ETIOLOGICAL DIFFERENCES OF STAGE 5 CHRONIC KIDNEY DISEASE AMONG ADULT PATIENTS ACROSS SECOND-LEVEL ADMINISTRATIVE REGIONS OF WEST JAVA IN 2023: BASED ON INDONESIAN RENAL REGISTRY

NASKAH ARTIKEL

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Lembar ini untuk menyatakan bahwa kami telah memeriksa salinan artikel hasil karya penulis dengan nama di atas dan menyatakan telah layak untuk diajukan dalam Sidang Hasil Penelitian.

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dan telah berkomunikasi dengan nama-nama di atas dan menyepakati untuk dilakukan ujian hasil penelitian terhadap mahasiswa tersebut dengan cara (sidang / ~~desk evaluation~~) pada tanggal …

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ABSTRAK

Aim

Chronic kidney disease (CKD) is a global health problem with an increasing prevalence. In Indonesia, data on the etiology of stage 5 CKD remain limited at the national level, despite the need for localized approaches to ensure effective prevention strategies. Variations in healthcare services and the management of chronic diseases across regions may influence the pattern of CKD etiology. More specific information at the regency or city level is essential for planning targeted interventions. This study aims to describe the etiological differences of stage 5 CKD among adult patients across level 2 healthcare regions in West Java in 2023, based on data from the Indonesian Renal Registry.

Methods

Data from the 2023 Indonesian Renal Registry (IRR) were reviewed for all new stage 5 CKD patients aged over 18 years in regencies and cities across West Java. A total of 11.611 patients from 26 regencies/cities were included in the analysis. The reviewed data comprised the location of dialysis units at the regency/city level, patient age, sex, and CKD etiology. Cases with incomplete data were excluded from the analysis. Comparisons of etiological distributions across regions were conducted using analytical statistical tests.

Results

A total of 11,611 eligible end-stage renal disease (ESRD) cases from 26 regencies/cities in West Java in 2023 were analyzed, excluding Pangandaran Regency due to the absence of hemodialysis facilities. Male patients constituted 51.89% (6,026 cases), slightly higher than females at 49.11% (5,585 cases). The predominant age group was 45–64 years, with the highest cases in the 55–64 age range (3,444 cases). Hypertensive kidney disease (E4) was the most common etiology, accounting for 48.27% of cases, followed by diabetic nephropathy (E2) at 27.19% and primary glomerulopathy (E1) at 10.89%. Regional variation was observed; for example, diabetic nephropathy predominated in Cirebon and Karawang,

whereas primary glomerulopathy was highest in Subang. Other etiologies showed local dominance in certain regencies, such as other diseases (E9) in Ciamis, Cianjur, and Cirebon, and post-nephrectomy conditions (E8) in Sumedang. Six etiologies—hypertension, diabetes, primary glomerulopathy, other diseases, unknown etiology, and pyelonephritis—were consistently among the top three causes across regions. Chi-Square analysis indicated significant differences in etiological distribution (Pearson Chi-Square = 1054.128, df = 125, $p < 0.001$; Likelihood Ratio = 780.367, $p < 0.001$).

Conclusion

Hypertensive kidney disease remains the predominant cause of stage 5 chronic kidney disease (CKD) in West Java in 2023, with significant regional variations observed. Regarding regional variation, six etiologies consistently rank among the top three most common causes (MCE) across 26 regencies and cities. The Chi-Square test showed a statistically significant difference in the distribution of CKD etiologies among regions ($p < 0.001$), indicating that these differences are influenced by local demographic, social, and healthcare access factors. These findings emphasize the need for region-specific prevention and management strategies to effectively reduce the burden of end-stage renal disease, with particular attention to the differing risks in productive-age and elderly populations.

1. Introduction

Chronic Kidney Disease (CKD) is a growing global health issue, with a worldwide prevalence of 9.1% and an estimated total of 697.5 million cases in 2017. [1] The prevalence of CKD is higher in low- and middle-income countries, including Indonesia, which reported 638,178 cases of CKD in 2023, with West Java being the province with the highest number of cases at 114,619. .[2] Stage 5 CKD, or end-stage renal disease (ESRD), requires kidney replacement therapy (KRT), such as dialysis or transplantation, to sustain life. In Indonesia, hemodialysis (HD) is the most widely used method of KRT.[3] According to the 2020 Indonesian Renal Registry (IRR) data, hypertension (35%) and diabetes mellitus (29%) are the two main causes of stage 5 CKD.[4] However, this data is still aggregated at the national level and does not reflect the significant regional variations within Indonesia.

This contrasts with a meta-analysis in Southeast Asia, which involved 81 studies and 32,834 subjects, showing diabetic kidney disease as the leading etiology in Southeast Asia. Geographical, social, and healthcare access differences can lead to variations in CKD risk factors and etiologies.[5] For example, in West Java, the coverage of healthcare services for diabetes and hypertension varies widely among regencies, ranging from over 100% to less than 5%.[6] This variability highlights the importance of more specific local data to formulate more effective preventive interventions and disease management.

Therefore, this study reviews and compares the etiology of stage 5 CKD in adult patients on HD at the regency level in West Java Province in 2023, based on data from the Indonesian Renal Registry. This study is novel because it examines the variation in the causes of stage 5 CKD at the regency level in West Java, which has not been extensively discussed in previous national or regional studies. In addition to providing an

overview of the variations in the causes of stage 5 CKD in each regency, the results of this study are expected to serve as a basis for more targeted health policy planning. Detailed local etiology data allows for the identification of high-risk populations and the development of promotive and preventive programs tailored to local needs. Thus, this study not only contributes to the provision of more comprehensive epidemiological data but also supports efforts to reduce the burden of CKD sustainably in Indonesia, particularly in West Java Province.

2. Materials and Methods

2.1 Study Design

This study employed a quantitative analytical approach to assess the etiological profile of stage 5 CKD among adult patients in each regency and city of West Java. Secondary data were obtained from the IRR for the period of January to December 2023, including information on age, sex, dialysis unit location, and etiological diagnosis. The analysis method used was the chi-square test to examine the differences in proportions between various CKD etiologies. The study protocol was approved by the Ethics Committee of Universitas Padjadjaran.

2.2 Population and Subjects

The study population consisted of all CKD patients undergoing hemodialysis in the regencies and cities of West Java. The research subjects included all newly diagnosed stage 5 adult CKD patients (≥18 years old) undergoing hemodialysis in the regencies and cities of West Java Province, recorded in the IRR during the period of January to December 2023. Sampling was performed by reviewing the difference in proportions, with a minimum sample size of 4,544, based on the principle of the most prevalent etiology in a socially geographically similar population used for the calculation. All

newly diagnosed stage 5 CKD patients aged ≥18 years with complete data were included in the analysis; cases with incomplete data were excluded.

3. Results

Based on the data from this study, there were 11,845 cases, with a total of 11,611 meeting the selection criteria and eligible for analysis in West Java in 2023. Pangandaran Regency was excluded from this analysis because the region does not have a hemodialysis unit. Therefore, data from Pangandaran is not included in the distribution of ESRD cases in West Java, and only 26 regencies/cities were analyzed. Of this total, males dominated with 6,026 patients (51.89%), while females accounted for 5,585 patients (49.11%). This difference is also reflected in the distribution by region, with 19 regencies/cities predominantly male and 7 predominantly female. **(Table 1)**

Table 1 Number of ESRD Patients by Gender in each Regency/City

Regency/City	Number = n (%)		
	Gender		
	Male	Female	Total
Bandung Regency	220 (53,79%)	189 (46,21%)	409
Bandung Barat Regency	15 (60,00%)	10 (40,00%)	25
Bekasi Regency	219 (47,61%)	241 (52,39%)	460
Bogor Regency	411 (53,87%)	352 (46,13%)	763
Ciamis Regency	177 (52,52%)	160 (47,48%)	337
Cianjur Regency	38 (55,07%)	31 (44,93%)	69
Cirebon Regency	311 (50,08%)	310 (49,92%)	621
Garut Regency	47 (47,00%)	53 (53,00%)	100
Indramayu Regency	162 (49,39%)	166 (50,61%)	328
Karawang Regency	261 (44,01%)	332 (55,99%)	593
Kuningan Regency	257 (49,42%)	263 (50,58%)	520
Majalengka Regency	234 (51,66%)	219 (48,34%)	453
Purwakarta Regency	316 (45,21%)	383 (54,79%)	699
Subang Regency	71 (47,65%)	78 (52,35%)	149
Sukabumi Regency	96 (69,06%)	43 (30,94%)	139
Sumedang Regency	127 (51,84%)	118 (48,16%)	245
Tasikmalaya Regency	73 (50,69%)	71 (49,31%)	144
Bandung City	943 (53,95%)	805 (46,05%)	1748
Banjar City	36 (57,14%)	27 (42,86%)	63
Bekasi City	593 (53,76%)	510 (46,24%)	1103
Bogor City	230 (54,63%)	191 (45,37%)	421
Cimahi City	152 (55,07%)	124 (44,93%)	276
Cirebon City	261 (55,41%)	210 (44,59%)	471

