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Built Environment, Metabolic Risk Factors, and Self-Reported Kidney Disease in Missouri: A Population-Level Descriptive Study Using Public Health Behavioral Risk Factor Surveillance System (BRFSS) Data

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Abstract

Background: Chronic kidney disease (CKD) burden tracks heavily with metabolic comorbidities, yet the combined distribution of structural inequities - specifically the built environment - and physiologic risk factors has not been fully characterized at the population level in Missouri.

Objective: The objective of the study is to describe self-reported kidney disease across Missouri Behavioral Risk Factor Surveillance System (BRFSS) regions, household income categories, and education levels, alongside statewide metabolic and built environment indicators.

Methods: Using an ecological descriptive design and survey-weighted Missouri BRFSS aggregate data, we characterized the distribution of crude self-reported kidney disease prevalence across socioeconomic and geographic strata, alongside metabolic risks (diabetes, hypertension, and obesity) and built environment indicators. Estimates were re-extracted on October 11, 2026. The report identifies kidney disease, diabetes, BMI, and neighborhood indicators as 2024 data and high blood pressure and cholesterol as 2023 data. No inferential statistical testing was performed; all comparisons are descriptive.

Results: Statewide self-reported kidney disease prevalence was 4.10%. Statewide obesity and diagnosed diabetes prevalence estimates were 34.53% and 11.31%, respectively. Geographic patterns were observed, with kidney disease prevalence highest in the Southwest BRFSS region (6.49%) and lowest in the Central region (2.73%). Socioeconomic point estimates varied; prevalence was 8.60% in households earning $15,000-$24,000 and 2.20% in households earning $75,000 or more. Perceived neighborhood safety ranged from 59.00% in the lowest-income bracket to 90.60% in the highest-income bracket.

Conclusions: This descriptive analysis identifies differences in self-reported kidney disease prevalence across BRFSS regions and socioeconomic categories, alongside statewide metabolic and built environment indicators. These summaries do not establish individual-level co-occurrence, rural-versus-urban differences, or benefits of environmental interventions. This descriptive ecological design does not support individual-level causal conclusions; future research using longitudinal and individual-level data is needed to formally evaluate these relationships.

Categories: Environmental Health, Epidemiology/Public Health, Nephrology
Keywords: behavioral risk factor surveillance system (brfss), built environment, chronic kidney disease, metabolic comorbidities, social determinants of health

Introduction

Chronic kidney disease (CKD) represents a substantial public health burden in the United States, with national surveillance data indicating a prevalence of 14% to 15% among adults [1]. Despite this widespread burden, a significant proportion of cases remain undiagnosed until the advanced stages of renal failure, a diagnostic latency that is clinically profound given the rapid physiological decline that may co-occur with metabolic dysfunction [1,2]. Type 2 diabetes mellitus and hypertension are not merely peripheral comorbidities; they are well-established in the literature as principal risk factors for renal pathology and have been reported in prior work to account for the vast majority of incident end-stage renal disease (ESRD) [1,3]. As the population-level rates of these metabolic conditions rise, the downstream sequelae of CKD, including escalated cardiovascular mortality and healthcare utilization, continue to multiply [1,4,5]. This trajectory underscores the critical need for prevention strategies that transcend clinical boundaries to address upstream factors of metabolic and renal health [4-6].

Increasingly, the built environment is recognized in the literature as a fundamental structural factor in

kidney health, primarily through its hypothesized capacity to modulate physical activity and dietary options [6,7]. Neighborhoods characterized by limited active transport infrastructure, such as low walkability indices, absent sidewalks, or poor perceived safety, have been reported to co-occur with sedentary behaviors and restricted access to nutrient-dense foods [7-9]. These structural inequities are associated in prior studies with the pathogenesis of metabolic comorbidities, including hyperglycemia, obesity, and hypertension [8-10]. Because these metabolic disruptions are the primary physiological correlates of renal vascular damage in the established literature, the structural characteristics of a community have been hypothesized to be associated with baseline population-level risk of CKD [1,6,10]. Consequently, population-level renal outcomes are increasingly discussed as co-occurring with environmental barriers, creating a "compound disadvantage" pattern in which geographic vulnerability and biological susceptibility may overlap [6,9,10].

