Socioeconomic Determinants of Chronic Kidney Disease: A Comprehensive Literature Review

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Abstract
Introduction: Chronic Kidney Disease (CKD) is a major global health challenge with psychosocial effects contributing to the substantial burden among vulnerable populations. These social determinants of health, such as poverty, education, and access to resources, profoundly influence CKD at all levels, including its prevalence, progression, and management. However, this body of research has a serious gap. The intricate interplay of all these factors is poorly understood, leaving many questions pending about effective interventions. The complex interaction of social determinants of health is incompletely understood, and this study seeks to examine the various social constructs that interplay to influence CKD outcomes, including disease management, healthcare access, and quality of life (QoL).
Methods: Undertaking an exhaustive literature review, this study investigates existing research based on its visibility on the Scopus database to determine key socioeconomic factors associated with CKD disparities that affect multiple countries.
Results and Discussion: Results show a significant association between socioeconomic disadvantage and poor CKD outcomes, leading to the vital implication for targeted interventions. In this context, poor access to healthcare services and knowledge of the disease, as well as economic barriers, stand out as major obstacles to optimal CKD control in the socioeconomically deprived groups. The study ends with a call for a more comprehensive strategy to tackle these inequalities, suggesting that a combination of enhanced social support networks, better access to healthcare facilities, and patient empowerment through education and resources could play vital roles in mitigating these disparities. In addition, it will be crucial for future studies to disaggregate this complex relationship with sociodemographic drivers, standardize their measures of impact across studies, and include populations representative of the diversity and heterogeneity seen in CKD. The effort to close these wide gaps will lead to a more equitable and effective approach for CKD management that can not only improve patient outcomes but also potentially reduce the worldwide burden of this chronic condition.

Keywords: Chronic, kidney, disease, socioeconomic, and CKD

Introduction

Background

The global burden of CKD is a major public health concern around the world, and its increasing prevalence and high morbidity and mortality are a significant challenge to health systems worldwide. Decades of research have demonstrated a demonstrable relationship between low socioeconomic status (SES) and an increased risk of CKD, as well as inferior health outcomes in affected individuals. Advanced age, lower SES (education, income, occupation), and urban residence have been associated with increased prevalence and severity of CKD. For example, individuals of lower SES are at a higher risk of developing CKD because of barriers to access to healthcare resources and preventative measures (Pitino, 2024; Kampmann et al., 2023). Low SES is also a major contributor to CKD progression, with lower SES patients having better clinical outcomes compared with higher SES patients (Floria et al., 2022; Khalid et al., 2022). SES affects CKD not only in terms of incidence but also in QoL and health management strategy. Research indicates that patients with low SES also report lower QoL and encounter hurdles to adequate treatment (Floria et al., 2022; Chaichana, 2024). These data emphasize the need to target these vulnerable populations with specialized interventions to reduce the inequality in health outcomes (Pitino, 2024; Sala and Rodrigues, 2022).

Crews et al. A systematic review and meta-analysis demonstrated that low SES individuals have a considerably higher risk of developing CKD relative to their high SES counterparts, emphasizing the substantial effect of social determinants on health outcomes (Pitino, 2024). Moreover, lower SES has been shown to correlate with higher prevalence and severity of CKD (as socioeconomic disadvantage comes hand in hand with reduced access to health care, including preventive services) (Sansuk, 2024). Moreover, several studies have indicated that socioeconomic determinants are a major factor influencing CKD management and prognosis, as patients with lower SES present worse health-related quality of life (HRQoL) and higher mortality rates (Floria et al., 2022; Sala and Rodrigues, 2022). SES is known to influence health outcomes, and this highlights the need for interventions to address health inequalities and promote effective care across at-risk demographics (Jonson, 2022). Improving health equity and public health outcomes related to CKD requires addressing these social determinants (Bao et al., 2022; Sansuk, 2024). Crews et al. conducted a systematic review and meta-analysis that showed that there is a large difference in the incidence of CKD between individuals with low SES and those with high SES, and this highlights the major impact of social determinants of health (Pitino 2024). This correlation is substantiated by the fact that lower SES correlates with higher rates of and severity of CKD because individuals in lower SES groups typically have trouble accessing healthcare and preventive care (Sansuk, 2024). Moreover, socioeconomic factors also substantially influence the management and outcomes of CKD, and

patients with low SES reportedly have poor HRQoL and higher mortality (Floria et al., 2022; Sala and Rodrigues, 2022). A continued review of health issues, like the nexus of socioeconomic factors and their role in health, is essential. This underscores the importance of gathering data to enable targeted interventions to mitigate these disparities and provide care to vulnerable populations (Huang, 2024). Implementing and addressing these social determinants will advance global health equity and significantly improve CKD outcomes (Bao et al., 2022; Sansuk, 2024).