Depok City	268 (53,39%)	234 (46,61%)	502
Sukabumi City	156 (52,70%)	140 (47,30%)	296
Tasikmalaya City	352 (51,99%)	325 (48,01%)	677
West Java	6026	5585	11611

In terms of age groups, patients in the 45–64 age range represent the dominant group, with the highest number of patients in the 55–64 age group (3,444 cases) and 45–54 age group (3,293 cases). These results indicate that the dominant age group falls within the productive age range, from young adulthood to older adulthood. **(Table 2)**

Table 2 Number of ESRD by Age in each Regency/City

Regency/City	Number= n (%)							
	Age (years)							
	18–24	25–34	35–44	45–54	55–64	65–74	>75	Total
Bandung Regency	14 (3,42%)	35 (8,56%)	79 (19,32%)	122 (29,83%)	108 (26,41%)	42 (10,27%)	9 (2,20%)	409
Bandung Barat Regency	1 (4,00%)	1 (4,00%)	3 (12,00%)	9 (36,00%)	4 (16,00%)	7 (28,00%)	0 (0,00%)	25
Bekasi Regency	10 (2,17%)	40 (8,70%)	78 (16,96%)	144 (31,30%)	127 (27,61%)	53 (11,52%)	8 (1,74%)	460
Bogor Regency	18 (2,36%)	50 (6,55%)	112 (14,68%)	253 (33,16%)	207 (27,13%)	94 (12,32%)	29 (3,80%)	763
Ciamis Regency	6 (1,78%)	16 (4,75%)	42 (12,46%)	98 (29,08%)	103 (30,56%)	56 (16,62%)	16 (4,75%)	337
Cianjur Regency	2 (2,90%)	5 (7,25%)	12 (17,39%)	18 (26,09%)	22 (31,88%)	10 (14,49%)	0 (0,00%)	69
Cirebon Regency	14 (2,25%)	52 (8,37%)	92 (14,81%)	181 (29,15%)	181 (29,15%)	91 (14,65%)	10 (1,61%)	621
Garut Regency	3 (3,00%)	11 (11,00%)	21 (21,00%)	30 (30,00%)	28 (28,00%)	5 (5,00%)	2 (2,00%)	100
Indramayu Regency	9 (2,74%)	31 (9,45%)	62 (18,90%)	90 (27,44%)	83 (25,30%)	47 (14,33%)	6 (1,83%)	328
Karawang Regency	11 (1,85%)	33 (5,56%)	95 (16,02%)	189 (31,87%)	180 (30,35%)	75 (12,65%)	10 (1,69%)	593
Kuningan Regency	12 (2,31%)	35 (6,73%)	81 (15,58%)	161 (30,96%)	158 (30,38%)	60 (11,54%)	13 (2,50%)	520
Majalengka Regency	8 (1,77%)	24 (5,30%)	64 (14,13%)	132 (29,14%)	139 (30,68%)	74 (16,34%)	12 (2,65%)	453
Purwakarta Regency	19 (2,72%)	33 (4,72%)	85 (12,16%)	220 (31,47%)	227 (32,47%)	95 (13,59%)	20 (2,86%)	699
Subang Regency	3 (2,01%)	10 (6,71%)	21 (14,09%)	40 (26,85%)	43 (28,86%)	22 (14,77%)	10 (6,71%)	149
Sukabumi Regency	2 (1,44%)	13 (9,35%)	31 (22,30%)	42 (30,22%)	40 (28,78%)	10 (7,19%)	1 (0,72%)	139
Sumedang Regency	7 (2,86%)	17 (6,94%)	34 (13,88%)	54 (22,04%)	81 (33,06%)	43 (17,55%)	9 (3,67%)	245
Tasikmalaya Regency	3 (2,08%)	11 (7,64%)	33 (22,92%)	29 (20,14%)	45 (31,25%)	17 (11,81%)	6 (4,17%)	144
Bandung City	26 (1,49%)	140 (8,01%)	260 (14,87%)	471 (26,95%)	478 (27,35%)	289 (16,53%)	84 (4,81%)	1748
Banjar City	1 (1,59%)	2 (3,17%)	9 (14,29%)	15 (23,81%)	25 (39,68%)	10 (15,87%)	1 (1,59%)	63

Bekasi City	16 (1,45%)	63 (5,71%)	149 (13,51%)	301 (27,29%)	335 (30,37%)	188 (17,04%)	51 (4,62%)	1103
Bogor City	6 (1,43%)	30 (7,13%)	62 (14,73%)	113 (26,84%)	128 (30,40%)	60 (14,25%)	22 (5,23%)	421
Cimahi City	6 (2,17%)	20 (7,25%)	38 (13,77%)	75 (27,17%)	84 (30,43%)	40 (14,49%)	13 (4,71%)	276
Cirebon City	10 (1,31%)	31 (4,06%)	48 (6,29%)	112 (14,68%)	165 (21,63%)	85 (11,14%)	20 (2,62%)	471
Depok City	6 (1,20%)	26 (5,18%)	58 (11,55%)	136 (27,09%)	158 (31,47%)	94 (18,73%)	24 (4,78%)	502
Sukabumi City	8 (2,70%)	14 (4,73%)	47 (15,88%)	79 (26,69%)	85 (28,72%)	46 (15,54%)	17 (5,74%)	296
Tasikmalaya City	11 (1,62%)	59 (8,71%)	114 (16,84%)	179 (26,44%)	210 (31,02%)	86 (12,70%)	18 (2,66%)	677
Seluruh Kab/Kota	232	802	1730	3293	3444	1699	411	11611

In terms of etiology, hypertensive kidney disease (E4) was the leading cause, accounting for 48.27% of cases, followed by diabetic nephropathy (E2) at 27.19%, and primary glomerulopathy (E1) at 10.89%. Other etiologies showed lower proportions, with E10 (715 cases), E9 (382 cases), E7 (190 cases), E8 (174 cases), E5 (88 cases), E3 (58 cases), and E6 (56 cases).

