Diseases at a Tertiary Care Hospital

Islam SF[1], Hossain MK*[2], Morshed SM[3], Rafi R[4], Karim MM[5], Mondal MC[6], Hossain RM[7]

Abstract

Background: Hereditary kidney diseases are an important cause of chronic kidney disease worldwide. Among these, Autosomal dominant polycystic kidney disease and Alport syndrome are the most common hereditary kidney diseases, leading to high blood pressure, progressive deterioration of kidney function and is responsible for a considerable portion of patients receiving hemodialysis globally.

Objective: To evaluate the clinical presentation, renal involvement, complications, and disease characteristics and outcomes of patients with the most common hereditary kidney disease that Autosomal Dominant Polycystic Kidney Disease and Alport syndrome, attending a tertiary care hospital in Bangladesh.

Methods: This prospective observational study was conducted over a period of 4 years 2022-2025 at the Department of Nephrology, Bangladesh Medical University, Dhaka, Bangladesh. A total of 170 patients, including 150 with polycystic kidney disease and 20 with Alport syndrome, were enrolled. Both group of patients were evaluated for clinical characteristics, family history, comorbidities, physical examination findings, laboratory investigations, imaging and renal function.

Results: A total of 170 patients with 150 had polycystic kidney disease and 20 had Alport syndrome were enrolled, including polycystic kidney disease patients 90 (60%) males and 60 (40%) females and cyst burden increased progressively with advancing age. Among 20 patients with a Male to Female ratio 19:1, mean age 20±8 years, Among patients with Alport syndrome, 30% exhibited fleck retinopathy, 75% had sensorineural deafness and a family history of kidney disease, and anterior lenticonus was identified in 20% of cases. Renal involvement was universal among patients with Alport syndrome. All patients (100%) had mild-to-moderate proteinuria, while nephrotic-range proteinuria was present in 80%. End-stage kidney disease was observed in 75% of patients, microscopic hematuria in 70%, hypertension in 60%, and gross hematuria in 25%. In contrast, among patients with polycystic kidney disease (, hypertension (26.7%) was the most common clinical manifestation, followed by dysuria (24.0%) and liver cysts (23.3%). Hematuria was also a common finding, with asymptomatic microscopic hematuria observed in 14.7% of patients and gross hematuria in 9.3%. Among the 150 patients with hereditary kidney diseases, In this study Among the 150 patients with hereditary kidney diseases, acute pyelonephritis was the most common clinical complication (8.0%), followed by cyst infections and salt-losing nephropathy (5.3% each). Acute kidney injury (4.7%) and cyst hemorrhage (4.0%) were also observed. More than half of the patients (55%) had early-stage chronic kidney disease (CKD stages I–II), whereas 45% had advanced CKD (stages III–V). Diabetes was the most common comorbidity (13.3%), followed by chronic pyelonephritis (7%) and Bronchial asthma (3%). Renal stone (3.0%) and Liver dys function (2%) were less frequently observed. Escherichia coli was the predominant pathogen for Urinary Tract Infection, followed by Pseudomonas, Klebsiella, Proteus, Enterobacter, Acinetobacter, and Candida species.

Conclusion: This study highlights the diverse clinical spectrum of hereditary kidney diseases, particularly Autosomal Dominant Polycystic Kidney Disease and Alport syndrome. Early recognition, regular assessment of renal function, family screening, and multidisciplinary management are essential for delaying disease progresson and improving patient outcomes.

1. Syed Fazlul Islam
Associate Professor, Department of Nephrology
Bangladesh Medical University, Dhaka, Bangladesh.
Email: dr.ripon113@gmail.com

2. Md. Kabir Hossain
Associate Professor, Department of Nephrology
Bangladesh Medical University
Email: drkhdmc@gmail.com

Correspondence to: Md. Kabir Hossain
Associate Professor, Department of Nephrology
Bangladesh Medical University (BMU), Dhaka, Bangladesh
Email: drkhdmc@gmail.com

3. Syed Mahbub Morshed
Associate Professor, Department of Nephrology
Shaheed Suhrawardy Medical College, Dhaka, Bangladesh
Email: smmorshed@yahoo.com

4. S M Remin Rafi
Medical Officer, Department of Nephrology
Bangladesh Medical University, Dhaka
Email: remin.rafi@yahoo.com

