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REVIEW PAPER

WILEY

Hypertension and chronic kidney disease in Asian populations

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Abstract

The countries of Asia are home to multiple ethnicities. There are ethnic differences in diet, culture, and attitudes towards health screening, access to care, and treatment of chronic diseases. Chronic kidney disease (CKD) and end-stage kidney disease (ESKD) have rising incidence and prevalence due to increased affliction with non-communicable diseases of diabetes and hypertension. To prevent the expensive complications of ESKD, one of the most important risk factors to control is hypertension in patients with CKD. We performed a narrative review on the prevalence of CKD in patients with hypertension, the prevalence and control of hypertension in patients with CKD, and the dietary sodium intake in CKD populations.

The countries of Asia are home to multiple ethnicities. There are ethnic differences in diet, culture, and attitudes towards health screening, access to care, and treatment of chronic diseases. Chronic kidney disease (CKD) and end-stage kidney disease (ESKD) have rising incidence and prevalence due to increased affliction with non-communicable diseases of diabetes and hypertension.[1,2] Chronic kidney disease (CKD) is associated with hypertension, and hypertension is often a factor implicated in causing CKD. Moreover, it is also a risk factor associated with kidney function decline in patients with diabetes. To prevent the expensive complications of ESKD, it is imperative that hypertension in pre-dialysis CKD is properly managed. We performed a narrative review on the prevalence of CKD in patients with hypertension, the prevalence and control of hypertension in patients with CKD, and the dietary sodium intake in CKD populations.

For this review, we performed a search on PubMed with medical subheadings of Asian, chronic renal failure, sodium, and hypertension. All English language articles retrieved were reviewed for relevance to the objectives of this review. The specific questions were the prevalence and control of hypertension in (1) CKD patients, (2) sodium intakes in different CKD population groups where available, and (3) ESKD attributed to hypertension from published papers or National Disease registries. For information on the rates and causes of ESKD, an internet search was performed for the search terms of country name, ESKD, dialysis, registry, and hypertension. The words "renal" and kidney" were used. Only reports in the English language were used. The causes of ESKD captured in National registries are usually based on diagnoses by treating physicians which may be proven by kidney biopsies or based on clinical diagnoses.

The prevalence of CKD in hypertensive Asian populations is summarized in Table 1 and the prevalence of hypertension as a cause of ESKD is shown in Table 2. Data are presented where available and direct comparisons may not be compatible due to different methodologies of population sampling and/or definitions. For the purpose of including data in this review, hypertension is defined as office systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥90 mmHg. Controlled vs. uncontrolled hypertension was also defined by this threshold. CKD was defined as estimated or measured glomerular filtration rate (GFR) <60 ml/min per 1.73 m^2. Some definitions of CKD may also include subjects with higher GFR but known urinary abnormalities including albuminuria or proteinuria. The reader is advised to review the source literature for the definition of CKD. However, the literature does not easily allow presentation of the data by sub-populations and ethnicities. Moreover, the recognition, identification, and classification of ethnic populations carry the interplay of true biological differences to socio-cultural and political drivers in countries.[3]

1 | SODIUM INTAKE

Sodium intake in the general population is an important driver of hypertension. In Table 3, we summarize the sodium intake in CKD populations where available. Due to population sampling in different time periods and study methods, it would be speculative to directly compare the intake of sodium and ascribe reasons for differences between different countries and ethnicities. The factors usually associated with differences in average sodium intake are age, gender, and body size.[4–6] Therefore, comparisons of the unadjusted population means are inappropriate. These data, however, provide information for potential targeted interventions in the studied populations.