Table 3 Number of ESRD by Etiology in each Regency/City

Regency/City	Number = n (%)										
	Etiology										
	E1[1]	E2	E3	E4	E5	E6	E7	E8	E9	E10	Total
Bandung Regency	111 (27.14%)	86 (21.03%)	0 (0.00%)	184 (44.99%)	2 (0.49%)	3 (0.73%)	6 (1.47%)	2 (0.49%)	3 (0.73%)	12 (2.93%)	409
Bandung Barat Regency	5 (20.00%)	10 (40.00%)	0 (0.00%)	10 (40.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	25
Bekasi Regency	42 (9.13%)	163 (35.43%)	3 (0.65%)	213 (46.30%)	3 (0.65%)	0 (0.00%)	1 (0.22%)	1 (0.22%)	15 (3.26%)	19 (4.13%)	460
Bogor Regency	86 (11.27%)	158 (20.71%)	1 (0.13%)	458 (60.03%)	12 (1.57%)	6 (0.79%)	6 (0.79%)	8 (1.05%)	6 (0.79%)	22 (2.88%)	763
Ciamis Regency	10 (2.97%)	111 (32.94%)	1 (0.30%)	157 (46.59%)	0 (0.00%)	3 (0.89%)	3 (0.89%)	0 (0.00%)	49 (14.54%)	3 (0.89%)	337
Cianjur Regency	5 (7.25%)	4 (5.80%)	1 (1.45%)	46 (66.67%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	12 (17.39%)	1 (1.45%)	69
Cirebon Regency	24 (3.86%)	360 (57.97%)	4 (0.64%)	129 (20.77%)	4 (0.64%)	4 (0.64%)	11 (1.77%)	3 (0.48%)	72 (11.59%)	10 (1.61%)	621
Garut Regency	27 (27.00%)	25 (25.00%)	0 (0.00%)	46 (46.00%)	0 (0.00%)	0 (0.00%)	1 (1.00%)	0 (0.00%)	0 (0.00%)	1 (1.00%)	100
Indramayu Regency	40 (12.20%)	49 (14.94%)	0 (0.00%)	192 (58.54%)	6 (1.83%)	1 (0.30%)	2 (0.61%)	1 (0.30%)	5 (1.52%)	32 (9.76%)	328
Karawang Regency	71 (11.97%)	241 (40.64%)	0 (0.00%)	211 (35.58%)	3 (0.51%)	1 (0.17%)	3 (0.51%)	9 (1.52%)	2 (0.34%)	52 (8.77%)	593
Kuningan Regency	54 (10.38%)	144 (27.69%)	1 (0.19%)	298 (57.31%)	0 (0.00%)	2 (0.38%)	10 (1.92%)	1 (0.19%)	8 (1.54%)	2 (0.38%)	520
Majalengka Regency	42 (9.27%)	90 (19.87%)	0 (0.00%)	289 (63.80%)	3 (0.66%)	1 (0.22%)	3 (0.66%)	2 (0.44%)	5 (1.10%)	18 (3.97%)	453
Purwakarta Regency	45 (6.44%)	105 (15.02%)	5 (0.72%)	415 (59.37%)	5 (0.72%)	2 (0.29%)	2 (0.29%)	5 (0.72%)	44 (6.29%)	71 (10.16%)	699
Subang Regency	69 (46.31%)	37 (24.83%)	0 (0.00%)	35 (23.49%)	0 (0.00%)	0 (0.00%)	4 (2.68%)	0 (0.00%)	2 (1.34%)	2 (1.34%)	149
Sukabumi Regency	20 (14.39%)	20 (14.39%)	0 (0.00%)	93 (66.91%)	0 (0.00%)	4 (2.88%)	0 (0.00%)	0 (0.00%)	1 (0.72%)	1 (0.72%)	139
Sumedang Regency	33 (13.47%)	69 (28.16%)	4 (1.63%)	80 (32.65%)	4 (1.63%)	1 (0.41%)	5 (2.04%)	47 (19.18%)	0 (0.00%)	2 (0.82%)	245
Tasikmalaya Regency	15 (10.42%)	15 (10.42%)	0 (0.00%)	113 (78.47%)	0 (0.00%)	0 (0.00%)	1 (0.69%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	144
Bandung City	220 (12.59%)	507 (29.00%)	14 (0.80%)	738 (42.22%)	11 (0.63%)	4 (0.23%)	60 (3.43%)	41 (2.35%)	88 (5.03%)	65 (3.72%)	1748
Banjar City	5 (7.94%)	12 (19.05%)	0 (0.00%)	23 (36.51%)	1 (1.59%)	0 (0.00%)	1 (1.59%)	1 (1.59%)	0 (0.00%)	20 (31.75%)	63

[1] E1 (Primary Glomerulopathy/Acute Glomerulonephritis), E2 (Diabetic Nephropathy), E3 (Lupus Nephropathy/Systemic Lupus Erythematosus), E4 (Hypertensive Kidney Disease), E5 (Polycystic Kidney Disease), E6 (Uric Acid Nephropathy), E7 (Obstructive Nephropathy), E8 (Chronic Pyelonephritis), E9 (Others), and E10 (Unknown).

Bekasi City	85 (7.71%)	335 (30.37%)	3 (0.27%)	445 (40.34%)	5 (0.45%)	3 (0.27%)	6 (0.54%)	5 (0.45%)	15 (1.36%)	201 (18.22%)	1103
Bogor City	46 (10.93%)	81 (19.24%)	4 (0.95%)	259 (61.52%)	8 (1.90%)	5 (1.19%)	2 (0.48%)	1 (0.24%)	9 (2.14%)	6 (1.43%)	421
Cimahi City	26 (9.42%)	66 (23.91%)	0 (0.00%)	122 (44.20%)	4 (1.45%)	0 (0.00%)	5 (1.81%)	24 (8.70%)	4 (1.45%)	25 (9.06%)	276
Cirebon City	42 (8.92%)	129 (27.39%)	2 (0.42%)	166 (35.24%)	9 (1.91%)	10 (2.12%)	34 (7.22%)	14 (2.97%)	14 (2.97%)	51 (10.83%)	471
Depok City	38 (7.57%)	144 (28.69%)	4 (0.80%)	274 (54.58%)	7 (1.39%)	6 (1.20%)	5 (1.00%)	0 (0.20%)	7 (1.39%)	16 (3.19%)	502
Sukabumi City	22 (7.43%)	24 (8.11%)	1 (0.34%)	237 (80.07%)	2 (0.68%)	0 (0.00%)	7 (2.36%)	0 (0.00%)	2 (0.68%)	1 (0.34%)	296
Tasikmalaya City	82 (12.11%)	172 (25.41%)	4 (0.59%)	372 (54.95%)	1 (0.15%)	0 (0.00%)	6 (0.89%)	4 (0.59%)	23 (3.40%)	13 (1.92%)	677
West Java	1265	3157	52	5605	90	56	184	170	386	646	11611

Based on the findings, it can be concluded that hypertension (E4) is the most common etiology across various regencies and cities in West Java. However, there is notable variation in the distribution of etiologies. For instance, Cirebon and Karawang show a higher proportion of diabetic nephropathy (E2) compared to hypertension (E4), while Subang Regency has the highest proportion of primary glomerulopathy (E1). **(Table 3)** Additionally, some regions exhibit a significant dominance of other etiologies. For example, Ciamis, Cianjur, and Cirebon demonstrate a predominance of other diseases (E9), and in Sumedang, post-nephrectomy conditions (PNC, E8) are among the top three etiologies—an observation not found in other regencies/cities. Therefore, six etiologies are consistently found among the top three across different regencies/cities in West Java: hypertension, diabetes, glomerulonephritis, other diseases, unknown etiology, and pyelonephritis.

Table 4 Proportion of

Regency/City	MCE1 (%)[2]	MCE2 (%)	MCE3 (%)
Bandung Regency	HT (44,99%)	GN (27,14%)	DN (21,03%)
Bandung Barat Regency	HT (40%)	DN (40%)	GN (20%)
Bekasi Regency	HT (46,3%)	DN (35,43%)	GN (9,13%)
Bogor Regency	HT (60,03%)	DN (20,71%)	GN (11,27%)
Ciamis Regency	HT (46,59%)	DN (32,94%)	**Others (14,54%)**
Cianjur Regency	HT (66,77%)	**Others (17,39%)**	GN (7,25%)
Cirebon Regency	DN (57,97%)	HT (20,77%)	**Others (11,59%)**
Garut Regency	DN (46%)	GN (27%)	DN (25%)
Indramayu Regency	HT (58,54%)	DN (14,94%)	GN (12,2%)
Karawang Regency	DN (40,64%)	HT (35,58%)	GN (11,97%)
Kuningan Regency	HT (57,31%)	DN (27,69%)	GN (10,38%)
Majalengka Regency	HT (63,8%)	DN (19,87%f)	GN (9,27%)
Purwakarta Regency	HT (59,37%)	DN (15,02%)	**Unknown (10,16%)**

[2] MCE: Most Common Etiology; DN: Diabetic Nephropathy; GN: glomerulonephritis

Subang Regency	GN (46,31%)	DN (24,83%)	HT (23,49%)
Sukabumi Regency	HT (66,91%)	DN (14,39%)	GN (14,39%)
Sumedang Regency	HT (32,65%)	DN (28,16%)	**PNC (19,18%)**
Tasikmalaya Regency	HT (78,47%)	DN (10,42%)	GN (10,42%)
Bandung City	HT (42,22%)	DN (29%)	GN (12,59%)
Banjar City	HT (36,51%)	**Unknown (31,75%)**	DN (19,05%)
Bekasi City	HT (40,34%)	DN (30,37%)	**Unknown (18,22%)**
Bogor City	HT (61,52%)	DN (19,24%)	GN (10,93%)
Cimahi City	HT (44,2%)	DN (23,91%)	GN (9,42%)
Cirebon City	HT (35,24%)	DN (27,39%)	**Unknown (10,83%)**
Depok City	HT (54,58%)	DN (28,69%)	GN (7,57%)
Sukabumi City	HT (80,07%)	DN (8,1%)	GN (7,43%)
Tasikmalaya City	HT (54,95%)	DN (25,41%)	GN (12,11%)
West Java	HT (48,27%)	DN (27,03%)	GN (10,89%)

Based on the Chi-Square test results presented in the table, the analysis of differences among the six etiological proportions was conducted using both the Pearson Chi-Square test and the Likelihood Ratio test. The Pearson Chi-Square test yielded a value of 1054.128 with degrees of freedom (df) = 125 and a p-value < 0.001, indicating a statistically significant difference among the categories tested. Similarly, the Likelihood Ratio test produced a value of 780.367 with a p-value < 0.001, further supporting the presence of significant differences.

