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Unit No. 1

PROTEINURIA AND HYPERTENSION WITH AND WITHOUT TYPE 2 DIABETES MELLITUS: 2025 UPDATE

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ABSTRACT

The Chronic Disease Management Skills Course is a yearly update on the management of six chronic medical conditions. This article covers the update on management of proteinuria and hypertension based on papers published in 2023 and 2024. Google and PubMed searches were conducted from 25-31 December 2024. Of 11 shortlisted papers, six papers are included in this update.

Keywords: Proteinuria, hypertension, chronic kidney disease, and type 2 diabetes mellitus

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INTRODUCTION

This chronic disease management skills course was started in 2019 as a yearly update of management of six chronic medical conditions prevalent in Singapore. This article provides an update of proteinuria and hypertension in patients with and without type 2 diabetes mellitus.

METHODOLOGY

Google and PubMed searches supplemented by hand searches were conducted from 25-31 December 2024. Keywords used were: Proteinuria, hypertension, chronic kidney disease, and type 2 diabetes mellitus. Literature searches were limited to Singapore and Southeast Asia and limited to the years of 2023 and 2024. A total of 11 papers were shortlisted, and information from six papers was included in this update. The 2024 ESC hypertension guidelines provided much current information on hypertension diagnosis and treatment.

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RESULTS

1. PROTEINURIA WITHOUT HYPERTENSION AND OUTCOME

The outcome of proteinuria without hypertension was reported by Lee H, Park MS, Kang MK, et al in 2023.[1] The authors explored the outcome of such patients and the risk of developing hypertension using screening data from patients in the Korean National Health Insurance Database.

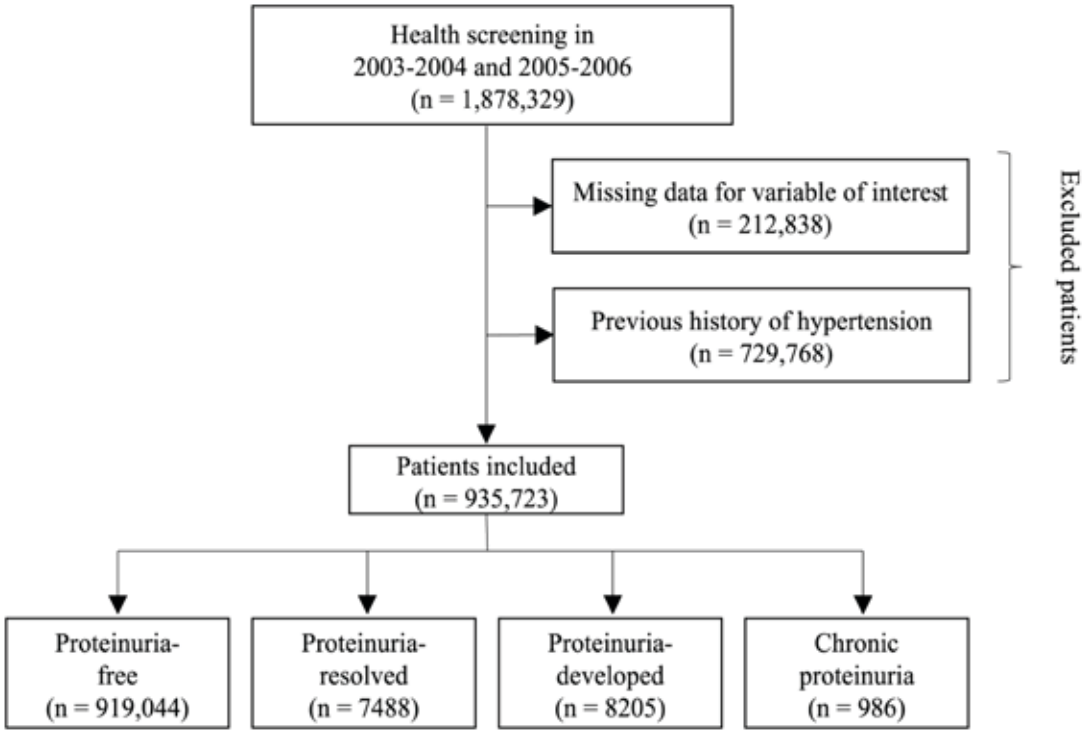
Data from participants without prior hypertension history who underwent their first health examination in 2003-2004 and a second examination in 2005-2006 were included in this study. Records with missing data for variable of interest, and patients with previous history of hypertension were excluded. A total of 935,723 patients were finally included out of a total of 1,878,329 patients screened. Based on their proteinuria status during these two examinations, included participants were classified into four groups: the proteinuria-free, proteinuria-resolved, proteinuria-developed, and chronic proteinuria groups. See **Figure 1**.

The study outcome was the incidence of hypertension. During this period, 346,686 (37.1 percent) cases of hypertension were reported. The chronic proteinuria group had the highest hypertension risk, followed by the proteinuria-developed, proteinuria-resolved, and proteinuria-free groups ($p<0.001$). Those who recovered from proteinuria had a lower risk of developing hypertension than those with chronic proteinuria (hazard ratio: 0.58; 95% confidence interval: 0.53-0.63, $p<0.001$). See **Figure 2** and **Table 1**.

