End-Stage Kidney Diseases in Immigrant Groups: A Nationwide Cohort Study in Sweden

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Keywords

End-stage kidney disease · Gender · First generation immigrants · Neighbourhood · Socioeconomic status

Abstract

Background: Our aim was to study the association between the country of birth and incident end-stage kidney disease (ESKD) in several immigrant groups in Sweden, using individuals born in Sweden or with Swedish-born parents as referents. **Methods:** A cohort study of first- and second-generation immigrants residing in Sweden between January 1, 1998 and December 31, 2012 was performed. Outcomes were defined as having at least one registered diagnosis of ESKD in the National Patient Register. The incidence of ESKD in different immigrant groups was used in the Cox regression models to estimate hazard ratios (HRs) and 95% CIs. All models were stratified by sex and adjusted for age, geographical residence, educational level, marital status, and neighbourhood socioeconomic status. **Results:** Compared to their referents, higher incidence rates and HRs of ESKD (HR; 95% CI) were observed in general among foreign-born

men (1.10; 1.04–1.16) and women (1.12; 1.04–1.21) but not among second-generation immigrants (persons born in Sweden with foreign-born parents). A particularly high incidence was noted among men and women from East-European countries, as well as from non-European regions. A lower incidence of ESKD was noted among men from Finland. **Conclusions:** We observed substantial differences in incidence of ESKD between immigrant groups and the Swedish-born population, which may be clinically relevant when monitoring preventive measures in patient subgroups with a higher risk of deteriorating kidney disease, and suggest higher attention to hypertension and diabetes control in immigrants. Mechanisms attributable to the migration process or ethnic differences may lead to an increased risk of ESKD.

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Take-home message: Mechanisms attributable to the migration process or ethnic differences may lead to an increased risk of end-stage kidney disease in certain immigrant groups. The increased risk of ESKD bring attention to strict hypertension and diabetes control in several immigrant groups.

Chronic kidney disease (CKD) with end-stage kidney disease (ESKD) being the final stage of CKD is a disorder of increasing importance in Europe [1], as well as in the world [2, 3]. The incidence of ESKD is found to vary most with age and ethnicity but also with the prevalence of diabetes [4]. The prevalence rate of CKD and ESKD in the county of Stockholm, the capital of Sweden, was estimated to be 6.1 and 0.12%, respectively [5]. In comparison, the prevalence of ESKD in the United States was estimated at 0.19% and in the United Kingdom at 0.09% [3].

Diabetic nephropathy is described as an epidemic, and has been estimated to account for about one third of all ESKD cases worldwide [6], paralleling the diabetes epidemic in the world [7]. Actually, worldwide non-European populations are found to have a higher prevalence of ESKD, mostly due to higher rates of ESKD caused by type 2 diabetic consequences, exceeding the rates expected when looking at the community prevalence of diabetes [4].

In addition to the finding that ethnicity is of importance for CKD and ESKD, socio-economic factors have been shown to be of importance for ESKD incidence, access to dialysis and kidney transplantation as well as for the prognosis in those with ESKD [8]. These findings are particularly important as migration is increasing both worldwide and to Sweden. Approximately 17% of the registered population in Sweden are foreign-born (data from Statistics Sweden) [9]. In general, the health of immigrants often may be better than that of the native population upon arrival to the new country. The migrating populations are also in general in better health than those of the same populations remaining in the country of origin; this is known as the “healthy migrant effect” [10]. Even if this better health status among immigrants in some countries could be linked to a selective immigration process in which people are granted entry to a new country after passing a medical screening examination, this selection is uncommon for immigrants to Sweden. However, the health of immigrants tends to decline with time of residence in the new home country [11, 12]. In addition, the health among immigrants is complex, and influenced by the ethnic, cultural and the economic diversity of the immigrants, the reason for migration, the migration process in itself, and the acculturation in the new home country.

Even if ethnical disparities in CKD and ESKD are well known, especially in the United States, with higher rates of ESKD among African, Hispanic and Native Americans [13], studies on immigrants and ESKD are scarce. Indo-Asians in the Netherlands have been shown to exhibit a higher incidence of end-stage diabetic nephropa-

thy [14]. In Canada, immigrants from sub-Saharan Africa and the Caribbean regions have the highest risk of ESKD needing maintenance dialysis [15]. Considering the lack of studies in general, further studies on this topic are warranted. Therefore, the aim of this study was to explore the risk of being diagnosed with ESKD among first- and second-generation immigrants in Sweden and whether that risk differed from the Swedish-born reference population, after taking potential confounders into account.