Table 5 Chi-square

Test Statistic	Value	df	p-value
Pearson Chi-square	1054.128[a]	125	<.001
Likelihood Ratio	1084.064	125	<.001
Valid Cases	2432		

4. Discussion

This study focuses on identifying the presence of etiological differences of ESRD across regency and cities in West Java. By examining variations in demographic characteristics and other contributing factors, this research aims to explore how these regional disparities may influence the progression of chronic kidney disease to its terminal stage. Many of the identified factors—such as lifestyle, access to healthcare, and comorbid conditions like diabetes mellitus and hypertension—are modifiable or

preventable. Understanding these regional etiological patterns is essential for developing targeted public health strategies and early interventions to reduce the burden of ESRD.

4.1 Etiological Patterns and Regional Variation: More Than Just Numbers

Hypertension is the leading cause of chronic kidney disease (CKD) in West Java. This aligns with the 2020 IRR report, which identified hypertension as the primary cause of CKD in Indonesia (4). This finding differs from global case data, where diabetes mellitus is the leading cause of stage 5 CKD. Several regional studies confirm that diabetic nephropathy is the main cause of advanced CKD, significantly contributing to the burden of kidney disease. A study conducted in the Netherlands reported that approximately 50% of total CKD cases have diabetes as the dominant etiology in the progression to end-stage kidney disease (7). Furthermore, a meta-analysis in Southeast Asia involving 81 studies and 32,834 subjects also indicated diabetic kidney disease as the leading cause of advanced CKD in the region (5). Even Malaysia, a neighboring country to Indonesia, showed that diabetes accounted for more than 50% of new patients undergoing dialysis between 2011 and 2021 (8). This may be due to the very high prevalence of hypertension in Indonesia, even among the productive age group. Research in Mataram revealed that high hypertension rates are associated with a diet high in salt, low physical activity, and elevated rates of obesity and smoking in Indonesian society, all contributing to hypertension as the main risk factor for CKD (11).

However, this study also found a relatively large proportion of cases with unknown causes (E10), reflecting that many patients present to healthcare facilities at the end-stage of kidney failure, making it difficult to determine the exact etiology. A study reported that the average delay in CKD diagnosis in the United States is 469 days. This delay can complicate the determination of the precise CKD etiology, which in turn may affect treatment strategies and patient prognosis (9). Conversely, E6 m had the lowest

proportion among other etiologies. This is consistent with literature stating that urate nephropathy, which is a direct cause, is rarely found in the general population (10).

Regarding regional variation, as shown in Table 4, there are six etiologies that rank among the top three most common etiologies (MCE) across 26 regencies/cities. Figure 1 shows that only Subang Regency, Bandung Regency, and Garut Regency have a significant percentage of E1 compared to other etiologies. Glomerulonephritis is an infectious disease affecting the glomerulus of the kidney. Post-streptococcal acute glomerulonephritis (PSAGN), a subtype, most commonly occurs in school-aged children (5–12 years). A study at RSUP Prof. R. D. Kandou Manado indicated that age ≥5 years and male sex are significant risk factors for PSAGN (11). Although the age distribution in Subang Regency does not show a significant difference compared to other areas, this could be due to other risk factors such as densely populated environments, poor hygiene, and the rainy season, which increase the risk of streptococcal infections that can trigger glomerulonephritis (11).

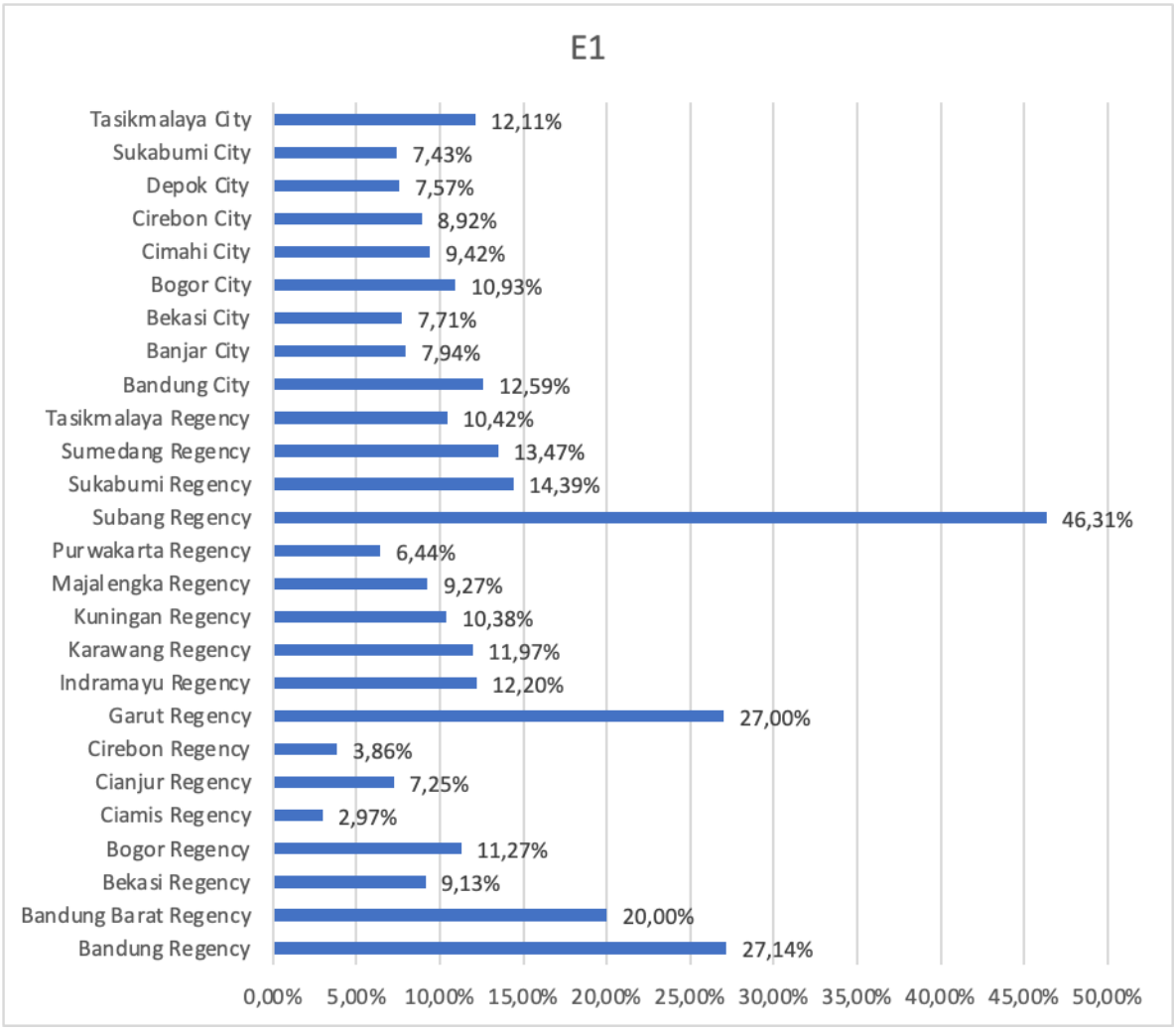
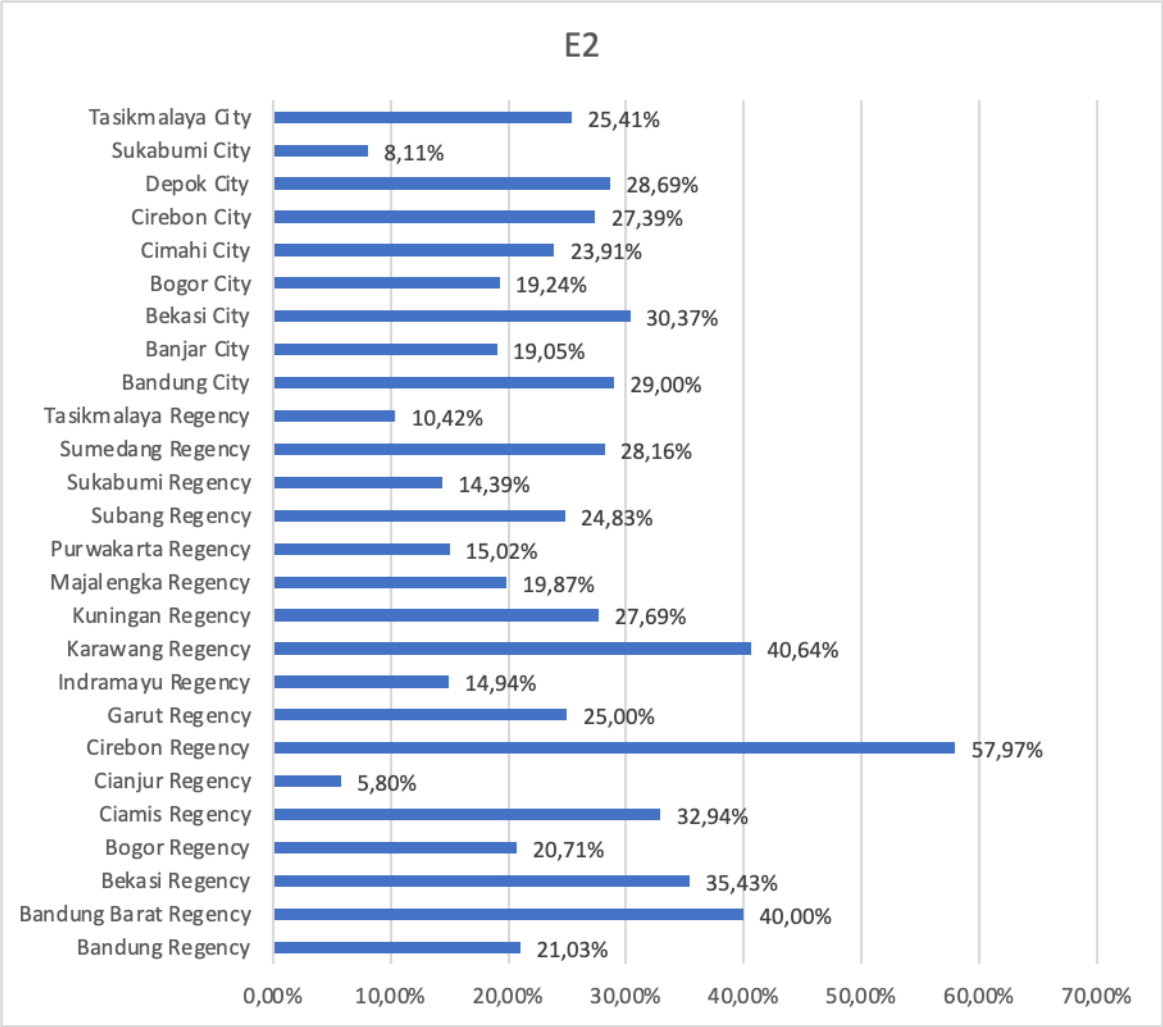