Conclusion

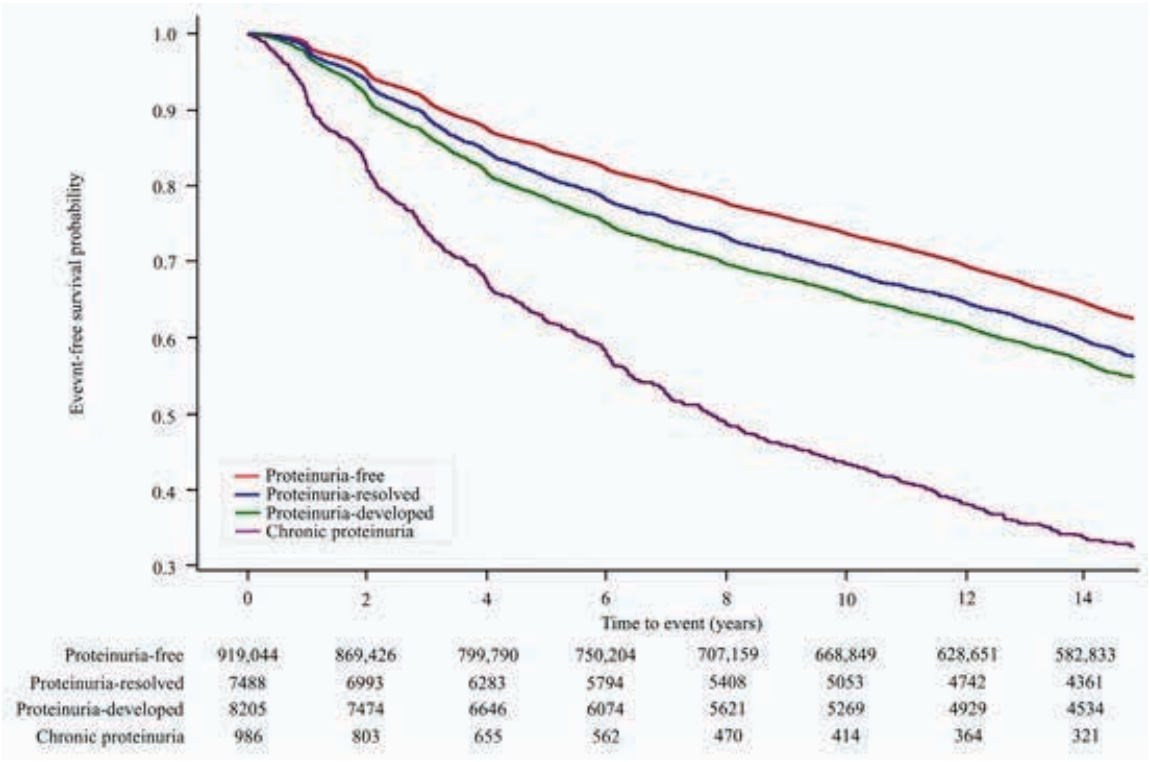
Effective management of proteinuria may potentially decrease the risk of developing hypertension and also decreased risk of future mortality.

Figure 1. Proteinuria without hypertension



Source. Lee H, Park MS, Kang MK, et al. 2023. PMID:37763181[1]

Figure 2. Proteinuria without hypertension and event-free survival probability



Source. Lee H, Park MS, Kang MK, et al. 2023. PMID:37763181[1].

Table 1. Proteinuria without hypertension. Multivariable Cox Analysis for incident hypertension by changes in proteinuria status

Group	Total (n)	Hypertension (n)	Incidence Rate (per 1000 Person Years)	HR (95% Confidence Interval)		
				Model 1	Model 2	Model 3
Proteinuria-free	919,044	339,260	31.5	1 (ref)	1 (ref)	1 (ref)
Proteinuria-resolved	7488	3131	37.4	1.19 (1.15, 1.23)	1.17 (1.13, 1.21)	1.17 (1.13, 1.21)
Proteinuria-developed	8205	3638	41.3	1.31 (1.27, 1.35)	1.31 (1.27, 1.35)	1.31 (1.26, 1.35)
Chronic proteinuria	986	657	81.4	2.61 (2.41, 2.81)	2.11 (1.95, 2.27)	2.09 (1.94, 2.26)
		p for trend		<0.001	<0.001	<0.001

Footnotes:
Model 1 was adjusted for age and sex
Model 2 was adjusted for age, sex, body mass index, household income, smoking, alcohol consumption, physical activity, history of diabetes mellitus, dyslipidaemia, atrial fibrillation, cancer, and renal disease
Model 3 was adjusted for age, sex, body mass index, household income, smoking, alcohol consumption, physical activity, history of diabetes mellitus, dyslipidaemia, atrial fibrillation, cancer, renal disease, and Charlson Comorbidity Index
HR = hazard ratio
CI = confidence interval

Source: Lee H, Park MS, Kang MK, et al. 2023. PMID: 37763181[1]

2. THE 2017, 2018, AND 2024 HYPERTENSION GUIDELINES COMPARED

A comparison of the ACC/AHA hypertension guidelines published in 2017 and the ESC/ESH hypertension guidelines published in 2018 was made by Whelton PK, Carey RM, Mancia G, et al.[2] Both are influential documents.

Table 2 shows the similarities of the two guidelines. Note that both sets of guidelines emphasised the importance of accurate blood pressure measurement. **Table 3** shows the differences of the two hypertension classifications. The 2017 ACC/AHA defined hypertension as ≥130/80 mmHg while the ESC/ESH defined hypertension as ≥140/80 mmHg. The BP treatment targets for ACC/AHA is <130/80 mmHg for all three age groups (16-64, 65-79, >60 years). The 2018 ESC/ESH guideline had BP treatment target, which is increasingly more lax in the older age groups. See **Table 3**.