Methods

Design

The nationwide registers used in the present study were the Total Population Register and the National Patient Register. The follow-up period ran from January 1, 1998 until hospitalisation/out-patient treatment of ESKD, death, emigration or the end of the study period on December 31, 2012, whichever came first. Out-patient diagnoses were included nationwide from 2001 and onwards from specialist care, not primary health care.

Study Population and Co-Morbidities

The total study population in the first-generation analysis was 6,449,649 of which 1,142,938 individuals were foreign born (551,228 men and 591,710 women), and 5,306,711 was Swedish-born (2,500,165 men and 2,806,546 women). In the second-generation analysis 8,396,377 individuals were included, of which 1,690,137 had foreign-born parents (866,983 men and 823,154 women) and 6,706,240 had Swedish-born parents (3,423,929 men and 3,282,311 women). Patients with an ESKD diagnosis prior to January 1, 1998 (1987–1997) were excluded in order to “wash-out” those with pre-existing disease (i.e., in the first-generation analysis 3,347 individuals, and in the second-generation analysis 2,826 individuals). For first-generation immigrants, country of birth was registered, and for second-generation immigrants, that is, with at least one foreign-born parent, country of birth for parents was registered, and the present study was based on analyses of 10 regions (Nordic countries, Southern Europe, Western Europe, Eastern Europe, Baltic countries, Central Europe, Africa, North America, Latin America and Asia) and separate analyses from 27 countries. Countries with less than 10 observed cases of ESKD were not analysed separately. First-generation immigrants were defined as those born outside Sweden and were compared to Swedish-born individuals. “The date of immigration” is actually the date of residence permit, that is, when the migrants receive their Swedish personal identification number, which normally occurs 8–10 months after the arrival to Sweden. Immigrants with residence permit in Sweden have full access to the Swedish health care system, while asylum applicants have access only to urgent care.

The outcome variable, ESKD, was based on the 10th revision of the International Classification of Diseases (ICD) or the Classification of Surgical Procedures (for ICD-10 codes, online suppl. material; for all online suppl. material, see www.karger.com/

doi/10.1159/000497063). Individuals with an ESKD diagnosed before 1998, that is, during the years 1987–1997 (according to ICD-9 1987–1996, and ICD-10 diagnosed in 1997) were excluded. We also identified co-morbidities according to ICD-10 for the following diagnoses: COPD, obesity, CHD, diabetes mellitus, alcoholism, stroke, hypertension, congestive heart failure, atrial fibrillation, gout, acute kidney failure, renal tubulo-interstitial diseases, post-procedural kidney failure and glomerular diseases.

Outcome Variable

Time was calculated from January 1, 1998 until hospitalisation/out-patient treatment of ESKD, death, emigration or the end of the study period on December 31, 2012, whichever came first.

Demographic and Socioeconomic Variables

The study population was stratified by sex. Age was used as a continuous variable in the analysis. Educational attainment was categorised as ≤ 9 years (partial or complete compulsory schooling), 10–12 years (partial or complete secondary schooling) and > 12 years (attendance at college and/or university). The geographic region of residence was included in order to adjust for possible regional differences in hospital admissions and was categorised as (1) large cities, (2) southern Sweden and (3) northern Sweden. Large cities were defined as municipalities with a population of $> 200,000$ and comprised the 3 largest cities in Sweden: Stockholm, Gothenburg and Malmö.

Neighbourhood Socioeconomic Status

Neighbourhoods were derived from Small Area Market Statistics. The index was categorised into 3 groups: more than 1 SD below the mean (high SES or low-deprivation level), more than 1 SD above the mean (low SES or high-deprivation level), and within one SD of the mean (middle SES or middle-deprivation level), with neighbourhood status classified as high, middle or low SES (corresponding to the categories low, middle and high-deprivation in the index) [16].

Statistical Analysis

The number of ESKD cases was presented for first-generation and second-generation immigrants and across baseline subject characteristics. Cox regression analysis was used for estimating the risk (hazard ratios [HRs] with 95% CIs) of incident ESKD in different immigrant groups compared to the Swedish-born population during the follow-up time. In the first-generation immigrants, all analyses were stratified by sex, but, in the second-generation immigrants, we adjusted for sex due to small numbers. Three models were used in our analyses: Model 1 was adjusted for age and region of residence in Sweden; Model 2 as Model 1 but also adjusted educational level, marital status and neighbourhood SES; and Model 3 as Model 2 but also adjusted for relevant co-morbidities.