Muntner et al. conducted a large-scale epidemiological study that highlighted an independent increased prevalence of CKD in lower educational attainment and lower household income, even after adjusting for known clinical risk factors (Pitino, 2024). This further validates the concept that socioeconomic conditions play a large role in health outcomes in both the general population and those with CKD. This work highlights the importance of investigating the complex causal pathways by which socioeconomic disadvantage influences the development and progression of CKD. Health disparities are significantly influenced by factors such as limited access to health services, unhealthy health behaviors, environmental exposures, and psychosocial stress (Bao et al., 2022; Kim, 2024). In addition, the results agree with the wider literature that SES is an indicator for health, influencing not only the burden of disease but also the quality of care and outcomes for people affected (Patel, 2023; Matłosz et al., 2022). Tackling these social determinants is critical for promoting health equity and building effective interventions for reducing the burden of socioeconomic disadvantage on CKD (Strasma, 2023; Kim et al., 2022). It is well documented in the literature that patients with low SES do poorly in CKD management. According to studies, these individuals tend to exhibit suboptimal disease management, which in turn translates into poorer treatment regimen adherence, delayed diagnoses, and poor access to specialized nephrology care (Pitino, 2024). An example of this would be Pitino's study explaining that CKD patients with low SES had poorer clinical outcomes and how impactful SES can be in terms of health (Pitino, 2024). Additionally, these disparities must be addressed with interventions that promote access to healthcare and provide adequate patient education. Patient navigator programs have been shown to help CKD patients overcome barriers to care and improve health outcomes (Guha et al., 2022). Furthermore, the introduction of policies that promote equitable access to healthcare services is imperative to minimize the negative implications of socioeconomic disadvantage on CKD management. In conclusion, the impact of these socioeconomic barriers is crucial in terms of improving the quality of care and outcomes for patients with CKD.

A comprehensive strategy is necessary to adequately confront the socio-economic inequalities in CKD. Such an approach should include public health policies, targeted interventions, and partnerships among healthcare providers, social services, and policymakers. As socioeconomic factors are strongly linked with CKD

prevalence and management, the author recommends a multifaceted approach to alleviate these inequalities (Sousa et al., 2023; Sansuk, 2024). Health system access specifically needs to be improved, especially for lower socioeconomic groups, as highlighted by public health policies. Educational initiatives such as those that augment community health resources and patient education serve to empower individuals and those with whom they have ties to better navigate and manage their health (Pitino, 2024; Sansuk, 2024). Barriers to care may be overcome in part through targeted interventions, such as patient navigator programs (Guha et al., 2022). Moreover, better collaboration among healthcare providers, social services, and policymakers is also important to develop healthcare models capable of treating the wide spectrum of social determinants of health that affect CKD (Sousa et al., 2023; Sansuk, 2024). In conclusion, a holistic approach to these strategies will help address the health of individuals with CKD, and perhaps most importantly, those from lower socioeconomic classes (Pitino, 2024; Sansuk, 2024; Huang, 2024).

Challenges and Limitations

Despite the well-documented impact of socioeconomic factors on CKD, as consistently shown by the literature, some opportunities and limitations should be considered. A key challenge is the lack of standardization, because SES can refer to so many different things, and studies may measure it in several different ways, making comparisons and evidence synthesis difficult (Sousa et al., 2023). For instance, Sousa et al. highlighted how inconsistent methodologies in defining SES can yield contradicting findings on its association with CKD prevalence and outcomes (Sousa et al., 2023). Furthermore, Pitino emphasized that the absence of standardized measures for SES might mask the actual magnitude of its influence on CKD management and progression (Pitino, 2024). The impact of socioeconomic factors, such as access to healthcare, health behaviors, and environmental aspects, is diverse and nuanced, adding another layer of complexity to the understanding of their impacts on CKD (Pitino, 2024). This multifactor construction argues for a broad-spectrum investigation involving a broad range of socioeconomic parameters and their relationships with clinical features. Overcoming these limitations is critical for the development of effective interventions and policies to reduce the burden of CKD in disadvantaged populations.