Table 2. Hypertension classifications 2017-2018: guideline similarities

Guideline Similarities	2017 ACC/AHA	2018 ESH
Accurate Blood Pressure Measurement	Office-based BP measurements and use of validated, cuffed devices and home/ ambulatory BP monitoring are recommended prior to diagnosing hypertension	
Cardiovascular Risk Calculator for Treatment Thresholds	Pooled Cohort Equation and SCORE2/DCORE2-OP provide estimates for 10-year risk of fatal and non-fatal cardiovascular events and should be used to guide treatment decisions	
Initial Pharmacotherapy Recommendations	Initial therapeutic choices include ACE inhibitors, angiotensin-receptor blockers, thiazide or thiazide-like diuretics, and calcium channel blockers Single pill combination therapy is a first-line strategy for many patients	

Source: Whelton PK, Carey RM, Mancia G, et al. Harmonization of the ACC/AHA and ESC/ESH Blood Pressure/ Hypertension Guidelines: Comparisons, Reflections, and Recommendations. JACC 2022. PMID: 35965201[2]

Table 3. Hypertension classifications 2017-2018: guideline differences

Guideline Differences	2017 ACC/AHA	2018 ESC/ESH
Hypertension Definition	≥130/80mmHg	≥140/90mmHg
Normal BP Ranges (mmHg)	Normal <120/80 Elevated: 120-129/<80	Optimal: <120/80 Normal: 120-129/80-94 High-Normal: 130-139/85-89
Hypertensive BP Ranges (mmHg)	Hypertension Stage 1: 130-139/80-89 Hypertension Stage 2: ≥140/90	Hypertension Grade 1:140-159/90-99 Hypertension Grade 2:160-179/100-109 Hypertension Grade 3: ≥180/≥110 Isolated systolic hypertension ≥140/<90
BP Treatment Targets		
18-64 years (mmHg)	<130/80	<130/80
65-79 years (mmHg)	<130/80	<140/80 (less than130/80 if tolerated)
>80 years (mmHg)	<130/80	140-150/<80
Pharmacotherapy	Initial therapy with beta-blockers reserved for specific conditions including ischaemic heart disease or heart failure	Beta blockers included as first-line therapy for hypertension

Source: Whelton PK, Carey RM. Manda G, et al. 2022. PMID: 35965201[1]/PMID:35950927[2]

Comparison of 2018 ESC/ESH with 2024 ESC Hypertension Guidelines

Unlike the 2018 ESC/ESH hypertension guidelines, which had different BP targets for treatment depending on age group, the 2024 ESC hypertension has a BP treatment target of 120-129/70-79 mmHg for all age groups. If this is not possible or not tolerated, then treatment using the BP target of As Low as Reasonably Achievable (ALARA) for all age groups is conducted. **Table 4** compares the 2018 ESC/ESH and 2024 ESC hypertension guidelines in detail.

Table 4. Hypertension classifications 2018 vs 2024 – comparisons

Reference	2018 ESC/ESH	2024 ESC
Hypertension Definition (mmHg)	≥140/90	**≥140/90**
Normal BP Ranges (mmHg)	Optimal <120/<80 Normal 120-129/80-84 High-Normal: 130-139/85-89	**Non-elevated BP: <120/70** **Elevated BP: 120-129/70-89**
Hypertensive BP Ranges (mmHg)	Hypertension Grade 1: 140-159/90-99 Hypertension Grade 2: 160-179/100-109 Hypertension Grade 3: ≥180/≥110 Isolated systolic hypertension ≥140/<90	**Hypertension: ≥140/90**
BP Treatment Targets		**120-129/70-79 and if not possible or not tolerated** **As Low As Reasonably Achievable (ALARA) principle (Page 3961, 2024 ESC Guidelines)**
18-64 years (mmHg)	<130/80	
65-79 years (mmHg)	<130/80	
>80 years (mmHg)	<130/80	
Pharmacotherapy	Initial therapy with beta-blockers reserved for specific conditions including ischaemic heart disease or heart failure	**Beta blockers included as first-line therapy for hypertension**

Source: Whelton PK, Carey RM. Manda G, et al. 2022. PMID: 35965201.[2] McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715[4]

3.1. HYPERTENSION MECHANISMS AND HYPERTENSION FACTORS

Figure 3 (reproduced from the 2024 ESC Figure 1) shows the current understanding of the hypertension mechanisms and hypertension factors. **Table 5** shows the effect of high blood pressure on organ damage in the eye, brain, heart, large and medium arteries, kidney, and microcirculation. Early and effective treatment of high blood pressure will hopefully attenuate such damage.

Figure 3. Hypertension mechanisms and hypertension factors

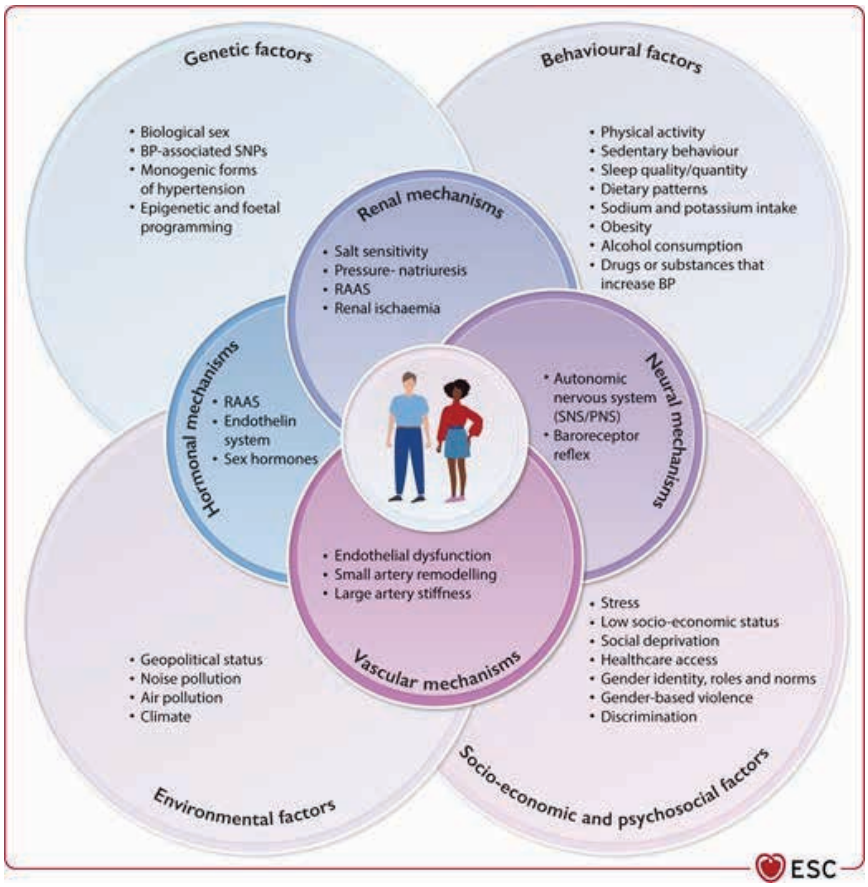
Hypertension mechanisms:

- Hormonal
- Renal
- Neural
- Vascular

Hypertension factors:

- Genetic factors
- Behavioural factors
- Socio-economic factors
- Environmental factors

2024 ESC Hypertension Guidelines



Source: Figure 1. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 35950927[4]

3.1.1 SECONDARY HYPERTENSION

Hypertension can also be due to secondary causes. **Figures 4A**, **4B**, and **4C** show the clinical features of three causes of secondary hypertension, namely: primary aldosteronism, renovascular hypertension, and obstructive sleep apnoea. Primary aldosteronism is mostly asymptomatic. Renovascular hypertension is more symptomatic and may declare its presence by presence of vascular bruits, arterial dissections, bilateral pulmonary oedema, multisite atherosclerosis, unexplained small kidney, or kidney asymmetry. Obstructive sleep apnoea is also likely to be symptomatic with symptoms such as: restless, intermittent sleep, recurrent awakenings, daytime sleepiness, fatigue, impaired concentration, apnoea, snoring, and obesity.

Figures 4A, 4B, 4C. Secondary causes of hypertension

Figure 4A. Primary aldosteronism (Figure 13, 2024 ESC)

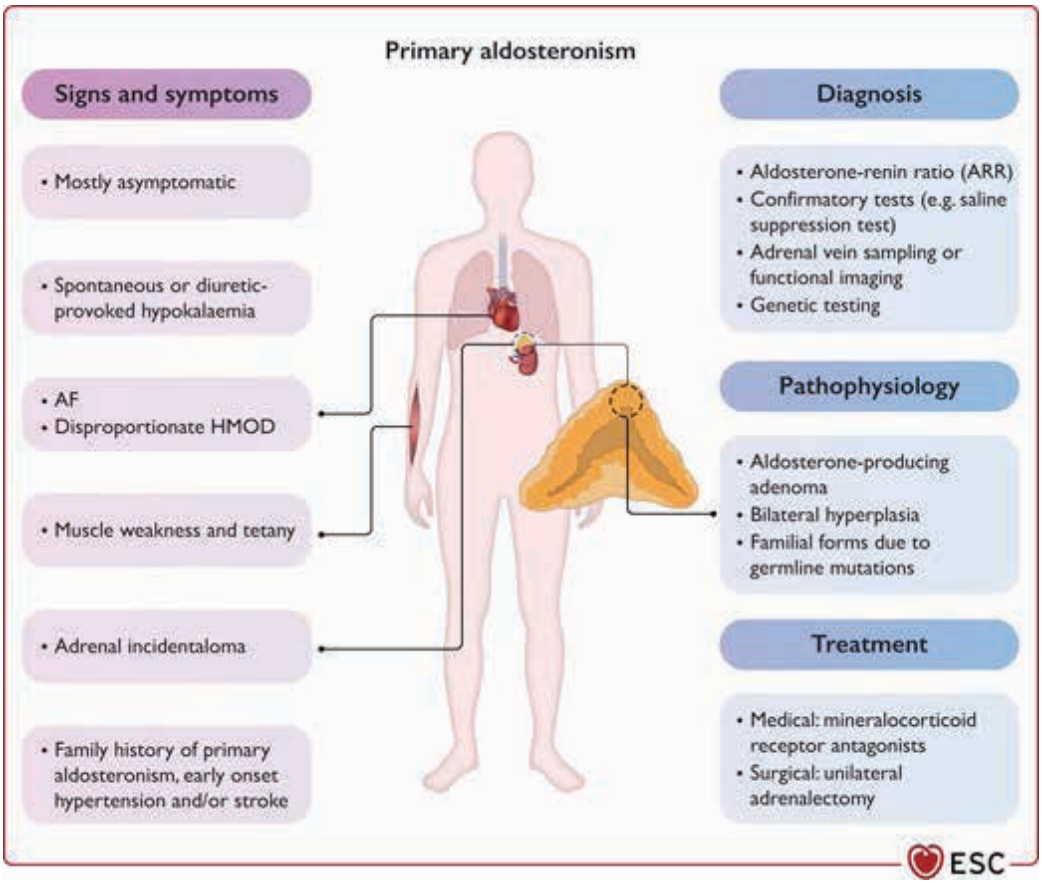


Figure 4B. Renovascular hypertension (Figure 14, 2024 ESC)