We also estimated the adjusted population attributable fraction (PAF), or population attributable risk, in per cent for risk factors, as prevalence (%) among cases multiplied by $HR-1/HR$, [17], using adjusted HRs for the different factors. PAF is useful in order to compare the impact of different risk factors on the incidence of the outcome, in this case of ESKD.

The study was approved by the regional ethics boards at Karolinska Institutet and Lund University.

Results

Characteristics of the study population of the first- and second-generation immigrants are shown in Table 1, with a total of 0.27% in the first-generation study being diagnosed with ESKD (0.36% among males and 0.19% among females), and of 0.15% in second-generation study (0.19% among males and 0.11% among females). The rates of cardiovascular diseases, diabetes and specific kidney diseases were higher in patients with ESKD in both first- and second-generation individuals compared to their respective referents (online suppl. Table 1a–c). The co-morbidity patterns were also generally similar among sub-groups of Swedish-born and foreign-born, and in men and women (online suppl. Table 1a–c).

Table 2 shows the HRs of incident ESKD for male and female first-generation immigrant groups compared to Swedish-born individuals, and second-generation immigrants with men and women combined, in full models (for all models, online suppl. Table 2a, b). Among males, only the Finnish men had a significantly lower risk for ESKD in the fully adjusted model, while significantly higher risks of ESKD were observed in several immigrant groups compared to Swedish-born individuals. Significantly higher risks for ESKD, compared to Swedish born, were observed among men from Eastern Europe (and specifically those from Bosnia and Bulgaria), Africa, Northern America, Asia (except Iran). Immigrant women from Denmark, Eastern Europe, Africa, Latin America and Asia (especially women from Iraq) were at higher risk for ESKD than their Swedish-born counterparts.

The results in the full models for second-generation immigrants with men and women combined are also shown in Table 2 (with all models shown in online suppl. Table 2c). The fully adjusted HRs showed no significant difference in ESKD risk between the total group with foreign-born parents compared to those with Swedish-born parents. However, some subgroups among the second-generation immigrants had significantly different risks for ESKD compared to the reference group. A lower risk was found among second-generation immigrants from Finland and Latin America, while an excess risk was found among individuals from the Netherlands, Bosnia and Asia, especially individuals from Lebanon.

We also estimated PAFs for first-generation male immigrants, first-generation female immigrants and second generation immigrants, with each group respec-

Table 1. Baseline characteristics and incident cases of ESKD in Swedish-born and immigrants