Current epidemiological literature frequently evaluates these risk factors in isolation or relies on national datasets that obscure critical regional variability [6,10-12]. Moreover, psychosocial stress and adverse neighborhood conditions have been increasingly recognized in prior studies as factors associated with CKD risk and progression [13]. There remains a distinct lack of data examining the co-distribution of socioeconomic status (SES), the built environment, metabolic risk factors, and CKD burden, particularly within the state of Missouri [14-16]. Missouri presents a highly relevant demographic and geographic profile, marked by stark contrasts in environmental exposures across its dense urban cores and geographically isolated rural counties [16-18]. Existing surveillance frameworks have not fully characterized how these specific geographic disparities and their corresponding infrastructure deficits co-occur with the prevalence of CKD [17,19,20]. Addressing this gap is essential to inform future studies and develop equitable interventions that account for local environmental constraints on metabolic health [6,9,10,16].

Therefore, this study uses an ecological descriptive design to analyze Missouri Behavioral Risk Factor Surveillance System (BRFSS) aggregate estimates identified by the source report as 2023-2024 data [20]. The objective of this descriptive analysis is to characterize survey-weighted, aggregate self-reported kidney disease prevalence across the seven BRFSS regions, household income categories, and education levels, alongside metabolic and built environment indicators. By the October 11, 2026, manuscript revision, the specific, measurable, achievable, relevant, and time-bound (SMART) objectives were to (1) tabulate statewide and seven-region 2024 kidney disease estimates, (2) summarize 2024 kidney disease estimates across six household income categories and four education categories, and (3) tabulate statewide metabolic and neighborhood indicators and income- and education-specific safety and sidewalk estimates, presenting the results in five tables and two figures. The source report identifies neighborhood indicators as 2024 data and blood pressure and cholesterol as 2023 data. These descriptive outputs provide a state-specific basis for further research on questions relevant to Missouri public health, rather than a test of geographic clustering or causal mechanisms [19-21].

Materials And Methods

Data source and design

This study employed an ecological descriptive design utilizing publicly available aggregate data from the Missouri BRFSS, with indicator-specific source years of 2023 or 2024 [20]. The BRFSS is a continuous, state-based, cross-sectional telephone survey administered by the Missouri Department of Health and Senior Services (DHSS) in collaboration with the Centers for Disease Control and Prevention (CDC). It collects standardized data on preventive health practices, chronic disease prevalence, and health risk behaviors among Missouri's non-institutionalized adult population aged 18 years or older.

Publicly reported Missouri BRFSS indicator estimates were re-extracted on October 11, 2026, from the Missouri Adult Health Data Report, an interactive reporting tool developed by the University of Missouri Extension CARES Data Tools in partnership with the Missouri DHSS [20]. CDC documentation describes BRFSS design weighting and iterative proportional fitting (raking); the investigators did not calculate survey weights or re-estimate survey variances [22]. Crude rates of self-reported kidney disease prevalence and other aggregate indicators were extracted for statewide summaries and available socioeconomic and regional comparisons. Analytic variables encompassed metabolic indicators (diabetes, hypertension, and obesity), SES (assessed using the report's household income brackets and education levels), and built environment indicators (including active transport infrastructure and perceived neighborhood safety). Because this study used aggregate-level indicator data, the analytic approach consisted of descriptive ecological comparisons across socioeconomic and geographic strata, presenting point estimates and available source-reported socioeconomic margins of error (MOE). No inferential statistical testing (e.g., chi-squared tests, regression modeling, or trend tests) was performed; all comparisons in this manuscript are descriptive.

The extraction selected Missouri statewide, crude rates rather than age-adjusted rates, the 10 indicators in Table *1*, and the income and education breakouts for kidney disease, neighborhood safety, and sidewalks. Kidney disease was queried separately for each BRFSS region. The corresponding report-interface workflow is location, data indicators, and reports; state and region selections use BRFSS, whereas county and city selections access the county-level study and were not included [20,23]. The public report identifier was MO_DHSS_BRFSS, with statewide location identifier 29. Crude indicator identifiers were 128-C (kidney

disease), 124-C (diabetes), 126-C (blood pressure), 127-C (cholesterol), 129-C (obesity), 130-C (overweight), 150-C (safety), 156-C (food access), 157-C (sidewalks), and 158-C (bicycling infrastructure). Income/education breakout identifiers were 12806/12807, 15006/15007, and 15706/15707. Region identifiers 1-7 represented Kansas City Metro, St. Louis Metro, Central, Southwest, Northwest, Northeast, and Southeast, respectively. The reproducibility supplement preserves exact public queries, returned aggregate records, source descriptions, and retrieval timestamps. October 11, 2026, is the documented re-extraction date used for this revision; the original historical download date is not available.