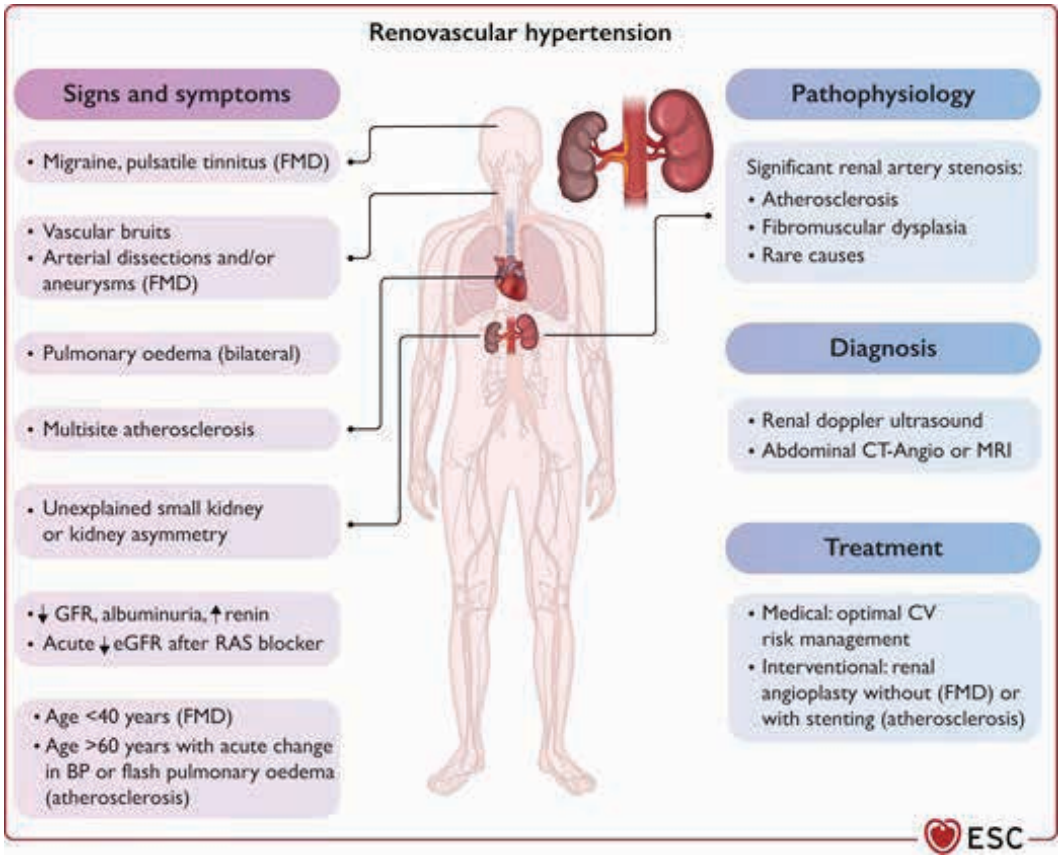
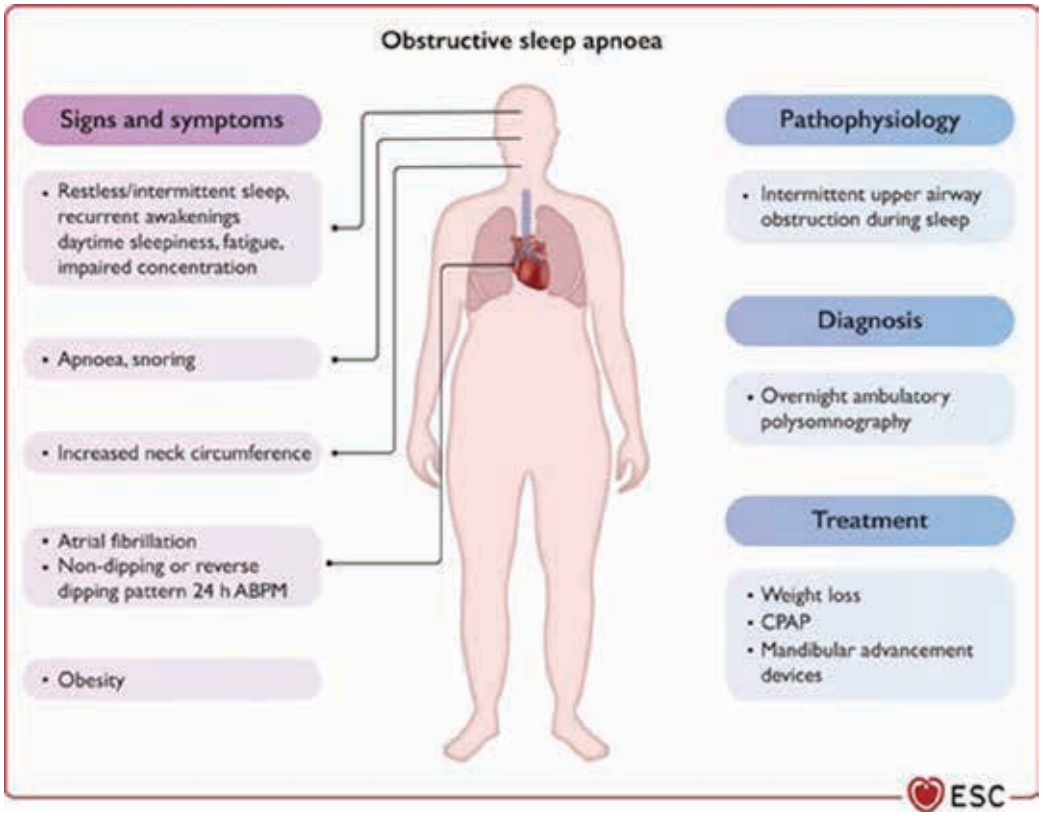


Figure 4C. Obstructive sleep apnoea (Figure 15, 2024 ESC)



Source: McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 35950927.[4]

Table 5. 2024 ESC. HT mechanisms & factors. Elevated BP, HT, & HMOD

No	Organ	Hypertension Mediated Organ Damage (HMOD)
1	Eye	Microvascular remodelling, Hypertensive retinopathy
2	Brain	White matter lesions, silent microinfarcts, Microbleeds, Brain atrophy, Cognitive impairment, Vascular dementia, Ischaemic stroke, Cerebral haemorrhage
3	Heart	DM, LA and LV dilatation, AF, Obstructive and non-obstructive coronary artery disease, Myocardial infarction, Diastolic and/or systolic heart failure
4	Large & medium arteries	Atherosclerosis, Vascular calcification, Arterial stiffness
5	Kidney	Glomerular arteriolar hypertension, Glomerulosclerosis, Albuminuria/Proteinuria, Reduced GFR
6	Microcirculation	Endothelial dysfunction, Increased vasoreactivity, Vascular remodelling, Fibrosis and inflammation, Increased peripheral vascular resistance

Source: Figure 2. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

3.2. BLOOD PRESSURE MEASUREMENT – OFFICE, HOME, AND AMBULATORY

Office blood pressure measurement needs to be checked against home blood pressure measurement or ambulatory blood pressure measurements. See details in **Tables 6**, **7**, and **8**. **Table 9** summarises the blood pressure readings for non-elevated blood pressure, elevated blood pressure, and hypertension for office BP, Home blood pressure measurement, and Ambulatory blood pressure measurements.