	First-generation individuals		Second-generation individuals	
	total population, <i>n</i> (%)	ESKD diagnosis, <i>n</i> (%)	total population, <i>n</i> (%)	ESKD diagnosis, <i>n</i> (%)
Total	6,449,649	17,598 (0.27)	8,396,377	12,744 (0.15)
Gender, females	3,398,256 (52.7)	6,498 (36.9)	4,105,465 (48.9)	4,617 (36.2)
Immigrants*	1,142,938 (17.7)	2,353 (13.4)	1,690,137 (20.1)	1,279 (10.0)
Educational level				
≤9	2,016,591 (31.3)	7,795 (44.3)	3,295,904 (39.3)	4,478 (35.1)
10–12	1,628,419 (25.2)	4,704 (26.7)	1,476,161 (17.6)	3,848 (30.2)
>12	2,804,639 (43.5)	5,099 (29.0)	3,624,312 (43.2)	4,418 (34.7)
Region of residence				
Large cities	2,068,768 (32.1)	6,641 (37.8)	2,045,918 (24.4)	4,624 (36.3)
Southern Sweden	2,696,328 (41.8)	7,663 (43.5)	2,652,246 (31.6)	5,503 (43.2)
Northern Sweden	1,684,553 (26.1)	3,294 (18.7)	3,698,213 (44.0)	2,617 (20.5)
Marital status				
Married	4,758,352 (73.8)	13,591 (77.2)	6,242,088 (74.3)	8,366 (65.6)
Not married	1,691,297 (26.2)	4,007 (22.8)	2,154,289 (25.7)	4,378 (34.4)
Neighbourhood deprivation				
Low	891,041 (13.8)	2,328 (13.2)	938,982 (11.2)	1,675 (13.1)
Middle	3,043,370 (47.2)	9,189 (52.2)	2,976,602 (35.5)	6,583 (51.7)
High	722,092 (11.2)	2,301 (13.1)	683,833 (8.1)	1,650 (12.9)
Unknown	1,793,146 (27.8)	3,780 (21.5)	3,796,960 (45.2)	2,836 (22.3)
Hospital diagnoses				
COPD	288,885 (4.5)	1,679 (9.5)	420,336 (5.0)	1,127 (8.8)
Obesity	85,369 (1.3)	428 (2.4)	116,155 (1.4)	464 (3.6)
CHD	533,575 (8.3)	6,053 (34.4)	217,728 (2.6)	3,194 (25.1)
Diabetes	349,319 (5.4)	6,224 (35.4)	222,001 (2.6)	4,659 (36.6)
Alcoholism	136,348 (2.1)	598 (3.4)	185,296 (2.2)	674 (5.3)
Stroke	371,529 (5.8)	3,046 (17.3)	133,370 (1.6)	1,770 (13.9)
Hypertension	759,724 (11.8)	10,075 (57.3)	452,180 (5.4)	6,867 (53.9)
Heart failure	323,989 (5.0)	5,026 (28.6)	77,207 (0.9)	2,418 (19.0)
Atrial fibrillation	366,834 (5.7)	3,450 (19.6)	137,976 (1.6)	1,714 (13.4)
Gout	33,112 (0.5)	1,025 (5.8)	18,181 (0.2)	704 (5.5)
Acute kidney failure	29,650 (0.5)	3,362 (19.1)	13,816 (0.2)	2,475 (19.4)
Renal tubulo-interstitial disease	110,756 (1.7)	3,014 (17.1)	114,153 (1.4)	2,496 (19.6)
Post-procedural kidney failure	781 (0.0)	148 (0.8)	347 (0.0)	87 (0.7)
Glomerular disease	21,442 (0.3)	4,546 (25.8)	22,107 (0.3)	4,027 (31.6)

* Immigrant status in the second-generation individuals based on the country of birth in parents.
ESKD, end-stage kidney disease.

tively compared with their Swedish-born counterparts (online suppl. Table 3). The results, for each group, were as follows: for diabetes 24.3 vs. 18.9%, 20.6 vs. 21.4%, and 20.3 vs. 24.0%; for hypertension 40.6 vs. 39.4%, 45.6 vs. 35.5%, and 37.8 vs. 38.4%; for acute kidney failure 17.5 vs. 16.1%, 14.2 vs. 16.8%, and 17.7 vs. 16.3%; for renal tubulo-interstitial diseases 11.1 vs. 9.8%, 17.7 vs. 14.8%, and 17.3 vs. 14.8%; and for glomerular diseases 27.7 vs. 25.7%, 27.9 vs. 22.2%, and 33.6 vs. 30.2%.

Discussion

In this nationwide cohort study of more than 6 million individuals, we observed significant differences in risks for ESKD between first-generation immigrant groups and the Swedish-born controls. Mechanisms attributable to the migration process or ethnic differences may lead to an increased risk of ESKD in certain immigrant groups. The risk of ESKD was increased in first-generation immigrants from Eastern European countries, Africa and

Table 2. Incidence of ESKD in first-generation immigrant men and women, respectively, and second-generation men and women combined, expressed as HRs with 95% CIs