5. Md. Masudul Karim
Medical Officer, Department of Nephrology
Bangladesh Medical University
Email: masud15th@gamil.com

6. Manik Chandra Mondal
Assistant Professor, Department of Nephrology
Bangladesh Medical University, Dhaka, Bangladesh
Email: manikrmc40@yahoo.com

7. Rana Mokarram Hossain
Professor, Department of Nephrology
Bangladesh Medical University, Dhaka, Bangladesh
Email: ranamokarram@gmail.com

Introduction

Hereditary kidney diseases constitute an important cause of chronic kidney disease (CKD) and end-stage kidney disease (ESKD), contributing substantially to morbidity, mortality, and the need for renal replacement therapy worldwide. Among these disorders, Autosomal Dominant Polycystic Kidney Disease and Alport syndrome are the most common inherited kidney diseases, characterized by progressive renal dysfunction, hypertension, hematuria, proteinuria, and a variety of extra-renal manifestations [1]. Early diagnosis, appropriate monitoring, and timely intervention are essential to delay disease progression and improve long-term clinical outcomes.

Patients with Alport syndrome exhibited the characteristic clinical features of hereditary nephropathy. As Alport syndrome is predominantly an X-linked inherited disorder, males are more severely affected, whereas females are typically carriers and may have milder clinical manifestations, although some can also develop progressive kidney disease. Alport syndrome is another important hereditary kidney disease caused by mutations in the COL4A3, COL4A4, or COL4A5 genes, which encode type IV collagen, a major structural component of the glomerular basement membrane [2]. The disease is characterized by persistent microscopic hematuria, progressive proteinuria, sensory neural hearing deafness, ocular abnormalities such as anterior lenticonus and fleck retinopathy, and progressive decline in kidney function, frequently culminating in end-stage kidney disease [3]. The majority of cases follow an X-linked inheritance pattern, although autosomal dominant and autosomal recessive forms also occur. Early recognition of Alport syndrome facilitates appropriate renoprotective therapy, genetic counseling, and family screening. [4]. Autosomal Dominant Polycystic Kidney Disease is the most common inherited cystic kidney disorder, characterized by the progressive development of multiple fluid-filled cysts in both kidneys and various extra-renal organs [5]. It causes a gradual and irreversible decline in kidney function, ultimately leading to kidney failure. Autosomal Dominant Polycystic Kidney Disease affects approximately 1 in 400 to 1,000 live births and accounts for 5–10% of end-stage kidney disease worldwide, making it one of the leading inherited causes of renal failure [6]. The disease results from mutations in either the PKD1 or PKD2 genes, located on chromosomes 16p13.3 and 4q21, respectively, and follows an autosomal dominant pattern of inheritance with variable clinical expression [7]. Although considerable progress has been made in understanding the pathogenesis of Autosomal Dominant Polycystic Kidney Disease, the molecular mechanisms underlying disease progression remain incompletely understood. Polycystins, encoded by the PKD genes, are expressed in renal tubular epithelial cells as well as in the pancreatic and hepatic ducts. These proteins are localized to the primary cilium, where they regulate mechanosensory signaling, intracellular calcium homeostasis, cell proliferation, and tubular architecture. Mutations in polycystins disrupt these pathways, resulting in abnormal epithelial proliferation and progressive cyst formation [8].

The clinical course of autosomal dominant polycystic kidney disease is highly variable, even among affected members of the same family. Although patients are often asymptomatic during childhood, clinical manifestations usually appear in adulthood and include hypertension, hematuria, abdominal or flank pain, recurrent urinary tract infections, nephrolithiasis, and progressive deterioration of renal function [9]. Extra-renal manifestations such as hepatic cysts, intracranial aneurysms, cardiac valvular abnormalities, and colonic diverticulosis are also frequently encountered [10]. Hypertension is one of the earliest and most important clinical manifestations, primarily resulting from activation of the renin–angiotensin–aldosterone system, and is a major determinant of cardiovascular complications and progression of kidney disease [11]. Disease severity varies according to the underlying genotype, with PKD1 mutations generally associated with earlier onset and more rapid progression to kidney failure than PKD2 mutations [12]. Despite the considerable clinical burden of hereditary kidney diseases, information regarding their clinical characteristics, complications, and outcomes remains limited in Bangladesh. Therefore, the present study was undertaken to evaluate the clinical profile, renal involvement, disease characteristics, complications, microbiological findings of urinary tract infections, and clinical outcomes of patients with the most common hereditary kidney diseases, particularly autosomal dominant polycystic kidney disease and Alport syndrome, attending a tertiary care hospital. The findings are expected to improve understanding of these disorders and support earlier diagnosis, appropriate management, and better long-term patient care in resource-limited settings.