Socioeconomic determinants, including education, income, occupation, and neighborhood characteristics, are often multifaceted and intertwined, making it difficult to isolate the effect of each determinant on CKD. These factors often interact, and studies indicate that they are difficult to differentiate in their specific contributions to the prevalent patterns and outcomes of CKD (Sousa et al., 2023; Pitino, 2024). For instance, Sousa et al. These overlapping influences can cloud our understanding of how each of these socioeconomic indicators individually contributes to health disparities in CKD (Sousa et al., 2023). Likewise, Pitino underlines

the importance of recognizing the multifaceted nature of SES when examining health outcomes, as these elements can play a cumulative role in disease handling and progression (Pitino, 2024). In addition, the relationship between health behaviors and socioeconomic factors also adds to the complexity of this association. Lifestyle choices at lower SES are more likely to be less healthy behaviors, which can heighten the risk for CKD (Pitino, 2024). Such complexity in relation to CKD requires a holistic approach to both research and policymakers who want to understand and address the diverse range of socioeconomic factors that ultimately converge to contribute to CKD.

Most research on CKD has taken place in high-income countries, and this represents a major gap in knowledge about the socioeconomic determinants of CKD in low- and middle-income settings. A considerable portion of the global CKD population still does not receive the appropriate management, which is particularly worrisome in regions in which the CKD burden may be even more severe given greater socioeconomic burdens (Pitino, 2024). For example, work like that of Pitino highlights the scarcity of such data and the need for more work looking at diverse populations, especially those living in low- and middle-income nations, to better grasp how these factors can affect CKD outcomes (Pitino, 2024). In addition, the unique challenges faced by these populations require focused research efforts, including limited access to healthcare, poor health education, and environmental factors. Knowledge of these dynamics is essential to tailor effective public health interventions and policies to the needs of populations living in lower-income contexts with the intention of mitigating the burden of CKD and improving health outcomes (Pitino, 2024).

Although there is a variable correlation of SES potentiating with the progression of CKD, the relationship has not always been definitive. An alternative view suggests that SES alone provides too simplistic an account of the multi-factorial etiology of CKD, counteracting the potentially important individual behaviors and genetics that are also major players. For example, although lower SES may be associated with less access to healthful foods, the selection of what to eat is ultimately an issue of personal choice. Likewise, even though poorer communities are more likely to be exposed to environmental toxins, individual behaviors, such as smoking, drinking, and physical activity, have a significant impact on CKD risk. As such, attributing differences in CKD solely to SES ignores the key factor of individual responsibility in health outcomes. In addition, genetic variants independent of SES significantly predispose individuals to CKD. An emphasis on SES might distract research efforts and funding away from these biological research/disablers, possibly impeding the search for better therapies and preventive measures.

This brings us to the next counterargument, which is focused on the limitations of current research methodologies in establishing a direct causal link between SES and CKD. A number of studies are based on observational data, which are vulnerable to the

effects of confounding variables and reverse causation. However, CKD onset can cause unemployment and decrease income, creating the impression that lower SES causes CKD. In addition, SES is a complex construct, and there are few direct measures of this variable; instead, it is often assessed via proxies such as education and income, which may not reflect every aspect of socioeconomic conditions. This measurement-related challenge poses multiple problems that can bias classification and estimates of the true association between SES and SES and CKD. Moreover, intra-socioeconomic group variation is usually neglected. People in the same income bracket have very different social and environmental contexts that affect their health outcomes.

Rationale

The significance of this study is that CKD is a major public health challenge with considerable individual, societal, and economic impacts. The knowledge of the related factors of CKD is valuable to find out and to lessen the CKD burden among the affected populations, particularly in vulnerable groups. Although an association between these two complex constructs is accepted in this context, there remain significant gaps in the current literature requiring further exploration.