Table 6. Office blood pressure measurement

1	Measure blood pressure after five minutes seated comfortably in a quiet environment
2	Use a validated device with an appropriate cuff size based on arm circumference
3	Place the BP cuff at the level of the heart with the patient's back and arm supported
4	Measure BP three times (1-2 min apart) and average the last two readings
5	Obtain further measurements if the readings differ by >10 mmHg
6	Measure BP in both arms at the first visit to detect between arm differences
7	Record heart rate and exclude arrhythmia by pulse palpation

Source: Figure 3. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

Table 7. Home-based blood pressure measurement

1	Measure blood pressure after five minutes of rest with arms and back supported
2	Use a validated BP device
3	Measure two readings on each occasion, 1-2 min apart
4	Obtain readings twice a day (morning and evenings) for at least three and usually seven days
5	Measure BP in both arms at the first visit to detect between arm differences
6	Record and average all readings and present results to clinician Hypertension = average HPBM >135/85 mmHg

Source: Figure 4. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

Table 8. Ambulatory blood pressure measurement

1	Use a validated BP device
2	Measure two readings on each occasion, 1-2 min apart
3	Obtain readings twice a day (morning and evenings) for at least three and usually seven days
4	Measure BP in both arms at the first visit to detect between arm differences
Footnote: Hypertension: APBM ≥135/80 mmHg over 24 hours or ≥135/85 mmHg for the daytime average or ≥120/70 mmHg for the nighttime average	

Source: Figure 5. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

Table 9. Blood pressure classification 2024 ESC (measurements in mmHg)

1	**Non-elevated blood pressure**	**Elevated blood pressure**	**Hypertension**
2	**Office BP** SBP<120 and DBP<70	**Office BP** SBP 120-139 or DBP 70-89	**Office BP** SBP≥140 and DBP≥90
3	**HBPM** SBP<120 and DBP<70	**HBPM** SBP 120-134 or DBP 70-84	**HBPM** SBP≥135 and DBP≥85
4	**ABPM** Daytime SBP<120 and Daytime DBP<70	**ABPM** Daytime SBP 120-134 or Daytime DBP 70-84	**ABPM** Daytime SBP≥135 or Daytime DBP≥85
5	Insufficient evidence confirming the efficacy and safety of BP pharmacological treatment	Risk stratify to identify individuals with high cardiovascular risk for BP pharmacological treatment	Cardiovascular risk is sufficiently high to merit BP pharmacological treatment initiation
Footnote: The diagnosis of hypertension and elevated BP requires confirmation using out-of-office measurements (HBPM or ABPM) or at least one additional subsequent office measurement			

Source: Figure 6. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

3.3. RISK FACTORS FOR ELEVATED BP LOWERING

Table 10 shows the risk factors for elevated BP lowering to reduce adverse outcomes.

Table 10. Risk factors for elevated BP lowering to reduce adverse outcomes

No	Risk factor	Outcome being prevented
1	Established clinical cardiovascular disease	Atherosclerotic cardiovascular disease Heart failure
2	Moderate or severe CKD	eGFR <60 mL/min/1.73 m^2 or Albuminuria >30mg/g (≥3 mg/mmol)
3	Other forms of hypertension-mediated organ damage	Cardiac Vascular
4	Diabetes mellitus	Type 1 and type 2 diabetes mellitus
5	Familial hypercholesterolaemia	Probable or definite familial hypercholesterolaemia

Source: Figure 7. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

3.4. PHYSICAL ACTIVITIES AND LIFESTYLE CHANGES THAT CAN REDUCE HIGH BP

Tables 11 and **12** show the physical activities and lifestyle changes that can reduce high BP.

Table 11. Physical activity & lifestyle changes to reduce BP

1	Aerobic exercise training of at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity: brisk walking, jogging, cycling, swimming (Class I)
2	Increase daily physical activity (steps/day, take stairs, walk/cycle)
3	Avoid sedentary lifestyle
4	Isometric resistance training: Low-to-moderate-intensity (3 sets of 1-2 min contractions: hand-grip, plank, wall sit)
5	Dynamic or isometric resistance training to complement aerobic exercise training 2-3 times/ week (Class I)
6	Dynamic resistance exercise training: Large muscle groups, low-to-moderate-intensity (2-3 sets with 10-15 reps: squat, push-ups, sit-up)

Source: Figure 16. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

Table 12. Physical activity & lifestyle to reduce BP

1	Increase potassium intake
2	Increase physical activity
3	Avoid sedentary lifestyle
4	Reduce salt (sodium chloride) intake
5	Reduce alcohol intake
6	No smoking

Source: Figure 17. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

3.5. MANAGEMENT OF HYPERTENSION IN FRAIL PATIENTS

Tables 13 and **14** show the management of BP in the nine categories of frail patients. BP treatment targets are increasingly relaxed in frail patients as they enter into more frail categories and also the number hypertension medications prescribed are reduced.