Figure 1 Glome

As shown in (Table 4), diabetes was not among the most common etiologies (MCE) in only one area, namely Cianjur Regency, with a percentage of 5.80%. The diabetes rate in Cianjur is relatively low compared to several other regions in West Java and Indonesia (Figure 2). According to data from the Cianjur District Health Office in 2021, the prevalence of diabetes mellitus was recorded at approximately 0.76%, and data from 2019 showed that there were 3,495 diabetes patients in Cianjur, with the highest number of cases in urban areas (12). This figure is lower than the national and West Java provincial prevalence, which according to the 2018 Riskesdas survey reached 1.7%–2% for individuals aged ≥15 years (13). This may be attributed to the fact that geographically, most of Cianjur is rural, where the community leads an active lifestyle such as farming

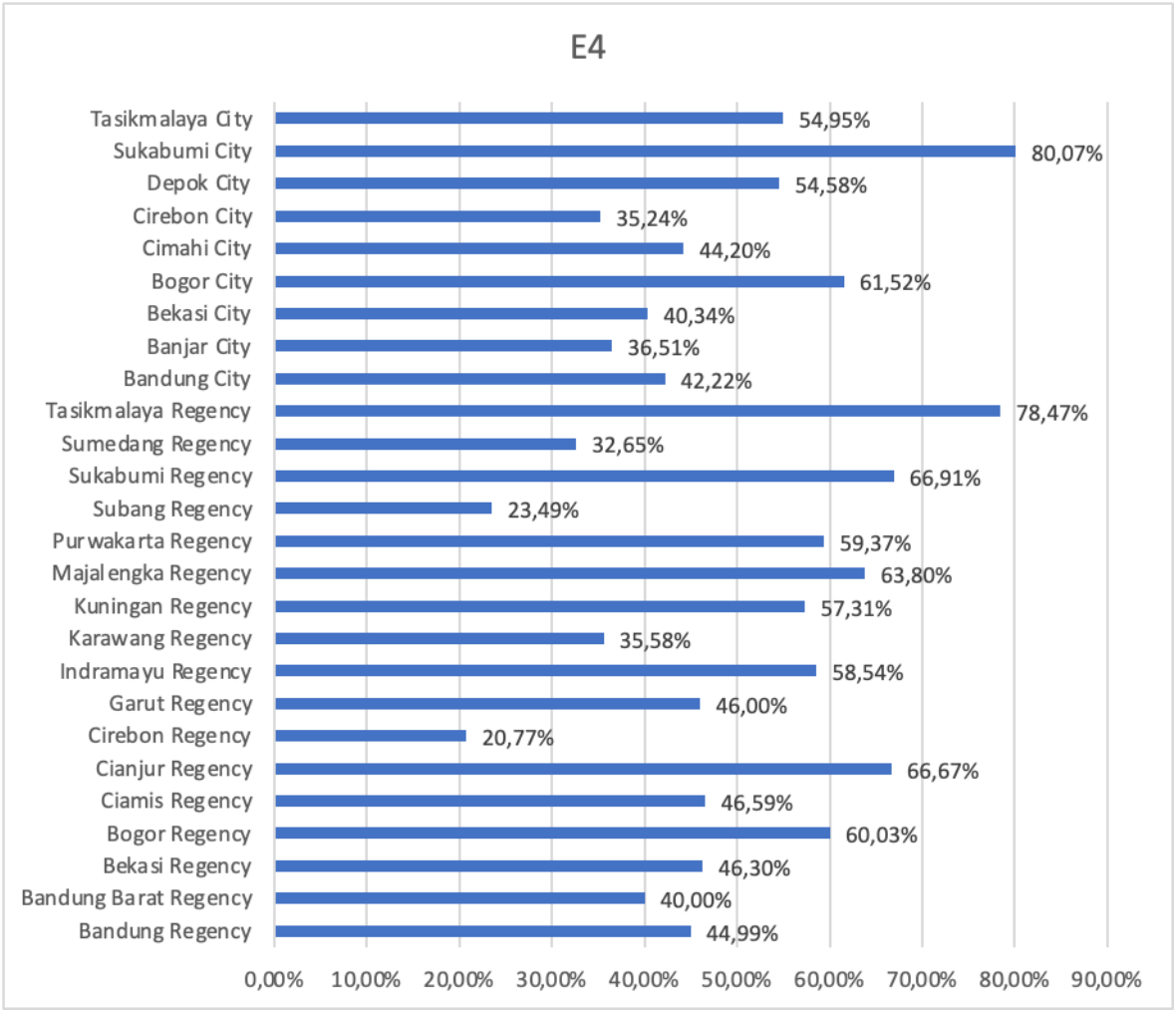
and gardening. This high physical activity, including the habit of walking as found in the Cianjur City Health Center (Puskesmas), contributes to lowering blood glucose levels and reducing the risk of type 2 diabetes mellitus (14).

In contrast, Cirebon Regency and Karawang Regency have percentages of E2 ranging from 40.6% to 57.97%. West Bandung Regency cannot be considered representative due to limitations in hospitals collecting data. Uncontrolled diabetes can occur when healthcare service coverage is suboptimal. In Cirebon Regency, healthcare coverage in 2023 was only 33.51%, placing it in the lower quartile in West Java. However, Karawang, which has a similarly high percentage of diabetes, reported a diabetes service coverage of 94%. This may be explained by the high treatment adherence in Karawang supported by active interventions from healthcare facilities and patient education. Furthermore, strong family support also improves adherence to blood sugar control (15). Conversely, research in Cirebon demonstrated that low service coverage is influenced by patient anxiety and poor quality of life, which negatively affects treatment adherence and diabetes management (16).