Methodology:

A prospective observational study was carried out in the Department of Nephrology, Bangladesh Medical University (BMU), Dhaka, Bangladesh. A total of 170 patients with hereditary kidney diseases, including 150 Polycystic Kidney Disease and 20 Alport syndrome enrolled in this study over

a period of 4 years. Patients with Polycystic Kidney Disease were diagnosed using the ultrasound-based Ravine's diagnostic criteria, while the diagnosis of Alport syndrome was established based on clinical features, family history, persistent urinary abnormalities, and characteristic audiological and ophthalmological findings. Pure tone audiometry and slit-lamp examination were performed for patients with suspected Alport syndrome. A detailed medical and family history was obtained from all patients, including a history of hereditary kidney disease, hypertension, dialysis, and Sensory neural Deafness among first-degree relatives. Information regarding the duration of hypertension, recurrent flank pain, recurrent urinary tract infection (UTI), hematuria, and other relevant symptoms was also recorded. Data were collected through face-to-face interviews using a structured questionnaire. Demographic information, including age and sex, was recorded. Relevant Laboratory investigations - complete blood count (CBC), urine routine microscopic examination (R/M/E) with culture/sensitivity test, serum creatinine, serum electrolytes, random blood sugar (RBS), ultrasonogram of whole abdomen (with MCC and PVR), CT scan of brain, plain x-Ray of kidney ureter and bladder (KUB) region were done following standard procedure. Serum creatinine levels were used to calculate the estimated glomerular filtration rate (eGFR), which was used to categorize the stages of chronic kidney disease (CKD). Pure tone audiometry, for sensory neural deafness, ophthalmology and slit- lamp examination eye was done. Demographic characteristics, clinical presentation, family history, comorbidities, laboratory findings, imaging results, renal involvement, complications, microbiological findings, and clinical outcomes were systematically recorded using a structured data collection form. After data verification and compilation, the dataset was entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp, Armonk, NY, USA) while categorical variables were presented as frequencies and percentages.

Rationale:

Hereditary kidney diseases, particularly Autosomal Dominant Polycystic Kidney Disease and Alport syndrome, are important causes of chronic kidney disease and end-stage kidney disease. Despite their clinical significance, data on their clinical profile and outcomes in Bangladesh are limited. Therefore, this study was undertaken to evaluate the clinical characteristics, complications, and outcomes of these disorders at a tertiary care hospital.

Limitation of study:

The study was conducted at a single tertiary care center. In addition, molecular genetic testing for PKD1, PKD2, COL4A3, COL4A4, and COL4A5 mutations was not available, limiting genetic confirmation and comprehensive family screening.

Key notes: Gross Hematuria, Acute pyelonephritis, Sensory neural deafness

Result:

A total of 170 patients with hereditary kidney diseases, including 150 Polycystic Kidney Disease and 20 Alport syndrome were included in this study to evaluate their clinical presentations, complications, and disease characteristics.

Table-01: Baseline Characteristics of the Study Participants with Polycystic Kidney Disease (n=150)

Characteristics	N = (150)	Percentage
M:F ratio (1.5:1)		
Age (24 - 62 years) mean age 36±12 years		
Sex Female Male	60 90	40% 60%
Positive Family History of Hypertension	20	13.3%
Family History of Multiple Renal Cysts	14	9.3%
Family History of Cerebral Hemorrhage	05	3.3%
Family h/o kidney disease	18	12%
History of Sudden Death in the Family	08	5.3%

Basic Characteristics of patient showed Male: Female ratio 1.5:1, mean age 36±12 years, 9.33% patients had Family History of Multiple Renal Cysts and 12% had family history of kidney disease.