Table 13. Management of BP in frail patients

1	Very fit – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age	Follow BP-lowering treatment guidelines as per younger cohorts, ensuring treatment is tolerated
2	Well – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g., seasonally	Evidence for benefits in reducing CVD events with more intensive treatment of BP
3	Managing well – People whose medical problems are well controlled, but are not regularly active beyond routine walking	Low-dose combination therapy to achieve BP control is reasonable
4	Vulnerable – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being slowed down, and/ or being tired during the day	ABPM if possible and regular review important, particularly if change in frailty

5	Mildly frail – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications)	These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy homework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework

Source: Figure 17. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

Table 14. Management of BP in frail patients

6	Moderately frail – Patients need help with all outside activities and keeping house. Inside, they often have problems with stairs, need help with bathing and may need cueing (prompting), and standing by with dressing	Evidence for benefit in CV event reduction not strong (poorly represented in clinical trials)
7	Severely frail – Completely dependent for personal care, from whatever cause (physical or cognitive). They seem stable and not at high risk of dying (within six months)	Exercise caution and clinical judgement in intensifying BP-lowering treatment, employing a shared decision approach
8	Very severely frail – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness	Single drug therapy may be reasonable in this cohort when initiating or maintaining BP-lowering treatment
9	Terminally ill – Approaching the end of life. This category applies to people with life expectancy <6 months, who are not otherwise evidently frail	Monitor for symptomatic orthostatic hypotension (OH), asymptomatic OH with falls, and poor treatment tolerance. Clinical judgement and APBM/HPBM to guide deprescribing or prescribing.

Source: Figure 17. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

3.6. MANAGING RESISTANT HYPERTENSION

The steps in managing resistant hypertension management are shown in **Table 15**.

Table 15. Resistant hypertension management steps

1	Office BP ≥140/90 mmHg despite three or more BP-lowering medications at maximally tolerated doses, including a diuretic
2	Referral to hypertension centre should be considered (Class IIa) – Exclude secondary and pseudo-resident hypertension; Treatment optimisation of BP-lowering medications, ideally 3-drug single pill combination (SPC)
3	3-drug SPC not effective – True treatment-resistant hypertension diagnosed
4	Spironolactone – if spironolactone is not tolerated: eplerenone (Class IIa)
5	Beta-blocker (if not already recommended for a compelling indication) (Class IIa)
6	Intensification of pharmacotherapy (alpha blockers, centrally acting BP-lowering drugs, K sparing diuretics, others (Class IIa)
7	Renal denervation (Class IIa)

Source: Figure 10. McEvoy JW, McCarthy CP, Bruno BM, et al. 2024 ESC. PMID: 39210715.[4]

4. PROTEINURIA AND HYPERTENSION IN DIABETIC AND NON-DIABETIC PATIENTS

Chronic kidney disease (CKD) aetiology varies greatly between developed and developing countries. In addition, differences in underlying pathogenesis and therapeutic options affect the progression towards advanced-CKD. The meta-analysis by Hustrini NM, Susalit E, Widjaja FF, et al[5] help us identify the aetiology of advanced-CKD in Southeast Asia nations.

In this meta-analysis, a systematic search in four electronic-databases and complementary search on national kidney registries and repository libraries were conducted until 20 July 2023. The risk of bias was assessed using Newcastle-Ottawa Scale for observational studies and Version-2 of Cochrane for intervention studies. A random-effects model was used to estimate pooled prevalence.

The authors analysed 81 studies involving 32,834 subjects. Nine of the 11 Southeast Asian countries participated: Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The remaining two (Laos, Timor Leste) did not participate. Pooled prevalence of advanced CKD aetiologies in Southeast Asia showed the following results:

- Diabetic kidney disease 29.2% (95% CI 23.88-34.78)
- Glomerulonephritis 20.0% (95% CI 16.84-23.38)
- Hypertensive 16.8% (95% CI 14.05-19.70)
- Other 8.6% (95% CI 6.97-10.47)
- Unknown 7.5% (95% CI 4.32-11.50)

Conclusion

The leading cause of advanced-CKD in Southeast Asia is Diabetic kidney disease (DKD), with a substantial proportion of glomerulonephritis. An efficient screening programme targeting high-risk populations (diabetes mellitus and glomerulonephritis) is needed, with the aim to delay CKD progression.

5. PROTEINURIA AND HYPERTENSION IN TYPE 2 DIABETIC PATIENTS IN SINGAPORE PATIENTS

The trajectory of estimated glomerular filtrate rate (eGFR), associated risk factors, and its relationship with end-stage kidney disease (ESKD) among a multiethnic patient population with type 2 diabetes in Singapore has been studied by Feng L, Bee YM, Fu X, et al and published in 2024.

Methods

This study included 62,080 individuals with type 2 diabetes aged ≥18 years in a multi-institutional SingHealth Diabetes Registry between 2013 and 2019. eGFR trajectories were analysed using latent class linear mixed models. Factors associated with eGFR trajectories were evaluated using multinomial logistic regression. The association of eGFR trajectories with ESKD was assessed via competing risk models.