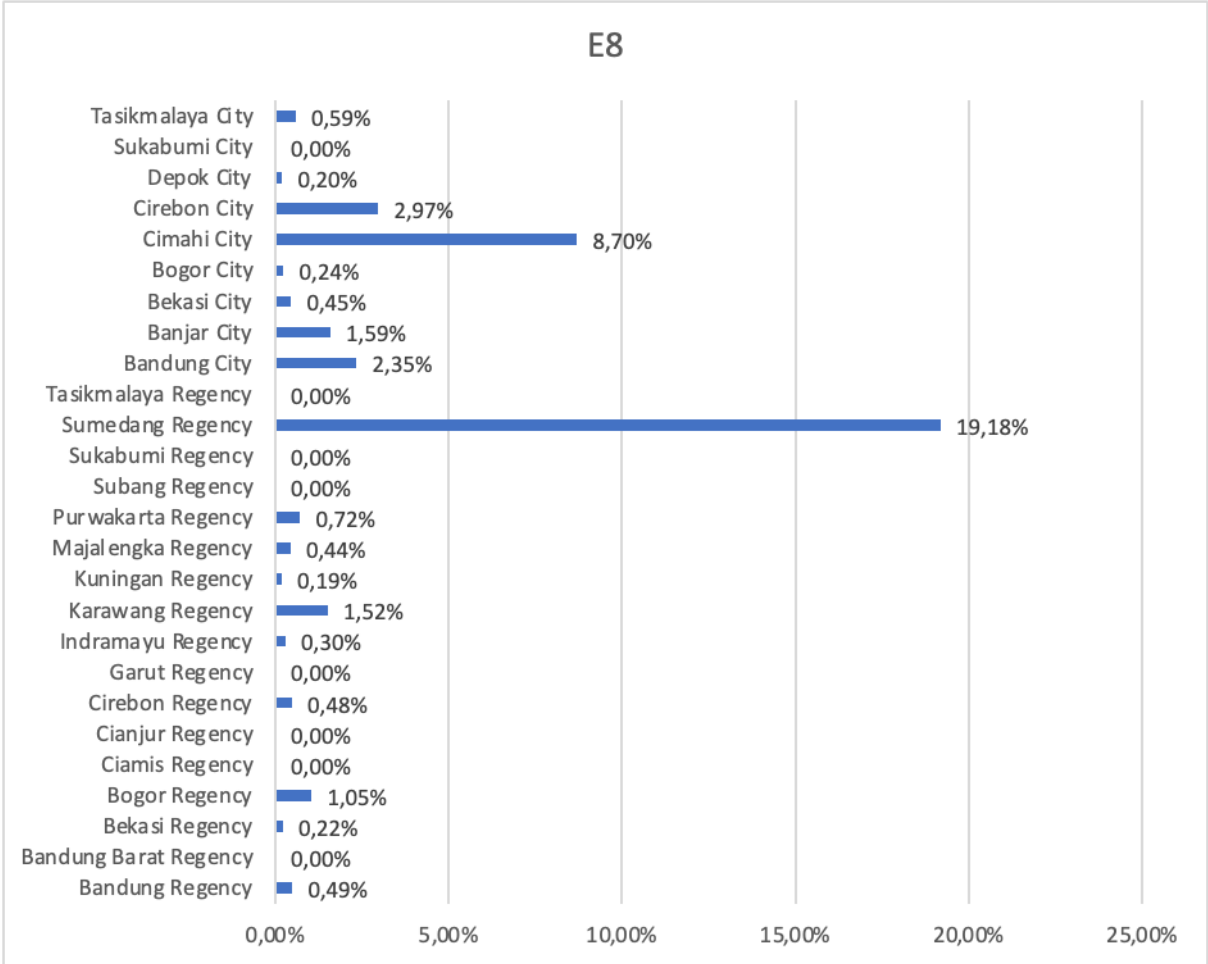
Hypertension is an etiology included among the most common etiologies (MCE) in all regencies and cities across West Java (Figure 3). Some areas exhibit extremely high hypertension rates, such as Sukabumi City at 80.07% and Tasikmalaya Regency at 78.47%. According to the West Java health profile, both regions have healthcare service coverage below 100%, specifically 76.77% in Tasikmalaya Regency and 68.49% in Sukabumi City (6). Furthermore, there is a need for individual awareness to manage hypertension through proper self-management. A 2022 study reported that many hypertensive patients in Sukabumi have poor quality of life and have not adequately practiced self-management, despite efforts of treatment and counseling provided by local health centers (18). Literature studies indicate that the impact of uncontrolled hypertension on the incidence of end-stage renal disease is significantly greater compared

to well-controlled hypertension. Uncontrolled hypertension increases the risk of kidney failure by several folds (17). Naturally, hypertension rates are closely linked to healthy lifestyle patterns. A study in Madura illustrated how culturally habitual consumption of salty and high-fat foods can contribute to hypertension (19).



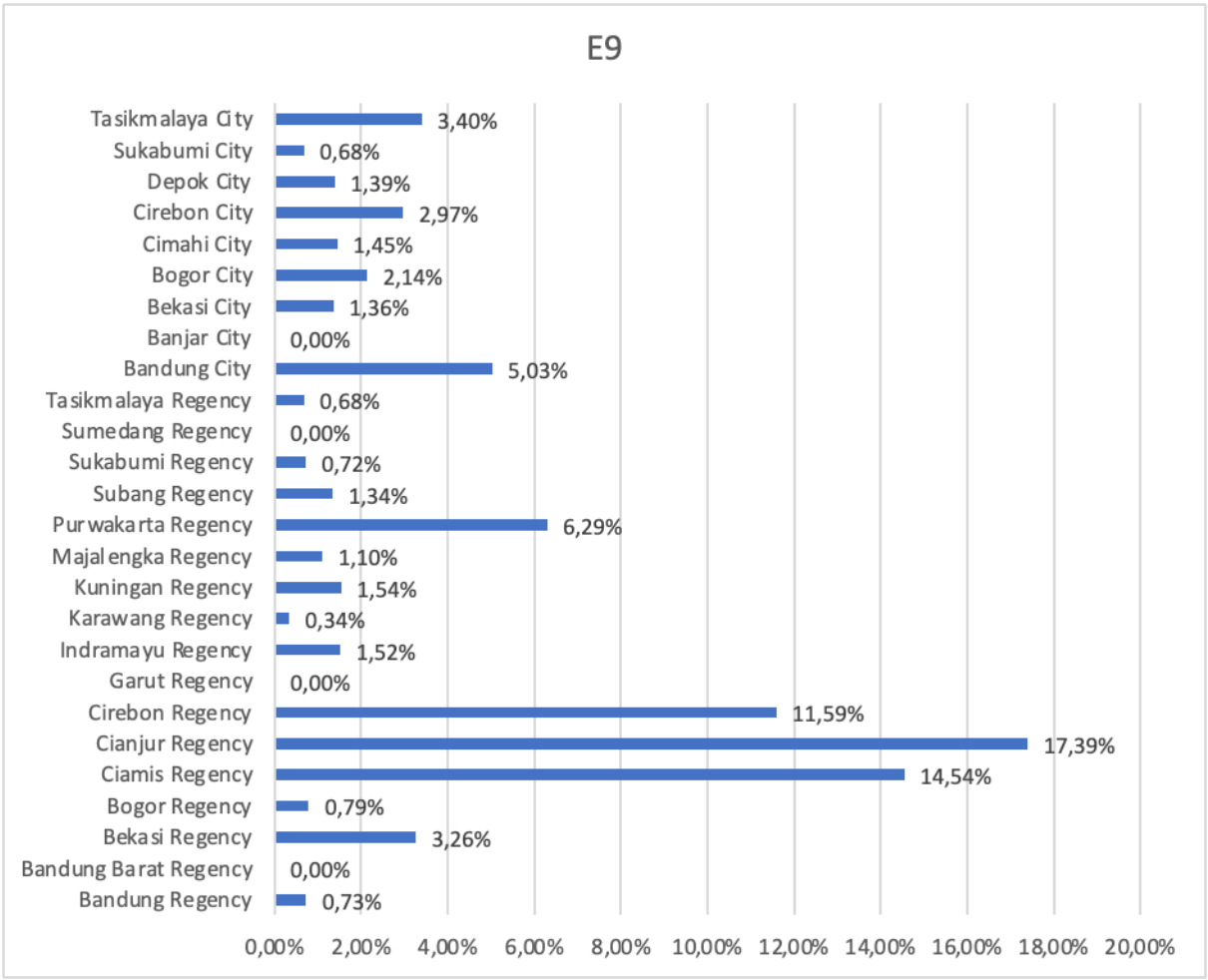
Sumedang Regency is the only area where pyelonephritis (E8) is the most common etiology (MCE) (Table 4). Other regions do not show significant pyelonephritis cases, except for Cimahi City (Figure 4). The main risk factors for this infection include female sex, extreme ages (infants and the elderly), history of urinary tract infections, diabetes, pregnancy, kidney stones, anatomical and functional abnormalities of the urinary tract, immune status, catheter use, and sexual behavior factors (20). In Indonesia,

regions with dominant E8 cases include Bali. A study at RSUD Sanjiwani Gianyar, Bali, reported that the majority of non-dialysis CKD patients treated were elderly with a mean age of 66 years, and the most frequent etiology of CKD in these patients was chronic pyelonephritis (53% of patients). The etiology of chronic pyelonephritis in Bali is often associated with structural abnormalities of the kidney and urinary tract, both congenital and acquired, such as kidney stones, prostate enlargement, and retroperitoneal fibrosis. These abnormalities cause urinary flow obstruction, facilitating recurrent infections and kidney damage (21). This situation may warrant attention in areas with high E8 prevalence due to the lack of research conducted in each respective region.