Table 2: Clinical characteristics of Alport syndrome

Characteristics	N = (20)	Percentage
M:F ratio (19 :1)		
Age (16 - 40 years) mean age 20±8 years		
Sex (Female /Male)	01 19	5% 95 %
Fleck Retinopathy	06	30%
Cataract	03	15%
Macrothrombocytopenia	05	25%
Sensory neural Deafness	15	75 %
Family h/o kidney disease	15	75 %
Anterior lenticonus	04	20 %

Basic Characteristics of patients with Alport syndrome showed Male-to-Female ratio 19:1, mean age 20±8 years, 30% patients had fleck Retinopathy, while both 75% patients were sensory neural deafness and family history of kidney disease. Anterior lenticonus was observed in 20% had of patients. (Table-2)

Table 3: Patterns of renal involvement in Alport syndrome

Patterns of renal involvement	n = 20	%
Hypertension	12	60%
Gross Heamaturia	05	25%
Microscopic Heamaturia	14	70%
Proteinuria mild to moderate	20	100%
End -stage kidney disease	15	75%
Proteinuria nephrotic range	16	80%

Renal involvement was universal among patients with Alport syndrome. All patients (100%) had mild-to-moderate proteinuria, while nephrotic-range proteinuria was present in 80%. End-stage kidney disease was observed in 75% of patients, microscopic hematuria in 70%, hypertension in 60%, and gross hematuria in 25%. (Table-3)

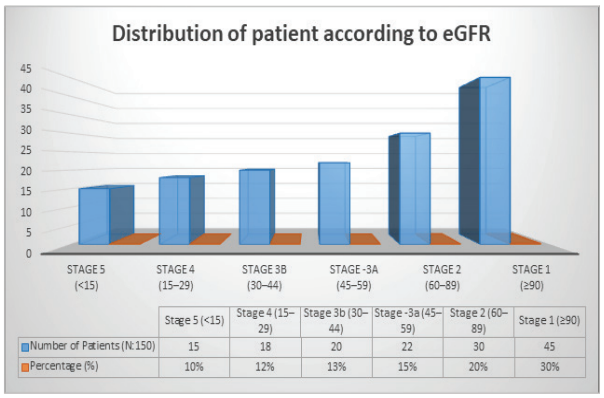


Figure-4: Distribution of Patients of Hereditary Kidney Diseases according to eGFR Categories

Distribution of patient according to eGFR showed majority of patient are stage I (30%) patient and stage II (20%) patient presented whereas in stage 3a & 3b have (15% & 135). Stage IV have 12% of patient and 10% in stage-V respectively. (Figure-4)

Table 05: Spectrum of Clinical Manifestations in Patients with Polycystic Kidney Disease (N = 150)

Clinical presentations	Frequency	Percentage
Dysuria	36	24%
Hypertension	40	26.7 %
Anemia	10	6.7 %
History of unconsciousness	6	4%
Asymptomatic microscopic hematuria	22	14.7 %
Gross hematuria	14	9.3 %
Polycythemia	18	12 %
Hypotension	19	12.7 %
Jaundice	5	3.3 %
Liver cysts	35	23.3 %
Proteinuria (mild to moderate)	15	10 %

Among the 150 patients with polycystic kidney disease, hypertension (26.7%) was the most common clinical manifestation, followed by dysuria (24.0%) and liver cysts (23.3%). Hematuria was a frequent finding, with asymptomatic microscopic hematuria observed in 14.7% and gross hematuria in 9.3% of patients. Hypotension (12.7%), polycythemia (12.0%), and mild-to-moderate proteinuria (10.0%) were also noted, while anemia (6.7%), history of unconsciousness (4.0%), and jaundice (3.3%) were relatively uncommon. (Table 5).

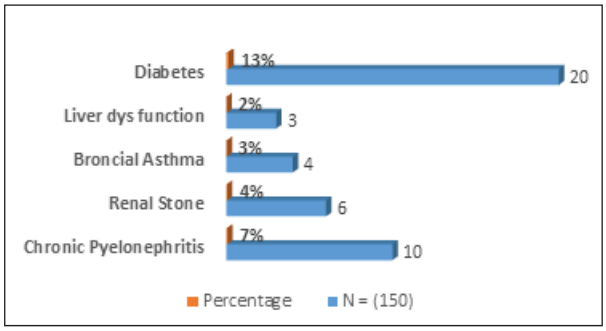


Figure- 6: Prevalence of Comorbidities among Patients with Hereditary Kidney Diseases (N = 150)

Figure 6 Comorbidities

Among the 150 patients with hereditary kidney diseases, Diabetes was the most common comorbidity (13.3%), followed by chronic pyelonephritis (7%) and Broncial asthma (3%). Renal stone (3.0%) and Liver dys function (2%) were less frequently observed.