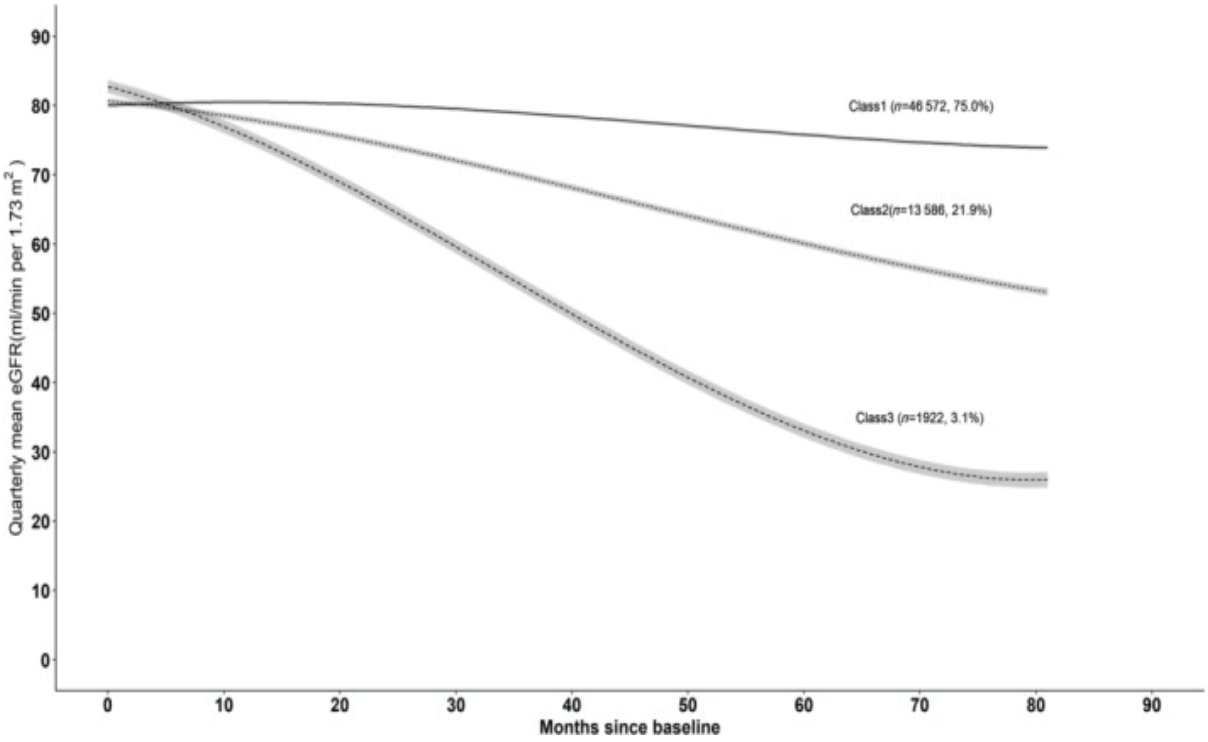
Results

Trajectory of kidney function, determined by eGFR, was found to be nonlinear. The trajectory pattern was classified as stable initially then gradual decline (75 percent); progressive decline (21.9 percent); and rapid decline (3.1 percent). Younger age, female sex, Malay ethnicity, lower-income housing type, current smoking, higher glycated haemoglobin, lower low-density lipoprotein, higher triglyceride, uncontrolled blood pressure, albuminuria, cardiovascular disease, hypertension, and higher eGFR levels each were associated with progressive or rapid decline. Compared with the trajectory of stable initially then gradual eGFR decline, progressive decline increased the hazard of ESKD by 6.14-fold (95% confidence interval [CI]: 4.96-7.61)) and rapid decline by 82.55 folds (95% CI: 55.90-121.89). See **Figure 5**.

Conclusions

Three nonlinear trajectory classes of kidney function were identified among multiethnic individuals with type 2 diabetes in Singapore. About one in four individuals had a progressive or rapid decline in eGFR. Our results suggest that eGFR trajectories are correlated with multiple social and modifiable risk factors and inform the risk of ESKD.

Figure 5. Kidney function trajectories, associated factors, and outcomes in multiethnic Asian patients with T2DM in SG (published in J Diabetes 2024 (PMID: 38169157)



Younger age, female sex, Malay (vs Chinese) ethnicity, lower-cost housing type, current smoking, higher HbA1c, lower LDL-C, higher TG, higher albuminuria levels, uncontrolled BP, CVD, hypertension, each were associated with a progressive or rapid decline in kidney function

ACKNOWLEDGEMENTS

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LEARNING POINTS

- **A nationwide population-based cohort study in South Korea demonstrated that proteinuria without hypertension needs to be treated to prevent persistent proteinuria and future mortality.**
- **Both the 2017 American College of Cardiology (ACC)/American Heart Association (AHA) and the 2018 European Society of Cardiology (ESC) and European Society of Hypertension (ESH) emphasised accurate BP measurements. Office-based BP readings need to be checked by home blood pressure measurements or ambulatory BP measurements.**
- **Hypertension in older adults should be treated to prevent worse outcomes, but individualisation is important.**
- **The 2024 ESC retained the hypertension definition of ≥140/90 mmHg in defined by the 2018 ESC/ ESH. Additionally, the 2024 ESC introduced two new BP readings, namely, non-elevated BP of <120/70 mmHg and elevated BP 120-139/70-89 mmHg.**
- **BP treatment targets in 2024 ESC clinical practice guideline are BP <140/90 mmHg, and less than 130/80 mmHg if tolerated, based on the ALARA (As Low as Reasonably Achieved) principle.**
- **A meta-analysis of advanced chronic kidney disease in Southeast Asia by Hustrini NM, Susalit E, Widjaja FF, et al published in 2024 (PMID-38587764), provided useful current information on advanced CKD aetiologies in Southeast Asia. The authors analysed 81 studies involving 32,834 subjects. Pooled prevalence of advanced CKD aetiologies in Southeast Asia showed the following results: Diabetic kidney disease 29.2% (95% CI 23.88-34.78), Glomerulonephritis 20.0% (95% CI 16.84-23.38), Hypertensive 16.8% (95% CI 14.05-19.70), Other 8.6% (95% CI 6.97-10.47), and Unknown 7.5% (95% CI 4.32-11.50)**
- **Kidney function trajectories, associated factors, and outcomes in multiethnic Asian patients in Singapore with T2DM showed that younger age, female sex, Malay (vs Chinese) ethnicity, lower-cost housing type, current smoking, higher HbA1c, lower LDL-C, higher TG, higher albuminuria levels, uncontrolled BP, CVD, hypertension each were associated with a progressive or rapid decline in kidney function.**