Indicator	Year	No. of interviews	Estimated count	Estimated percent
Outcomes & metabolic risk				
Self-reported kidney disease	2024	7,255	198,195	4.10%
Diabetes	2024	7,281	548,905	11.31%
High blood pressure	2023	7,183	1,748,649	36.20%
High cholesterol	2023	5,961	1,460,780	38.51%
Obesity (BMI ≥ 30)	2024	6,774	1,552,850	34.53%
Overweight (BMI 25.0-29.9)	2024	6,774	1,521,479	33.83%
Built environment				
Neighborhood has sidewalks	2024	6,389	2,493,064	60.55%
Access to healthy food	2024	6,327	3,254,960	79.72%
Community bicycling infrastructure	2024	6,276	1,410,255	34.87%
Neighborhood extremely/quite safe	2024	6,327	3,365,277	82.42%

TABLE 1: Statewide Prevalence of Metabolic Risk Factors and Built Environment Indicators in Missouri (2023-2024).

Years are the report's indicator-specific source labels. All percentages, interview counts, and estimated population counts were reproduced from Missouri output on October 11, 2026 [20]. Interview counts are not weighted denominators. The source's count algorithm was not supplied. Statewide CI limits were not returned in the retrieved output and are omitted.

CI: confidence interval

To standardize the spatial analysis, geographic locations were classified using the seven Missouri BRFSS regions defined by the Missouri DHSS [20]: Kansas City Metro, St. Louis Metro, Central, Southwest, Southeast, Northwest, and Northeast. These regional groupings are the standard analytical unit used by the Missouri BRFSS and are necessary to produce statistically stable substate estimates given the limited county-level sample sizes in the annual survey. For analytic presentation, regional prevalence values are reported as survey-weighted crude rates and prevalence bands, as published in the Missouri BRFSS reports [20].

Human subjects and ethics

This study used publicly available, de-identified secondary aggregate data from the Missouri BRFSS, which is a publicly accessible surveillance dataset. No individual-level data, identifiable private information, or human biological specimens were accessed, and no interaction with human participants occurred. No additional ethics approval was obtained for this secondary aggregate-data analysis. No formal IRB determination or exemption classification is asserted.

Outcome

The primary outcome of interest was the aggregate, self-reported prevalence of clinician-diagnosed kidney disease. This variable was defined based on affirmative responses to the standardized 2024 BRFSS item asking whether a doctor, nurse, or other health professional had ever told the respondent that they had kidney disease (detailed in Table *2*) [24,25]. The survey prompt explicitly excluded kidney stones, bladder infections, and urinary incontinence. These exclusions do not establish chronic renal pathology or exclude all acute kidney conditions. Clinical CKD requires abnormalities of kidney structure or function persisting for at least three months; BRFSS does not establish laboratory findings, stage, or chronicity [26]. Therefore,

the study outcome is termed self-reported kidney disease; CKD is reserved for clinically defined disease and prior literature. Prevalence estimates were stratified by geographic region, household income, and educational attainment [20].

Variable	Definition	BRFSS question/metric
Self-reported kidney disease	Respondent's report of a clinician's diagnosis of kidney disease; does not establish clinical CKD	Affirmative diagnosis response to CCHC.10 (code 1), excluding kidney stones, bladder infection, and incontinence [24,25].
Neighborhood safety	Perceived safety of the local environment from crime	"How safe from crime do you consider your neighborhood to be?" (Responses: extremely safe, quite safe).
Sidewalks	Presence of pedestrian infrastructure	"Does your neighborhood have any sidewalks?"
Bicycling infrastructure	Presence of cycling infrastructure	Reported community roads or streets with shoulders or marked lanes for bicycling [20].
Access to healthy food	Ease of obtaining nutritious food	Agree or strongly agree that healthy foods were easy to purchase in the neighborhood [20].
Obesity	BMI ≥ 30.0 kg/m²	Calculated variable based on self-reported height and weight.

TABLE 2: Data Dictionary - Operational Definitions and BRFSS Survey Items.

Neighborhood definitions and 2024 source labels were verified in the Missouri Adult Health Data Report [20]. The kidney disease item and clinical indicator definitions are supported by DHSS and CDC documentation [24,25].