2 | CHINA

According to the 2002 National Health and Nutrition Survey in China, the prevalence of hypertension in the general population is 18%.[5] In a cross-sectional survey, the prevalence of CKD is 10.8%.[7] The C-STRIDE is a multicenter study of a cohort of Chinese pre-dialysis CKD patients with a broad spectrum of renal disease severity (39 hospitals located at 28 cities in 22 provinces).[8] A subgroup of 2251 out of 2873 (78.4%) subjects who had

TABLE 1 Prevalence of hypertension and CKD

Area	Population	Hypertension	CKD in hypertensive patients	Hypertension in CKD patients
China[7]	General	Overall 35.4%	61.2%	-
Hong Kong[11]	General	27.7%	-	-
India	Opportunistic	Overall 43.1%[14]	-	64.5%[15]
Japan[16]	General	45%	-	-
Malaysia	CKD subgroup	30.3%[36]	-	38.4%[20]
Singapore	General	23.5%[36]	7.6%[4]	-
South Korea	General	29.1%[29]	19.6%[30]	-
Taiwan	General	Men 26%,[33] Women 19%	-	-

Please refer to the source data for the definitions of hypertension, CKD, and other study cohort details. Direct comparisons are not appropriate.

TABLE 2 Prevalence of ESKD caused by hypertension

Area	ESKD due to hypertension (%)
China[9]	10.5
Hong Kong[13]	9.6
India[37]	12.8
Japan[18]	9.9
Singapore[26]	5
South Korea[31]	20
Taiwan[35]	8.3

Please refer to the source data for the definitions of hypertension, ESKD, and other study cohort details. Direct comparisons are not appropriate.

3 | HONG KONG

According to the Population Health Survey (PHS) 2014/15 conducted by the Department of Health, the prevalence of hypertension was 27.7% among persons aged 15–84 years. The prevalence increased steadily with age from 4.5% among those aged 15–24 years to 64.8% among those aged 65–84 years.[11] The mean 24-h urinary sodium excretion was 150.6 mmol (167.1 mmol in men, 135.6 mmol in women) among persons aged 15–84 years. The Screening for Hong Kong Asymptomatic Renal Population and Evaluation (SHARE) program was conducted in several large and representative residential communities from November to December 2003.[12] Out of 1811 participants, 1201 apparently "healthy" (asymptomatic and without history of diabetes, hypertension or CKD), the prevalence of positive (> or = 1+) urine dipstick for protein, glucose, blood, protein or blood, any urine abnormality, and hypertension was 3.2%, 1.7%, 13.8%, 16%, 17.4%, and 8.7%, respectively. In those aged > 60 years 33% had either hypertension or urine abnormalities vs. 24.0% in the 41–60 years group and 9.7% in the 20–40 years group. According to the Hong Kong Renal Registry, hypertension as a cause of ESKD is 9.6%.[13]

TABLE 3 Sodium intake

Area	Sodium intake method	Population	Average sodium (mmol/day)
China[8]	24-h urine	CKD (*n* = 2251)	138.0 (IQR: 90.0, 190.8)
Hong Kong[11]	24-h urine	General	150.6
Japan	24-h urine	General[19] CKD (*n* = 162)[6]	213 119.3 ± 57.8
Malaysia[23]	24-h urine	General	124.3
Singapore[38]	24-h urine	General overall Chinese Indian Malay	142.2 143.2 148.5 130
Singapore[28]	24-h urine	Healthy (*n* = 103) CKD (*n* = 232) Chinese Indian Malay Other	128.5 ± 66.5 123.3 ± 69.1 120.9 ± 71.9 144.2 ± 61.6 112.3 ± 67.4 133.1 ± 66.3
South Korea[32]	24-h urine	General Men Women	 181.7 151.3

Please refer to the source data for the definitions of CKD and other study cohort details. Direct comparisons are not appropriate.

hypertension at enrollment were studied. The overall average SBP and DBP were 133.6 ± 17.5 mmHg and 82.9 ± 11.1 mmHg, respectively. In the controlled hypertensive group (1268, 56.3%) SBP was 122.9 ± 10.3 mmHg and DBP was 77.3 ± 7.1 mmHg. Whereas, in the uncontrolled hypertensive group (952, 42.3%) mean SBP was 147.9 ± 14.6 mmHg and DBP was 90.5 ± 10.9 mmHg. Cai et al[9] reported that hypertension as a cause of ESKD was 10.5%. In a review and meta-analysis, Tan et al reported that there were regional differences in sodium intake, with generally higher intake in the northern regions compared with southern parts of China.[10] In men, the mean urinary sodium excretion was 194.76 mmol/24 h (95% CI, 179.27–210.25). In women, the mean urinary sodium excretion was 181.54 mmol/24 h (95% CI, 167.10–195.99). The situation in Hong Kong and Taiwan are discussed in sections below.