Table 7: Classification of Patients with autosomal dominant polycystic kidney disease According to the Ultrasound-Based Ravine's PKD1 Diagnostic Criteria (N = 150)

Age (Years)	Criteria Original Ravine's PKD1 diagnostic Criteria	Frequency	Percentage
≥60	≥4 cysts in each kidney	35	23.3%
40-59	≥ 2 cysts in each kidney	45	30%
30-39	≥ 2 cysts in each kidney	38	25.3%
15-29	≥ 2 cysts, unilateral or bilateral	32	21.3%

According to Ravine's PKD1 diagnosis criteria all study patients were categorized. It was observed that, cyst distribution increases steadily with age. In this study, 21.3% of patients aged 15-29 years had ≥2 cysts (unilateral or bilateral). In the 30-39 years and 40-59 years age groups, the majority met the criteria of ≥2 cysts in each kidney (25.3% and 30% respectively). Among patients aged ≥60 years, 23.3% had ≥4 cysts in each kidney, reflecting disease progression with age. Overall, cyst burden rises with increasing age, consistent with the natural history of Autosomal Dominant Polycystic Kidney Disease (Table- 7).

Table 8: Spectrum of Clinical Complications among Patients with Hereditary Kidney Diseases (N = 150)

Complications	Frequency	Percentage
Acute pyelonephritis	12	8%
Cyst infections	08	5.3 %
Acute kidney injury	7	4.7 %
Salt -losing nephropathy.	08	5.3 %
Sub -arachnoid hemorrhage	02	1.3 %
Acute pancreatitis	3	2%
Cyst hemorrhage	6	4%
Renal stones	4	2.7 %
Septicemia	3	2%

In this study Among the 150 patients with hereditary kidney diseases, acute pyelonephritis was the most common clinical complication (8.0%), followed by cyst infections and salt-losing nephropathy (5.3% each). Acute kidney injury (4.7%) and cyst hemorrhage (4.0%) were also observed. Less frequent complications included renal stones (2.7%), acute pancreatitis and septicemia (2.0% each), and subarachnoid hemorrhage (1.3%). cases respectively (Table 8).

Table 9: Distribution of Bacterial Isolates in Patients with Hereditary Kidney Diseases Presenting with Urinary Tract Infection (n = 40)

Organisms	Frequency	Percentage
Pseudomonas	6	15%
Klebsiella	4	10%
E-coli	20	50%
Proteus	4	10%
Acenetobacter	2	5%
Enterobacter	1	2.5%
Candida	1	2.5%

Among the 40 patients with hereditary kidney diseases presenting with urinary tract infection, Escherichia coli was the predominant pathogen, accounting for 50.0% of isolates. Pseudomonas spp. was the second most common organism (15.0%), followed by Klebsiella spp. and Proteus spp. (10.0% each). Acinetobacter spp. constituted 5.0% of isolates, while Enterobacter spp. and Candida spp. were isolated infrequently (2.5% each) cases respectively (Table-9).

Discussion:

Hereditary kidney diseases are an important cause of chronic kidney disease (CKD) and end-stage kidney disease (ESKD), with Autosomal Dominant Polycystic Kidney Disease and Alport syndrome being the most prevalent inherited disorders worldwide [13]. Autosomal Dominant Polycystic Kidney Disease is a multisystem disease characterized by progressive renal cyst formation, hypertension, renal impairment, and several extra-renal manifestations, whereas Alport syndrome is characterized by progressive nephropathy associated with sensorineural hearing loss and ocular abnormalities [14]. In our present prospective observational study evaluated the clinical profile and outcomes of 170 patients with hereditary kidney diseases, including 150 patients with Polycystic Kidney Disease and 20 patients with Alport syndrome, treated at a tertiary care hospital.