BRFSS: Behavioral Risk Factor Surveillance System; CKD: chronic kidney disease; DHSS: Department of Health and Senior Services; CDC: Centers for Disease Control and Prevention

Primary exposures (built environment)

Built environment characteristics were operationalized as descriptive neighborhood indicators of interest for population-level metabolic and renal health. Data extracted from the Missouri Adult Health Data Report focused on critical domains of community infrastructure, identified by the report as 2024 data. Healthy food access was operationalized as agreement or strong agreement that healthy foods, including whole grains, low-fat foods, fruits, and vegetables, were easy to purchase in the neighborhood. Neighborhood safety was defined as the percentage of participants who classified their neighborhood as "extremely safe" or "quite safe" from crime. Active transport infrastructure was evaluated based on the presence of any neighborhood sidewalks and community roads or streets with shoulders or marked lanes for bicycling [20]. These self-reported measures do not directly assess infrastructure quality or use, dietary intake, or objective crime rates.

Metabolic risk factors (descriptive context)

To provide population-level context, metabolic risk factors were included as descriptive indicators. The analysis incorporated aggregate prevalence estimates for obesity (BMI ⩾ 30.0 kg/m²) and overweight status (BMI 25.0-29.9 kg/m²). Furthermore, the population-level prevalence of specific chronic conditions, including diagnosed diabetes, hypertension, and hypercholesterolemia, was extracted to contextualize metabolic comorbidity burden. Diabetes excluded pregnancy-only diabetes and prediabetes or borderline diabetes; the indicator was not restricted to type 2 diabetes. Hypertension excluded pregnancy-only and borderline or prehypertensive responses. High cholesterol concerned a reported diagnosis among respondents meeting the source's cholesterol-testing eligibility definition [24]. These variables collectively describe the baseline metabolic burden within the statewide adult population and were not covariates in an adjusted model [20].

Demographic stratification

Sociodemographic characteristics were examined to identify structural patterns in disease burden. Stratification variables included household income (categorized into the report's displayed brackets) and educational attainment. For the purposes of this analysis, SES is operationalized as an annual household income category; education was described separately rather than combined into an SES index. These stratification variables were used to describe socioeconomic patterns in self-reported kidney disease prevalence [20]. Income categories were under $15,000, $15,000-$24,000, $25,000-$34,999, $35,000-$49,999, $50,000-$74,999, and $75,000 or more. Education categories were less than high school, high school/General Educational Development (GED), some college, and college graduate or higher. The second income label reproduces the Missouri report ($15,000-$24,000); its apparent discrepancy with standard

BRFSS category notation was not resolved by changing the source category or estimate.

Analytic plan

The analytic approach was descriptive. We characterized statewide aggregate data, reporting prevalence as survey-weighted percentages and estimated population counts, and socioeconomic estimates with the source's available MOE. Stratified comparisons were used to describe household income, education, and regional patterns. No hypothesis tests were performed; therefore, no p-values, effect estimates, or measures of association (e.g., odds ratios, relative risks, and correlation coefficients) are reported. Differences described in the text reflect differences in point estimates between strata and do not imply statistical significance.

Table *1* reproduces the report's separate number of interviews and estimated count fields. Interview counts vary by indicator and are not weighted eligible-response denominators. Estimated counts were copied directly from the published output, rather than calculated from interview counts or a selected census population. The investigators did not reclassify or impute respondent-level missing values, and no unavailable aggregate cells were reconstructed. All cells retained in the revised tables were returned by the source service. Retrieved source methodology fields did not specify exact unknown/refused/missing-response rules, suppression thresholds, indicator-specific weighted denominators, the population-count algorithm, or complete variance procedures. These source-processing gaps limit independent reconstruction of the underlying survey analysis even though the aggregate retrieval is reproducible.

At the regional level, directly retrieved kidney disease point estimates were examined to describe geographic variation. The report returned no overall regional rows for the neighborhood indicators in the corresponding requests. The prior sex-derived regional environmental estimates were excluded because the pooling procedure and the required weighted eligible-response denominators were not documented. Because this is an ecological analysis utilizing aggregate public health surveillance data, individual-level causal inferences are not supported. Regional comparisons were not interpreted as rural-versus-urban effects, spatial clustering, or associations between infrastructure and kidney disease. Statewide and regional confidence interval (CI) limits were not supplied in the retrieved Missouri output and are not presented. Socioeconomic MOE fields were retained in percentage points, but their confidence level was not specified in the retrieved fields; no new 95% CIs were assigned. Tables and the updated income visualization were prepared using Python 3.12.14 and Matplotlib 3.10.8 (Python Software Foundation, Fredericksburg, VA, USA), without re-estimating participant-level survey statistics.