First, the absence of a uniform approach for quantifying SES, coupled with varying methodologies across the studies, creates disparities in the evaluation of the true impact of SES on the prevalence, outcomes, management, and progression of CKD. Methodologically, designing a study addressing this knowledge gap has its challenges, and to constructively influence the clinical care of severe joint disease, we have to balance socioeconomic indicators and interaction with clinical factors in a timely and contemporary manner.

Second, the rich and interdependent nature of socioeconomic factors, including education, income, occupation, and neighborhood characteristics, renders the disentanglement of the independent contributions of each factor to CKD difficult. This study will explore the complexity of these different interactions to elucidate their individual and collective relationships with CKD.

Third, most of the existing research is from high-income countries, and this is a misconception that CKD is only a high-income disease while we are dealing with more severe socioeconomic disparities in low- and middle-income countries having a huge burden of CKD. To address this gap, the present study aims to focus on diverse populations, including low- and middle-income countries, which will provide a more nuanced picture of how socioeconomic factors impact CKD outcomes in these settings.

Finally, while this relationship between SES and CKD is often stated, some arguments exist against the acceptability and nature of the association. This study will take a closer examination of these contrasting viewpoints, which each attribute the impact of SES on CKD either to individual behaviors, genetic predispositions, or shortcomings in current research

methodologies precluding a direct causal linkage determination between SES and CKD.

This study has 5 objectives. First, use standardized measures of SES (e.g., education level, income level, occupational categories) for comparability across studies and a more accurate assessment of the contribution of SES to CKD. Second, assess the complex interplay of socioeconomic factors, including educational attainment, income, occupation, and neighborhood characteristics, while quantifying their individual and cumulative contributions to the development and progression of CKD. Third, to explore the socio-economic determinants of CKD among diverse populations, both in high-income and low-and-middle-income countries, and see how they influence CKD outcomes in different settings, to address the currently predominant bias toward high-income countries in such research. Fourth, to appraise divergent views on the SES-CKD link in which individual behaviors, genetic vulnerabilities, and methodological restrictions compete for prominence, effectively leading to a better insight into the complexity of SES-CKD interrelationships. Fifth, to develop targeted interventions and policies required to address the socioeconomic disparities in CKD prevalence, outcomes, management, and progression to reduce the global burden of CKD.

Methods

The aim of this systematic literature review was to examine the socio-economic determinants of CKD using the Scopus database, according to the PRISMA guidelines. The first search will be conducted on the following keywords: "chronic," "kidney," "disease," "socioeconomic," and "CKD," which is predicted to result in about 677 documents. The publication date range is then narrowed to dates between 2022 and 2025, resulting in approximately 159 documents. Further refinement will involve limiting the subject area to "Medicine," which is anticipated to result in approximately 142 documents. Lastly, by article type, the search is limited to articles, resulting in about 117 articles. After the database search and filtering, two independent reviewers will screen the title and abstract of the remaining 117 articles. Differences between reviewers will be discussed and resolved by consensus or by the involvement of a third reviewer if needed. Articles will meet the following inclusion criteria: studies on human populations with CKD, exploring socioeconomic determinants such as income, education, occupation, social support, and/or healthcare access. The outcomes of interest were the association of socioeconomic factors with CKD prevalence, incidence, progression, mortality, and QoL. Observational or interventional studies will be accepted. Exclusion of non-English articles, reviews, editorials, commentaries, letters to the editor, case reports, conference abstracts, articles that do not concern the human population, and studies not directly measuring the socioeconomic determinants of CKD will be applied. After abstract screening, 39 full articles will be retrieved for independent review. A standardized

form will be used to extract data from the selected articles, including study characteristics (authors, year of publication, country, study design, sample size, population characteristics), socioeconomic factors considered, CKD outcomes assessed, and main findings. Result synthesis will consist of a narrative description of the results. The results will be reported according to the PRISMA guidelines, which will include a flow diagram of the study selection process, study characteristics and results, and assessment of study limitations.