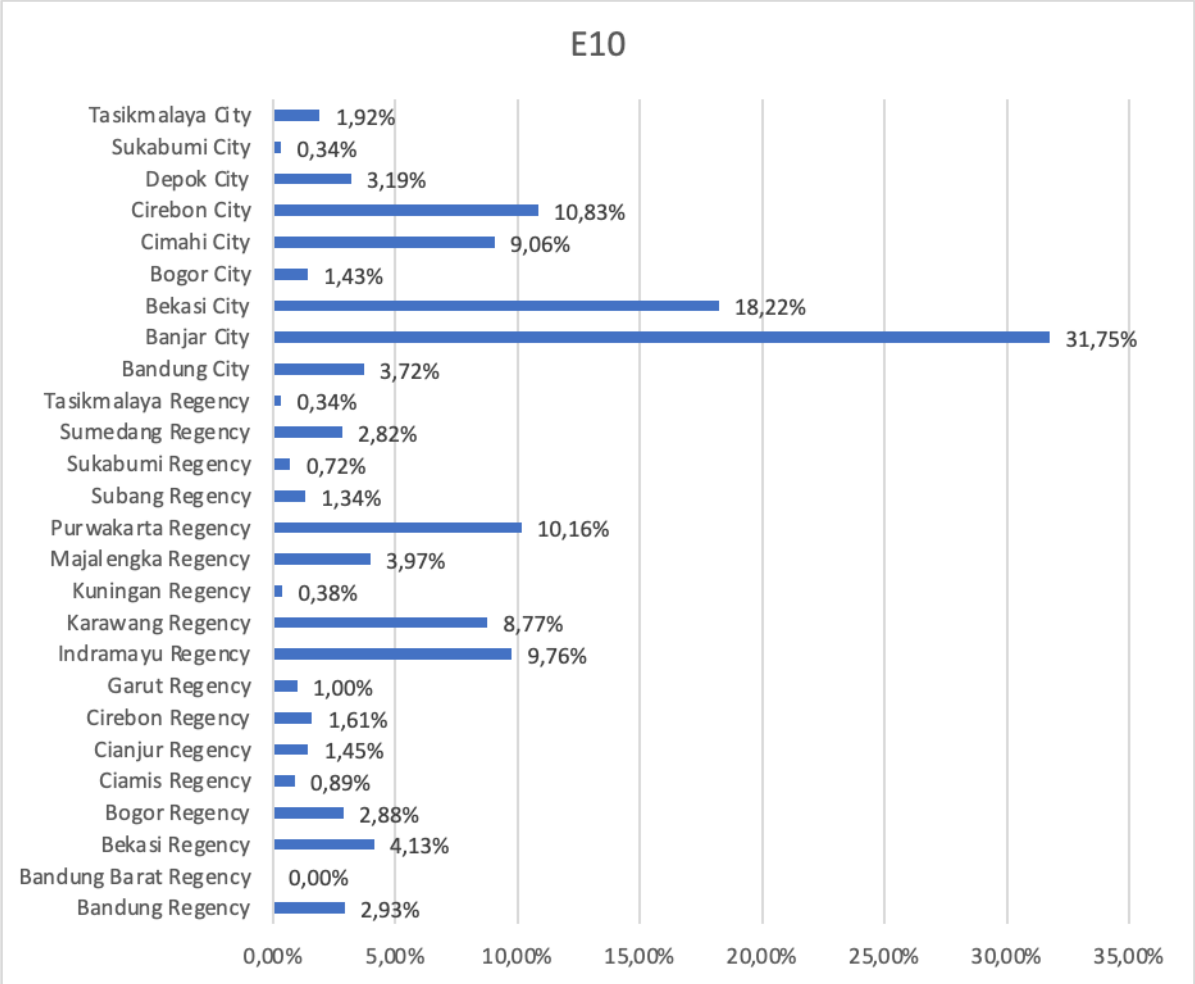
Several cities show a relatively high percentage in the “other” category as causes of end-stage renal disease (ESRD), namely Cirebon Regency, Cianjur Regency, and Ciamis Regency. This category does not include cases with unknown etiology but refers

to identified causes that are not part of the major groups such as diabetes mellitus, hypertension, or glomerulonephritis. A high percentage in this category may indicate the presence of specific but less common etiologies that are relatively dominant in those regions. This can reflect good diagnostic quality, where local healthcare facilities are able to clearly recognize uncommon causes. A study at RSUD Majalaya showed that the quality of life of ESRD patients improved when diagnosis and management, including comorbidities, were adequately performed. These findings reflect an increasing capacity of healthcare facilities in West Java to provide adequate services (22). Furthermore, the level of education and public awareness also supports early detection and diagnosis of chronic kidney disease in a region (23). Therefore, these findings may serve as an important signal to conduct further studies on local risk factors or specific causes contributing to ESRD in these cities.



Studies in Indonesia have shown that the primary causes of end-stage renal disease (ESRD) are generally hypertension and diabetes mellitus; however, there is a significant percentage of patients with unclear or "unknown etiology" (E10). This is often due to limitations in nephrology diagnostic facilities and incomplete documentation of chronic kidney disease history (24). Similar patterns are observed in Purwakarta Regency, Banjar City, Bekasi City, and Cirebon City, with the highest percentage reported in Banjar City at 31.75%. Several studies emphasize the need to improve access to and quality of diagnostics to reduce the number of ESRD cases with unknown causes, as well as to conduct further research to identify local or endemic risk factors that may play a role (24–25). In Banjar City, the possibility of referral cases from Pangandaran Regency—

which currently lacks its own hemodialysis unit —may contribute to patients presenting with more advanced kidney function decline.



Considering all the factors discussed above, it can be concluded that the etiological pattern of end-stage renal disease (ESRD) in West Java Province reflects the complex interaction between medical, demographic, socioeconomic, and environmental determinants. The high prevalence of hypertensive nephropathy and diabetic nephropathy in this region not only indicates an increasing burden of metabolic diseases but also highlights disparities in access to preventive and curative healthcare services, which vary significantly across regencies and cities. These disparities underscore the influence of structural factors, such as the availability of healthcare facilities, quality of services, and community education, on the progression rate of metabolic diseases toward advanced

CKD. Moreover, urban lifestyles characterized by unhealthy dietary patterns and low physical activity contribute significantly to the rising rates of hypertension, a major contributor to ESRD in this region. Therefore, a region-based approach that considers local factors is crucial to reducing the incidence of advanced CKD. Prevention and management strategies for CKD need to be adaptively designed by strengthening primary healthcare services, enhancing community education, and developing cross-sectoral policies sensitive to local contexts to address disparities and improve long-term health outcomes.

4.2 The Uneven Burden of Disease: Etiological Disparities Across Regions

In (Table 4), the Pearson Chi-Square test was used to examine whether there are significant differences in the distribution of proportions among categories of end-stage chronic kidney disease (CKD) etiologies across various regencies and cities in West Java. The Chi-Square statistic value of 1054.128 with degrees of freedom (df) = 125 and p-value < 0.001 indicates that the variation in etiological proportions across regions is not due to chance but is statistically significant. In other words, the distribution of stage 5 CKD etiologies differs significantly between the studied regencies and cities. The Likelihood Ratio test, an alternative to the Chi-Square test used to validate Pearson's results—especially when data contain categories with small frequencies—yielded a value of 1084.064 with df = 125 and p-value < 0.001, further supporting the existence of significant differences among etiological categories. Both tests reinforce the finding that the observed differences are statistically real. This is also evident from the overall proportion comparisons, showing significant differences for both the six etiologies included in the most common etiologies (MCE) and the overall distribution in West Java. The validity and reliability of these test results are supported by the very small p-value (< 0.001), indicating that the findings are highly significant statistically, with a low probability of occurring by chance. The degrees of freedom at 125 reflect the data

complexity encompassing multiple etiological categories and regions. Thus, the analysis demonstrates statistically significant differences in etiological distributions among West Java regions in 2023, or can be stated as meaningfully different. The variation in etiological proportions indicates heterogeneity in risk factors and triggers according to the social and environmental characteristics of each region.