Results

Statewide prevalence and environmental context

The estimated prevalence of self-reported kidney disease among Missouri adults was 4.10%, representing approximately 198,195 individuals. Metabolic factors presented a concurrent burden, with obesity affecting 34.53% of the population. Regarding the built environment, 60.55% of residents reported having neighborhood sidewalks, and 34.87% reported community roads or streets with shoulders or marked lanes for bicycling (Table *1*). These statewide estimates indicate that while a majority of the population reports basic pedestrian infrastructure, reported cycling infrastructure is less common, and metabolic disease remains prevalent [20]. These are separate population-level summaries and do not establish that the same respondents experienced kidney disease, a metabolic condition, and a particular neighborhood exposure.

Socioeconomic gradients in disease and safety

Socioeconomic stratification revealed descriptive patterns in both health outcomes and perceived environmental quality. Self-reported kidney disease prevalence showed a non-monotonic pattern by household income, peaking at 8.60% among households earning $15,000 to $24,000, compared with 2.20% among households earning $75,000 or more (Table *3*; Figure *1A*). Perceived neighborhood safety increased across the reported income categories, ranging from 59.00% in the lowest-income bracket to 90.60% in the highest-income bracket (Table *4*; Figure *1B*). These patterns are separate comparisons within socioeconomic strata and do not establish individual-level co-occurrence of kidney disease and neighborhood conditions [16,20].

Characteristic	Estimated percent (MOE, pp)
Annual household income	
Under $15,000	4.00% (3.30)
$15,000-$24,000	8.60% (5.30)
$25,000-$34,999	7.90% (4.80)
$35,000-$49,999	5.80% (2.60)
$50,000-$74,999	3.20% (1.90)
$75,000+	2.20% (1.00)
Education level	
Less than high school	5.30% (3.60)
High school or GED	4.80% (1.80)
Some college	4.00% (1.50)
College graduate or higher	3.00% (1.10)

TABLE 3: Prevalence of Self-Reported Kidney Disease Stratified by Socioeconomic Status and Demographics (Missouri BRFSS, 2024).

Values are survey-weighted crude percentages. Parentheses contain the source-reported margin of error (MOE) in percentage points (pp), not CI endpoints; the retrieved fields did not specify a confidence level. "Under $15,000" is presented as a separate category to preserve the source's income brackets. The $15,000-$24,000 label is reproduced as displayed by the report. Subgroup interview counts were not supplied in these breakouts.

Source: Missouri Adult Health Data Report, re-extracted October 11, 2026 [20].

GED: General Educational Development; BRFSS: Behavioral Risk Factor Surveillance System; CI: confidence interval