	First-generation males		First-generation females		Second-generation males and females combined	
	HR	95% CI	HR	95% CI	HR	95% CI
Sweden	1		1		1	
All foreign-born men	1.10	1.04–1.16	1.12	1.04–1.21	0.98	0.92–1.04
Nordic countries	0.83	0.75–0.92	1.00	0.90–1.11	0.96	0.89–1.04
Denmark	1.05	0.85–1.29	1.51	1.17–1.94	1.16	0.97–1.38
Finland	0.75	0.66–0.85	0.89	0.78–1.02	0.89	0.80–0.98
Iceland	0.49	0.12–1.95	1.26	0.41–3.92	0.27	0.04–1.91
Norway	1.04	0.81–1.34	1.13	0.89–1.45	1.04	0.89–1.20
Southern Europe	0.97	0.75–1.23	1.23	0.82–1.83	0.95	0.69–1.31
France	0.61	0.23–1.62	1.70	0.64–4.53	0.73	0.27–1.95
Greece	0.99	0.64–1.54	1.11	0.56–2.23	0.74	0.38–1.42
Italy	0.90	0.57–1.41	1.46	0.66–3.26	1.30	0.79–2.17
Spain	1.10	0.62–1.93	1.55	0.70–3.46	0.49	0.16–1.52
Other Southern European countries	1.25	0.65–2.40	–		1.64	0.74–3.65
Western Europe	1.03	0.87–1.23	0.83	0.65–1.06	1.02	0.86–1.21
The Netherlands	0.63	0.26–1.51	1.67	0.63–4.44	2.12	1.23–3.65
UK and Ireland	1.16	0.79–1.70	0.92	0.38–2.20	0.97	0.58–1.61
Germany	1.03	0.82–1.30	0.81	0.61–1.06	0.94	0.76–1.17
Austria	1.36	0.84–2.19	0.37	0.09–1.48	1.13	0.67–1.90
Other Western European countries	0.72	0.36–1.45	1.95	0.63–6.05	0.89	0.33–2.37
Eastern Europe	1.27	1.11–1.46	1.33	1.09–1.61	0.90	0.73–1.12
Bosnia	1.86	1.38–2.51	1.26	0.79–2.02	1.83	1.16–2.88
Yugoslavia	1.07	0.90–1.28	1.22	0.95–1.55	0.78	0.61–1.01
Croatia	1.18	0.61–2.26	1.87	0.84–4.16	1.07	0.27–4.28
Romania	1.33	0.87–2.05	1.43	0.68–3.00	0.62	0.20–1.92
Bulgaria	2.71	1.22–6.03	1.73	0.43–6.94	–	
Other Eastern European countries	2.37	1.38–4.09	2.90	1.45–5.82	2.19	0.71–6.80
Baltic countries	1.03	0.72–1.46	0.60	0.31–1.15	1.08	0.81–1.44
Estonia	1.05	0.72–1.53	0.53	0.25–1.11	0.97	0.70–1.34
Latvia	0.91	0.34–2.41	1.11	0.28–4.43	1.76	0.98–3.19
Central Europe	1.03	0.84–1.27	1.05	0.79–1.39	0.91	0.69–1.19
Poland	0.84	0.61–1.18	0.96	0.66–1.41	0.92	0.64–1.32
Other Central European countries	1.16	0.68–1.95	1.65	0.89–3.07	0.76	0.36–1.60
Hungary	1.23	0.90–1.68	0.93	0.52–1.69	0.98	0.61–1.57
Africa	2.13	1.73–2.62	1.80	1.23–2.61	1.13	0.76–1.69
Northern America	1.50	1.03–2.17	1.41	0.80–2.48	0.92	0.67–1.27
Latin America	1.24	0.93–1.65	1.64	1.18–2.27	0.57	0.33–0.98
Chile	1.48	1.08–2.04	1.38	0.89–2.15	0.72	0.39–1.33
Other South American countries	0.77	0.42–1.44	2.09	1.30–3.37	0.34	0.11–1.05
Asia	1.54	1.37–1.73	1.51	1.29–1.77	1.23	1.02–1.48
Turkey	1.44	1.10–1.88	1.39	0.98–1.97	1.09	0.75–1.57
Lebanon	1.84	1.31–2.58	1.13	0.61–2.11	2.03	1.32–3.12
Iran	0.74	0.53–1.04	1.32	0.85–2.05	0.82	0.47–1.45
Iraq	2.17	1.72–2.73	2.65	1.91–3.68	1.25	0.80–1.95
Other Asian countries	1.80	1.49–2.17	1.37	1.07–1.75	1.27	0.93–1.74
Russia	0.99	0.51–1.90	0.89	0.43–1.87	1.44	0.94–2.20

Only full models shown, that is, adjusted for birth year, region of residence in Sweden, educational level, marital status, neighborhood deprivation and comorbidities.

Bold values are significant.

ESKD, end-stage kidney disease; HR, hazard ratio.

Asia (especially from Middle Eastern countries) and lower in men from Finland.

The Finnish immigrant group in Sweden is traditionally one of the largest, and Finland has also been a high-risk country for cardio-vascular diseases; this also holds among Finnish immigrants in Sweden [18], why a higher risk of ESKD could be expected. However, we observed a lower risk for ESKD in Finnish immigrants compared to Swedish-born, which is a bit puzzling.