4 | INDIA

The prevalence of hypertension varies according to the population sampled.[14] The overall prevalence is 29.8% (95% CI: 26.7–33.0, with differences in prevalence between rural and urban regions (27.6%

[23.2–32.0] and 33.8% [29.7–37.8]). The pooled estimate for percentage of hypertensive patients having their BP under control in rural and urban India was 10.7 (6.4–15.0) and 20.2 (11.6–28.8), respectively. The cross-sectional Screening and Early Evaluation of Kidney Disease study screened 6120 Indian subjects from 13 academic and private medical centers. The prevalence of CKD is 17.2%, and prevalence by CKD stages G1, G2, G3, G4, and G5 are 7%, 4.3%, 4.3%, 0.8%, and 0.8%, respectively.[15] In this cohort, 43.1% had hypertension and 18.8% had diabetes.

5 | JAPAN

The prevalence of hypertension in the general population is 45%.[16] The prevalence of CKD was estimated using data from the Japanese annual health check program in 2005.[17] From 11 different prefectures, there were 5 74 024 participants >20 years old (male 2 40 594, female 3 33 430). The prevalence of CKD stages G1, G2, G3, and G4 plus G5 were 0.6, 1.7, 10.4 and 0.2%, respectively. The Annual Dialysis Report of 2016 reported hypertensive nephrosclerosis as a cause of ESKD of 9.9%.[18] From 1953 to 2014, the weighted mean urinary sodium excretion in healthy adult Japanese populations was 4900 ± 190 mg/day (213 mmol/day).[19] During this period, urinary sodium excretion decreased significantly by 4350 mg/day. Amano et al recruited 162 CKD outpatients who had a mean 24-h urinary sodium excretion of 2744 ± 1330 mg.[6]

6 | MALAYSIA

Malaysia has a multi-ethnic population. Hooi et al reported a prevalence of CKD of 9.07% out of 15 147 respondents who agreed to participate in the CKD sub-study from the National Health and Morbidity Survey 2011.[20] The prevalence of hypertension in this sample was 38.4% and diabetes was 19.6%. The prevalence of ESKD has risen rapidly with rising prevalence of diabetes. The National Action Plan for Healthy Kidneys (ACT-KID) 2018-2025 envisioned increasing the control of hypertension in the primary care of CKD patients from 41.2% to more than 60% to reduce the incidence of ESKD.[21] Moreover, there was a plan to increase the use of renin-angiotensin system blockers from 54.6% to more than 70%. Other than age, the odds ratio (3.09, 1.92–4.97) for risk of CKD was highest in patients with hypertension. In a study of hypertensive patients on primary care follow-up over 10 years, the incidence of new CKD was 30.9% (n = 142) with an annual rate of 3%.[22] The BP control rate improved from 15.2% at baseline to 18.9% at 5 years and 41.1% at 10 years. In cross-sectional study using 24-h urine sodium excretion, the average sodium intake was 2860 ± 1369 mg/day (124.3 mmol/day).[23]

7 | SINGAPORE

Singapore has a multi-ethnic population comprising of 74.4% Chinese, 13.4% Malay, 9% Indian, and 3.2% other in 2019.[24] The National Disease Registry Office (NDRO) reported that more than 65% of incident end-stage kidney disease (ESKD) patients starting dialysis had diabetic kidney disease as the main cause in 2018.[25] This is in contrast to an earlier report in 1997 which showed that glomerular disease to be a more common cause of ESKD, and hypertension as the primary etiology of ESKD was 5%.[26] The age-standardized incidence rate of ESKD needing dialysis in Malay patients increased significantly from 2008 to 2017 and is proportionately higher compared to Indian and Chinese patients over the years.