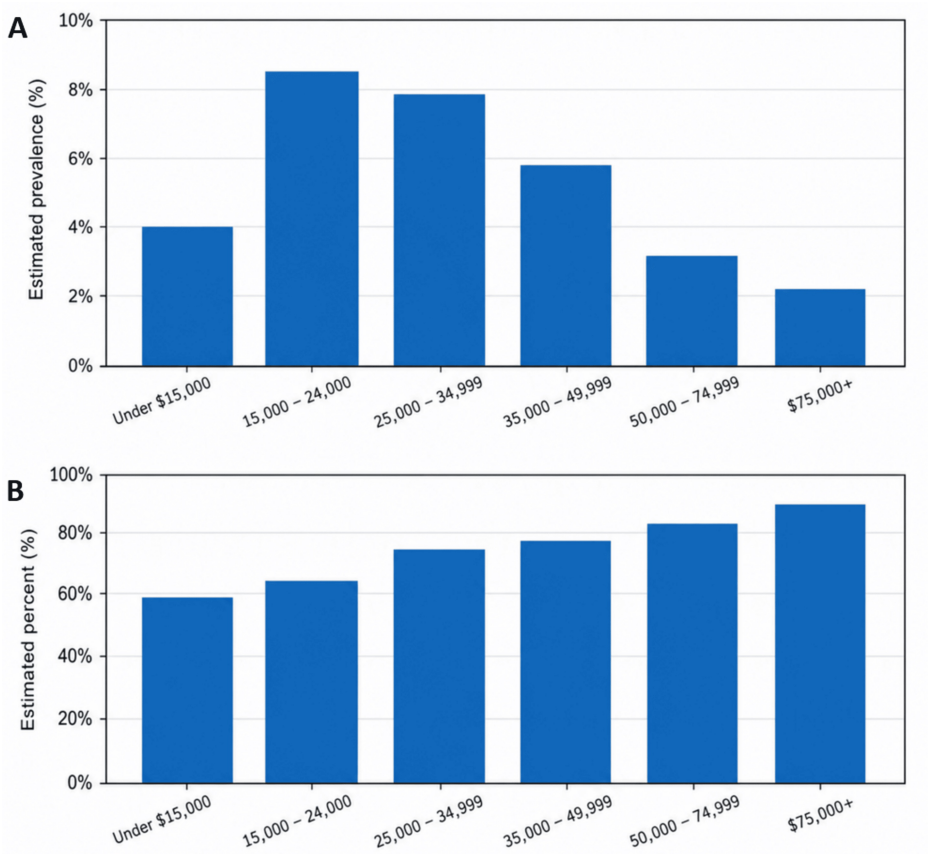


FIGURE 1: Estimated Prevalence by Annual Household Income (Missouri BRFSS, 2024).

Socioeconomic status (SES) is operationalized for this analysis as annual household income category. Values are survey-weighted percentages from the 2024 Missouri BRFSS. (A) Self-reported kidney disease prevalence by household income. Kidney disease prevalence peaks at 8.60% among households earning $15,000-$24,000 and is lowest (2.20%) among households earning $75,000 or more. (B) Perceived neighborhood safety (extremely or quite safe) by household income. Perceived safety increases monotonically with household income, ranging from 59.00% in the lowest-income bracket to 90.60% in the highest-income bracket. Error bars show the source's reported margins of error in percentage points; the confidence level was not specified in the retrieved fields. Differences are descriptive and unadjusted.

These are original author-generated visualizations based on publicly available BRFSS aggregate data.

Data source: Missouri Department of Health and Senior Services, BRFSS, 2024 [20].

BRFSS: Behavioral Risk Factor Surveillance System

Characteristic	Neighborhood extremely/quite safe (%) (MOE, pp)	Neighborhood has sidewalks (%) (MOE, pp)
Annual household income		
Under $15,000	59.00% (11.90)	64.70% (11.30)
$15,000-$24,000	63.50% (10.20)	55.40% (10.00)
$25,000-$34,999	75.30% (8.80)	53.80% (9.40)
$35,000-$49,999	77.50% (5.90)	57.20% (6.80)
$50,000-$74,999	83.60% (4.50)	60.50% (6.40)
$75,000+	90.60% (2.40)	64.60% (3.90)
Education level		
Less than high school	70.70% (9.90)	53.30% (10.30)
High school or GED	80.80% (3.50)	56.10% (4.50)
Some college	83.00% (3.40)	59.80% (4.60)
College graduate or higher	87.10% (2.60)	68.60% (3.80)

TABLE 4: Built Environment and Safety Indicators Stratified by Socioeconomic Status (Missouri BRFSS, 2024).

Values are survey-weighted crude percentages stratified by income brackets and education level. Parentheses contain source-reported margins of error (MOE) in percentage points (pp), not CI endpoints; the confidence level was not specified in the retrieved fields. Subgroup interview counts were not supplied. The report identifies these indicators as 2024 data.

Source: Missouri Adult Health Data Report, re-extracted October 11, 2026 [20].

GED: General Educational Development; BRFSS: Behavioral Risk Factor Surveillance System; CI: confidence interval

The kidney disease estimate for households earning under $15,000 was 4.00%, lower than several adjacent income categories. Sidewalk availability did not increase consistently with income: the estimates were 64.70% in the lowest-income category and 64.60% in the highest. By education, kidney disease point estimates ranged from 5.30% among adults with less than high school to 3.00% among college graduates or those with higher education. Safety and sidewalk point estimates increased across the displayed education categories (Tables *3*, *4*). These unadjusted comparisons were not tested for statistical significance.

Self-reported kidney disease prevalence was highest in the Southwest region (6.49%) and lowest in the Central region (2.73%; Table *5* and Figure *2*). The Northeast (4.11%) and Southeast (5.06%) regions fell within the 3.88%-5.06% intermediate band, while the Kansas City Metro (3.87%) and St. Louis Metro (3.48%) regions fell within the 3.22%-3.87% band (Figure *2*). The Northwest region (3.21%) also reported a low prevalence, falling within the 2.73%-3.21% band alongside Central. These geographic point-estimate differences were not interpreted as evidence of spatial clustering, rural-versus-urban effects, or regional co-distribution with infrastructure or metabolic conditions [20].