Many immigrant groups showed a higher risk of ESKD than Swedish-born: both men and women from Eastern Europe, Africa and some Asian countries. In the earlier mentioned Canadian study, immigrants from sub-Saharan Africa were one of the immigrant groups with the highest risk of ESKD needing maintenance dialysis treatment [15]. Immigrants from Bosnia have earlier been shown to have higher cardio-vascular risks, for example, for atrial fibrillation, coronary heart disease and congestive heart failure [18–20]. The proportion of refugees among immigrants from Bosnia (17–22%) and Iraq (10–17%) is the highest among all immigrant groups [20] – why stress before migration, or during the migration process, could be a factor of importance [21, 22]. However, based on a previous study, we judge that this factor could explain only around 10% of the increased risk [20]. Besides, the earlier described Balkan endemic nephropathy, where environmental factors, more specifically Aristolochia plants, probably play an important role, could possibly have contributed to the higher risk of ESKD among East-European immigrants [23]. However, the increased risk also among second-generation immigrants born in Sweden not being exposed to Aristolochia plants, but with parents born in Bosnia, seems to contradict this hypothesis. The higher risk of ESKD among some non-European first-generation immigrant groups is not surprising, considering that non-European populations are found to have an excess ESKD, mostly due to rates of type 2 diabetic ESKD exceeding the community prevalence of diabetes [4]. The high contribution of hypertension and diabetes is of particular importance, as these are conditions where a sufficiently good treatment could prevent many ESKD cases. Diabetes is also more common in non-European immigrants in Sweden, especially Middle Eastern immigrants [24].

Other causes of ESKD are also common in some parts of the world: glomerulonephritis and unknown causes in countries in Asia as well as in sub-Saharan Africa [3]. The absence of an increased risk for ESKD in many second-generation immigrant groups indicates that the risk for first-generation immigrants seems to be associated with environmental rather than genetic factors. Besides, the so-

cio-economic situation in itself can hardly explain the lower risk in second- compared to first-generation immigrants, as adjustment for socio-economic factors only changed the HRs marginally. The increased risk in some immigrant groups, that is, among individuals with 1 or 2 parents from the Netherlands, Bosnia and Lebanon, is difficult to explain but could eventually be due to chance when considering the small number of events in separate groups.

For the results in the calculations of PAFs, some differences are of interest, even if the findings were similar between immigrants compared to Swedish-born, and with almost identical results in the second-generation immigrants. Among immigrant women, the PAFs were higher for hypertension, 45.6 vs. 35.5% among Swedish-born, and, for glomerular disease, 27.9 vs. 22.2%. However, the statistical power was insufficient for estimating PAFs for separate regions or countries.

There are several limitations to this study, which must be kept in mind when interpreting the results. The number of subjects with incident ESKD was rather low, why we had to show results for all ages among men and women, although the patterns of ESKD differs between younger and older individuals [4], and merge men and women in the analyses of second-generation immigrants. We chose to include only ESKD diagnoses, as CKD in other stages seems to be under-reported. As the National Patient Register, diagnoses from primary care where most patients with, for example, hypertension and diabetes receive their care are not included. Consistent findings among men and women in several of the immigrant groups could be considered more valid, while single results should be interpreted with some caution. Assessing population attributable risk or PAF can be performed in different ways, and we decided to use the approach proposed by Miettinen [17], as this gives illustrative information fairly easy to interpret. One disadvantage, however, is that if summarizing the PAFs, the sum will exceed 100%, which must be kept in mind when interpreting results. Despite these limitations, a major strength of this study is the linkage of diagnoses from individual patients to national demographic and socio-economic data. Besides, as we could use national Swedish data, it was possible to analyse men and women from different types of sociodemographic backgrounds.

In conclusion, in this cohort study with the Swedish population of 6 million men and women, we observed a higher incidence of ESKD among several immigrant groups. It is important in the clinical situation to consider the increased risk for ESKD in some groups, in order to de-

tect possible treatable disorders in due time. It is also important to carefully monitor preventive pharmacotherapy in patients with a higher risk of deteriorating kidney disease, especially in hypertension and diabetes, such as those with concomitant diseases in certain immigrant groups. The different patterns among first- and second-generation immigrant groups could contribute to shed new light on the relative importance of genetic and environmental factors behind ESKD in different immigrant groups.

Disclosure Statement

The authors have no conflicts of interest to disclose. The results presented in this paper have not been published previously in whole or part.

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Authors Contribution

P.W., A.C.C., X.L., J.Ä., J.S., and K.S.: designed the study. X.L.: analyzed data, and all authors participated in the interpretation of data. P.W. and A.C.C.: drafted the manuscript and all other authors revised it critically for important intellectual content.