The significant imbalance in ESRD burden between regencies and cities in West Java reflects potential disparities in risk factors, healthcare access, and socioeconomic determinants influencing community health in each area. This aligns with a study conducted in the United States, where overall medical access showed that the Midwest, South, and West regions had lower odds ratios compared to the Northeast, indicating more limited access (1). In New South Wales, significant variation in CKD incidence was found between regions, with higher rates in regional and remote areas compared to major cities. Large local variation within some metropolitan areas reflects the social complexity of those regions (8). This phenomenon may also occur among regencies and cities in West Java. Urban areas in West Java generally have better health infrastructure, a higher number of healthcare facilities, and a more evenly distributed healthcare workforce. Conversely, rural and remote areas still face major challenges in accessing health services. A study showed disparities in health service access between elderly populations in urban and rural areas, finding that rural facilities and healthcare personnel remain limited, along with financial barriers and mistrust of medical personnel among communities (2). The 2018 Riskesdas report indicates that 42.4% of rural Indonesians (including in West Java) consider access to hospitals difficult, and 36.8% struggle to access primary healthcare facilities such as community health centers (puskesmas) (3).

Besides geographic factors, socioeconomic characteristics also play a critical role. Data from the United States show that patients with higher incomes and private insurance

have greater chances of accessing medical care (1). This is relevant to the condition in West Java, where economic disparities between regions also contribute to unequal healthcare access. Poverty rates in urban areas are 7.19%, whereas in rural areas they reach 9.30% (4). Therefore, regions with higher poverty and lower income levels likely face greater difficulties in accessing healthcare, including costs, distance, and service availability.

Thus, a local needs-focused approach is crucial in the management and preventive actions for chronic kidney disease. Several studies recommend preventive interventions tailored to local characteristics, such as modifications of healthy lifestyles, blood pressure and blood sugar control, and education on risk factors, to reduce CKD incidence. This approach also involves community empowerment and increasing awareness through culturally relevant educational media adapted to local education levels (5–7).

4.3 Sex-Based Distribution of ESRD Cases Across Regions

From the data presented in (Table 1), although the difference is not large, the male predominance is consistent with findings from various national and international studies. This aligns with the IRR 2018–2020 data and SKI 2023, which also recorded a higher national prevalence of chronic kidney disease (CKD) in males compared to females (1–4). Similarly, data from the Chronic Renal Insufficiency Cohort (CRIC) indicate that males more frequently experience advanced CKD and faster disease progression than females (5). Thus, the data from West Java are consistent with this epidemiological pattern.

Physiologically, this difference can be explained by hormonal factors. Estrogen in females exerts a protective effect on kidney function, whereas testosterone in males tends to accelerate renal damage progression (10–11). Over time, estrogen levels in women decrease due to menopause, which is related to hypertension risk—a leading cause of

CKD in West Java. The American Heart Association journal reports that the prevalence of hypertension and uncontrolled hypertension varies by age and sex. Between ages 43–46, males have a higher prevalence of uncontrolled hypertension (33%) compared to females (23%). However, after ages 61–64, uncontrolled hypertension becomes more prevalent in females, and at ages 91–94, 56% of females and 40% of males experience uncontrolled hypertension (12). This is consistent with the 2023 Indonesian Health Survey (SKI), which shows that females have higher prevalence, proportion, and numbers of hypertension cases compared to males.

Beyond these risk factors, the 2018 Riskesdas and 2023 SKI reports consistently indicate that females tend to undergo routine health check-ups more often than males. This is reflected in higher healthcare coverage and health awareness among females, which may contribute to the higher case numbers (4,13). A qualitative study in Lebanon showed that females possess better knowledge, attitudes, and behaviors toward preventive health services, such as immunizations, cancer screenings, and chronic disease examinations, compared to males (16). However, social and cultural barriers—including gender norms, family support, traditional female roles, and family decision-making—limit females' access to advanced healthcare. These barriers exist at individual, interpersonal, community, and healthcare system levels, significantly affecting women in low- and middle-income countries (17). In Argentina, females have a 2.2-fold higher risk of facing difficulties accessing the healthcare system compared to males (14). The dominance of husbands in family health decision-making exemplifies how patriarchal structures affect access to advanced healthcare services (15). This leads to differing patterns in early detection and management of kidney disease between females and males.

Behaviorally, females exhibit better health beliefs than males, which correlates with healthier behaviors. Males tend to underutilize healthcare services and engage more

frequently in risky behaviors such as smoking and alcohol consumption (18). A retrospective study in West Java found that significant risk factors for hypertension include physical inactivity, smoking habits, excessive salt intake, and alcohol consumption. These factors may contribute to the higher incidence of CKD in males. However, it is important to note that although males predominate, the difference in the number of male and female patients is not always statistically significant and is sometimes small; in some cases, females are more numerous (19). Additionally, the male-to-female ratio varies by region, indicating that the prevalence of CKD in females is also high and warrants equal attention in prevention and management.

4.4 The Age Factor

The study results show the highest absolute number of cases occurring in the productive age group, namely 45–64 years (Table 2). However, based on the 2023 West Java Health Profile, the elderly population (>60 years) in West Java amounts to 5,202,244 individuals, while the productive age population (15–60 years) is estimated at 34,124,672 individuals. When calculating the proportion of end-stage renal disease (ESRD) cases relative to the total population of each group, the proportion of ESRD in the elderly is approximately 0.04% of the total elderly population in West Java, whereas the proportion in the productive age group is about 0.028% of the total productive-age population (3). Thus, although the absolute number of ESRD cases is higher in the productive age group compared to the elderly, the proportion of ESRD cases among the elderly relative to their population is slightly higher. This condition underscores that the elderly have a relatively greater risk of ESRD and therefore require special attention in efforts to prevent and manage chronic kidney disease (CKD) in the region.

A systematic study based on the 2021 Global Burden of Disease (GBD) data confirms that both the prevalence and mortality rates due to CKD have increased globally over the past three decades, primarily driven by population growth and aging. The data

indicate that the CKD burden is lowest in children, then sharply rises with age, peaking in the 65–69 age group, and remains high in the elderly (4). Physiological decline in kidney function due to aging, combined with the high prevalence of diabetes mellitus and hypertension in older age, accelerates CKD progression (5). This is supported by international comparison data from the 2022 United States Renal Data System (USRDS), showing ESRD incidence dominated by those aged >65, both in Asia and globally (6).

Nonetheless, the difference between elderly and productive-age groups in Indonesia is not large. The onset of hypertension and diabetes in Indonesia, according to the 2018 Riskesdas, begins during the productive age, thus disease progression control in this group remains important. Local epidemiological data show that hypertension and type 2 diabetes emerge earlier, increasing CKD progression risk in the productive age group (45–64 years) (7). One study showed a progressive increase in hypertension prevalence among younger age groups: 7.35% in ages 18–24, 10.41% in 25–34, and 21.35% in 35–44 years (2). Factors such as suboptimal disease control, lifestyle, and limited healthcare access also accelerate kidney disease progression in the Indonesian population (8–9). This highlights the need for special attention to this age group in CKD prevention and management.

Therefore, although productive age dominates, differences in age prevalence across regions may arise due to socioeconomic factors and healthcare access (1). The data show some areas with a higher percentage of young adults, such as Garut Regency, Sukabumi Regency, and Tasik Regency with percentages >20%, compared to Cirebon City where the proportion is relatively low at 6.89%. This may indicate better preventive programs in the productive age group. According to the 2023 West Java Health Profile, Cirebon City has hypertension service coverage of 99.93% and diabetes coverage of 99.97%. This demonstrates the importance of early and effective chronic disease

management given the rising incidence of chronic diseases in Indonesia (3). Hence, CKD prevention and management programs should be tailored according to age factors, with specific interventions targeted at both the productive age and elderly groups.

5. Conclusions

The conclusion of this study indicates that hypertensive kidney disease remains the predominant cause of stage 5 chronic kidney disease (CKD) in West Java in 2023, with significant regional variations in etiology across regencies and cities. Regarding regional variation, as shown in Table 4, there are six etiologies that rank among the top three most common etiologies (MCE) across 26 regencies/cities. The Chi-Square test revealed a statistically significant difference in the distribution of CKD etiologies among regions ($p < 0.001$), confirming that these variations are not due to chance but are influenced by local demographic, social, and healthcare access factors. These findings highlight the importance of developing targeted prevention and management strategies tailored to the specific characteristics of each region to effectively reduce the burden of end-stage renal disease. Furthermore, special attention should be given to both productive-age and elderly populations, as their risks and disease patterns differ.

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