BRFSS region	Self-reported kidney disease (%)
Kansas City Metro	3.87
St. Louis Metro	3.48
Central	2.73
Southwest	6.49
Northwest	3.21
Northeast	4.11
Southeast	5.06
Missouri (statewide)	4.10

TABLE 5: Regional Prevalence of Self-Reported Kidney Disease by BRFSS Region.

Values are survey-weighted crude prevalence estimates. Kidney disease estimates are exact regional point estimates, re-extracted directly for each region on October 11, 2026. Regional CI limits were not returned. Regional built environment estimates derived from sex breakouts were excluded because the pooling method and weighted eligible-response denominators were not documented.

Data source: Missouri Adult Health Data Report, BRFSS, 2024 [20].

BRFSS: Behavioral Risk Factor Surveillance System; CI: confidence interval

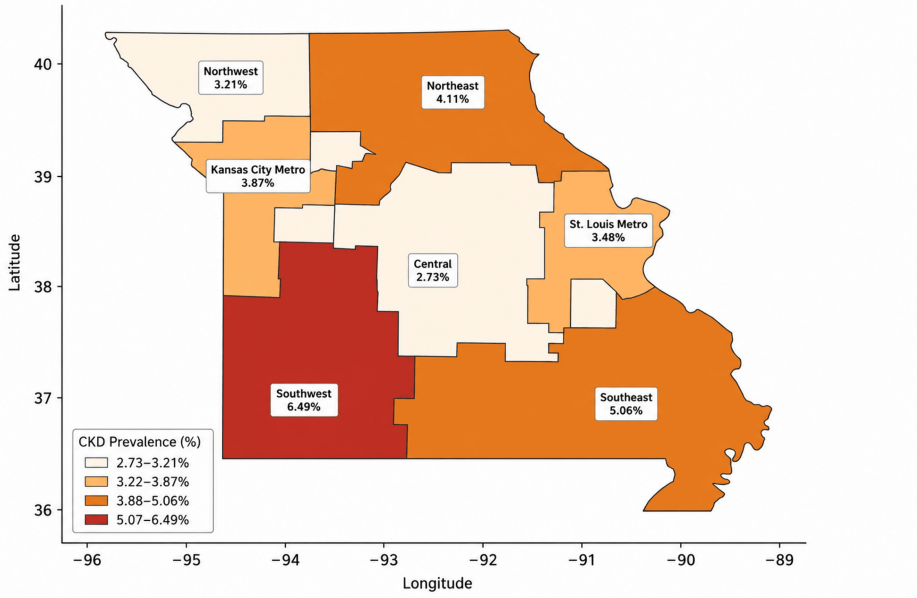


FIGURE 2: Estimated Prevalence of Self-Reported Kidney Disease by BRFSS Region in Missouri (Missouri BRFSS, 2024).

This is an original author-generated choropleth map based on publicly available data from the Missouri BRFSS, 2024. Regions are color-coded by self-reported kidney disease prevalence bands: 2.73%-3.21% (lightest), 3.22%-3.87%, 3.88%-5.06%, and 5.07%-6.49% (darkest).

Data source: Missouri Department of Health and Senior Services, BRFSS, 2024 [20]. Figure prepared by the authors using Python 3.12.14 and Matplotlib 3.10.8 (Python Software Foundation, Fredericksburg, VA, USA).

BRFSS: Behavioral Risk Factor Surveillance System; CKD: chronic kidney disease

Discussion

The analysis of Missouri BRFSS data describes geographic and socioeconomic patterning of self-reported

kidney disease, alongside socioeconomic differences in perceived neighborhood safety [20]. Our findings describe regional point-estimate differences without establishing non-random clustering or an association with infrastructure or metabolic profiles. Specifically, the Southwest region reported the highest kidney disease point estimate (6.49%) and Central the lowest (2.73%). These separate aggregate summaries do not establish that adults reporting kidney disease had a particular metabolic condition or experienced an adverse neighborhood exposure. While aggregate metabolic risk factors, such as obesity and hypertension, are described in prior literature as relevant to kidney health, this study did not measure their prevalence among respondents with kidney disease or evaluate regional metabolic co-distribution [3,6,10].