The demographic characteristics of our Polycystic Kidney Disease cohort were comparable to those reported previously. The mean age was 36±12 years, with a male-to-female ratio of 1.5:1, indicating a slight male predominance, similar to earlier studies [15]. Ultrasound-based Ravine's criteria proved useful for diagnosis in our setting, demonstrating progressive cyst burden with increasing age, consistent with the natural history of Autosomal Dominant Polycystic Kidney Disease [16]. These findings emphasize the value of ultrasonography as an affordable and reliable diagnostic tool in resource-constrained settings where genetic testing is

unavailable. Hypertension was the most frequent clinical manifestation in patients with Autosomal Dominant Polycystic Kidney Disease (26.7%), followed by dysuria (24.0%) and liver cysts (23.3%). Microscopic hematuria, gross hematuria, and mild-to-moderate proteinuria were also common findings. Hypertension remains one of the earliest manifestations of Autosomal Dominant Polycystic Kidney Disease and is closely associated with activation of the renin–angiotensin–aldosterone system, progressive renal dysfunction, and increased cardiovascular risk [17]. The presence of hepatic cysts further highlights the multisystem nature of the disease and is consistent with previous reports describing liver cysts as the most common extra-renal manifestation of Autosomal Dominant Polycystic Kidney Disease [18].

Our findings also demonstrated that most patients were diagnosed during the early stages of CKD, with 50% of patients in CKD stages I and II, while 30% were in stage III and only 20% had advanced CKD (stages IV and V). Early diagnosis offers an opportunity for blood pressure control, treatment of complications, and interventions aimed at slowing disease progression. Nevertheless, a considerable proportion of patients had advanced CKD, reflecting delayed presentation and limited access to specialized nephrology services in developing countries [19]. Among the associated comorbidities, chronic pyelonephritis, and chronic obstructive pulmonary disease were the most frequently observed. Clinical complications were generally related to urinary tract infection and cyst disease, with acute pyelonephritis being the most common complication (8.0%), followed by cyst infection and salt-losing nephropathy (5.3% each). Acute kidney injury, cyst hemorrhage, renal stones, septicemia, and subarachnoid hemorrhage were less common but clinically significant complications. These findings highlight the importance of early recognition and prompt management of infectious and renal complications to preserve kidney function. Renal involvement was universal among patients with Alport syndrome. All patients (100%) had mild-to-moderate proteinuria, while nephrotic-range proteinuria was present in 80%. End-stage kidney disease was observed in 75% of patients, microscopic hematuria in 70%, hypertension in 60%, and gross hematuria in 25%. The bacteriological profile of urinary tract infections demonstrated that Escherichia coli was the predominant pathogen (50%), followed by Pseudomonas spp. (15%), while Klebsiella spp. and Proteus spp. each accounted for 10% of isolates. This distribution is consistent with previous studies reporting E. coli as the leading uropathogen in patients with hereditary kidney diseases and emphasizes the importance of urine culture and antimicrobial susceptibility testing to guide appropriate antibiotic therapy and minimize antimicrobial resistance [20].

The marked male (male ratio 19:1) predominance observed among patients with Alport syndrome is consistent with the X-linked inheritance pattern of the disease, in which hemizygous males typically develop more severe clinical manifestations, persistent proteinuria, microscopic hematuria, hypertension, sensory neural deafness, and a high prevalence of end-stage kidney disease were observed, while heterozygous females are usually carriers with a milder and more variable phenotype. Ocular manifestations, including fleck retinopathy and anterior lenticonus, were also identified. These findings are consistent with the recognized phenotype of Alport syndrome and underscore the importance of multidisciplinary evaluation involving nephrologists, audiologists, and ophthalmologists for timely diagnosis and comprehensive management. Overall, this study provides a comprehensive overview of the clinical spectrum of the two most common hereditary kidney diseases encountered in Bangladesh. The findings emphasize the importance of early diagnosis, family screening, regular assessment of kidney function, and prompt management of complications to delay disease progression and improve long-term patient outcomes.

Conclusion

This study highlights the clinical heterogeneity and systemic involvement of Autosomal dominant polycystic kidney disease and Alport syndrome in a Bangladeshi cohort. The absence of molecular diagnostics remains a barrier to comprehensive care. Early identification through family screening, regular imaging, and blood pressure control are essential to delay disease progression. Future initiatives should focus on expanding access to genetic testing, enhancing public awareness, and establishing longitudinal registries to better characterize disease trajectory in South Asian populations.

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