The profile of blood pressure management in a Singaporean multi-ethnic Asian CKD patient population was reported previously.[27] In a cohort of 613 patients (mean age of 57.8 ± 14.5 years; male 55.1%; Chinese ethnicity 74.7%), 35.7% of patients had a history of diabetes mellitus and 69.0% were previously diagnosed with hypertension. Only 62.1% of patients age <65 years and 36.6% of patients age >65 years were able to achieve SBP <140 mmHg. More than 90% of patients were able to achieve a DBP of <90 mmHg.

In a study of healthy adults (103) without diabetes, hypertension, or CKD, and patients with stable CKD (232), 24-h urine sodium was also obtained to assess sodium intake.[28] The mean urinary sodium excretion was 124.9 ± 68.3 mmol/day in these 335 subjects (mean age was 53.5 ± 15.1 years; 51.0% male; 38.5% Chinese, 29.6% Malay, 23.6% Indian; and 57.3% hypertensive). Patients with CKD stages G1 to G3 had urine sodium excretion >100 mmol. Overall, 40.1% patients with CKD urine sodium excretion <100 mmol. Ethnic Indian patients had higher urinary sodium excretion than ethnic Chinese and Malay patients. It appears that patients with CKD stages G4 and G5 adequately restricted sodium intake with access to medical treatment. However, interventions to reduce sodium intake should be intensified in healthy persons and patients with earlier stages CKD (G1 to G3), particularly in patients of Indian ethnicity.

8 | SOUTH KOREA

The Hypertension Epidemiology Research Group analyzed the 1998–2016 Korea National Health and Nutrition Examination Survey data and the 2002–2016 Korea National Health Insurance Big Data.[29] The age-standardized prevalence of hypertension was 29.1% (men 35.0%, women 22.9%) in 2016. The treatment rate of hypertension in 2016 was 60.1% for men and 64.3% for women (Additional files 1 and 2, page 19). The rate of controlled hypertension in treated patients was 71.0% for men and 70.6% in women. The Korean National Health and Nutritional Examination Survey 2011–2013 reported the prevalence of CKD (eGFR <60 ml/min/1.73 m^2) was 2.5%.[30] The prevalence by CKD stages G3a, G3b, and G4-5 were 1.9%, 0.4%, and 0.2%, respectively. Kim et al[31] reported that hypertension as a cause of ESKD was 20%. In a study of a city population, the average sodium intake in South Korea was 4180 mg/day

(181.7 mmol/day) for men and 3480 mg/day (151.3 mmol/day) for women.[32]

9 | TAIWAN

The Nutrition and Health Survey in Taiwan (NAHSIT) reported that the prevalence of hypertension was 26% in men and 19% in women, with a control rate of 21.0% in men and 28.5% in women.[33] Since the implementation of the National Health Insurance system in 1995, the control rate of hypertension improved significantly to 50%.[34] Hwang et al[35] analyzed the epidemiology of CKD and ESKD, and reported that the prevalence of CKD stages G1 to G5 was 11.9%. The prevalence of hypertension as a cause of ESKD was 8.3%.[35]

10 | SUMMARY

This review has several limitations. First, the variations of disease definitions and different populations studied did not allow direct analyses. Secondly, in trying to obtain very specific information, we may have omitted reports which have data from a more recent time period, or included a more representative population sample. Thirdly, by limiting searches to the English language, National reports for some countries may have been omitted.

The identification, classification, and management of hypertension in Asian patients require greater detailing of ethnicities. There are ethnic differences to the prevalence of hypertension and CKD. Some reports detail different ethnicities as a result of sampling from different regions. Others reported ethnic groups even for the same "race", example, Hakka ethnicity in Taiwanese Chinese. Whereas, minority ethnic groups may have only been recently recognized. To improve CKD outcomes, enhancements in the identification of hypertension and dietary sodium intake assessments are needed including detailing ethnicities where hypertension prevalence and control are different. This will improve specific treatment of some groups with both hypertension and CKD. Hypertension alone or in combination with other primary renal conditions are significant factors in causing ESKD. Studies on control rates in Asian patients with CKD should aim to identify barriers to achieving goal blood pressures.

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AUTHOR CONTRIBUTION

Boon Wee Teo and Gek Cher Chan wrote the initial draft of the paper. All authors provided input on specific data, reviewed, and edited the paper.

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