Prior literature proposes potential pathways linking neighborhood conditions, metabolic health, and kidney outcomes [6,10]. Built environments may influence renal risk by shaping opportunities for physical activity and access to healthy food [6,7,9]. Diabetes and hypertension are established clinical risk factors, but pathways involving physical activity and metabolic dysfunction were not tested in this analysis [3,6,10]. Furthermore, low perceived neighborhood safety has been proposed in prior literature as a psychosocial barrier to outdoor activity [9,13]. Chronic psychosocial stress co-occurring with unsafe environments has been hypothesized to involve neurohumoral pathways, including sustained sympathetic activation, with potential relevance to renal vascular health [13]. These mechanisms are hypotheses drawn from prior work, rather than explanations demonstrated by the present descriptive results.

Beyond physical activity, prior literature highlights the potential role of the local food environment in renal health [6,9,14,16]. Kidney disease point estimates did not increase uniformly as household income decreased: the highest estimate was in the $15,000-$24,000 category, whereas the under-$15,000 category had a lower estimate than several adjacent categories. In many rural and low-income urban areas, the local food environment may increase reliance on ultra-processed options that are often high in sodium and inorganic phosphates, dietary exposures implicated in CKD risk and progression in prior literature [14]. When considered in prior research, low walkability and economic strain may contribute to hypotheses about dietary and metabolic pathways [9,14,15]. However, this analysis did not measure dietary intake, kidney function, or progression, and it does not demonstrate that reported disease is a physiological response to a nephrotoxic environment.

These findings must be interpreted within the context of several study limitations. First, the cross-sectional, descriptive design limits the ability to infer causality, and the inherent risk of the ecological fallacy means that aggregate regional patterns cannot be directly translated to individual-level risk. Second, the reliance on self-reported data within the BRFSS sampling framework introduces the potential for recall bias and excludes institutionalized populations, which may result in an underestimation of the true disease burden [20]. Third, this analysis utilized broader regional strata (e.g., BRFSS regions such as Southwest and Southeast) and does not provide granular, county-level estimates, limiting the ability to describe county-level differences. Finally, because this analysis was unadjusted, the observed disparities may be influenced by residual confounding factors not captured in the dataset, such as genetic predisposition, differential healthcare access, or specific medication usage. Self-reported kidney disease also differs from laboratory-defined CKD because diagnosis awareness, recall, and healthcare access affect reporting; the 4.10% estimate should not be compared directly with national biomarker-based CKD estimates as if both measure the same outcome [1,26]. Age composition is especially relevant to unadjusted kidney disease comparisons. The seven regions were not a rurality classification. Statewide and regional CI limits, subgroup interview counts, and detailed source missing-response, suppression, denominator, count, and variance procedures were not supplied in the retrieved output. Available socioeconomic MOE fields did not specify a confidence level. Blood pressure and cholesterol refer to 2023, while the report identifies the other retained indicators as 2024. These limits constrain precision and interpretation even though the revised aggregate queries and values are preserved.

The descriptive variation in reported kidney disease across Missouri identifies questions for further research, rather than establishing a required shift in prevention policy [20]. Additional individual-level and longitudinal analyses could examine neighborhood conditions after accounting for age, metabolic risk factors, socioeconomic circumstances, and healthcare access. Public health investments in sidewalks, lighting, and community recreational spaces may be evaluated as community-health strategies alongside established clinical management of diabetes and hypertension [3,6,9,10]. Furthermore, clinicians may consider patients' environmental and socioeconomic circumstances when supporting metabolic health [9,15,16]. This study does not establish that those investments reduce kidney disease prevalence or that observed geographic differences are caused by infrastructure deficits.

Conclusions

Self-reported kidney disease prevalence in Missouri varies across geographic and socioeconomic strata. Metabolic risk factors and characteristics of the built environment provide separate population-level context. The regional comparisons do not establish rural-versus-urban differences, individual-level co-occurrence, causal mechanisms, or the effectiveness of environmental interventions. Additional studies using individual-level longitudinal data are needed to further evaluate these patterns and identify interventions that may reduce disparities in CKD burden.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Jose M. Garchitorena, Amta Azeem, Aviral C. Sharma, Mohammed Abu-Salah, Noah Nigro

Acquisition, analysis, or interpretation of data: Jose M. Garchitorena, Amta Azeem, Aviral C. Sharma, Noah Nigro

Drafting of the manuscript: Jose M. Garchitorena, Amta Azeem

Critical review of the manuscript for important intellectual content: Jose M. Garchitorena, Amta Azeem, Aviral C. Sharma, Mohammed Abu-Salah, Noah Nigro

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Disclosures

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