Countries such as the United States, Canada, Australia, and European nations have institutionalized research programs examining the socioeconomic determinants of CKD, leading to a great volume of literature. However, there is a marked lack of evidence from low- and middle-income countries, where the burden of CKD is typically greater and the socioeconomic gradients sharper.
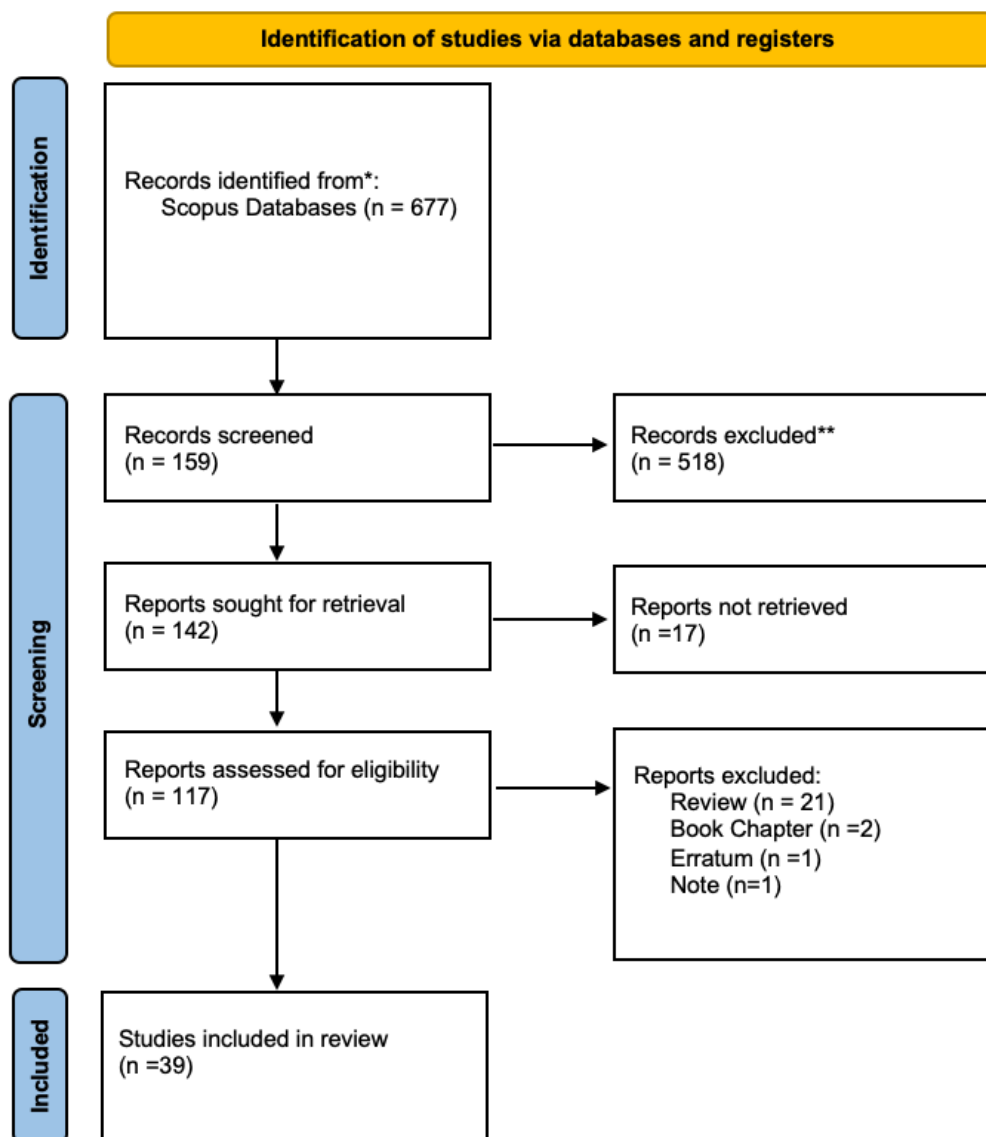

Figure 1. PRISMA flowchart of the identification and included studies.

Result and Discussion

Homogenizing SES Metrics in CKD Patients

SES is a construct of interest in CKD patient populations, but there is a lack of standardized SES measurement in CKD patients. Therefore, understanding the multifaceted impact of socioeconomic factors on health outcomes in CKD patients requires further methodological work to standardize SES measurement. The relationship between SES and renal outcomes is

well established, with those with lower SES experiencing worse health outcomes, specifically higher rates of morbidity and mortality among patients with CKD. This measurement was found to be highly correlated with the health outcomes of patients with CKD, highlighting the importance of considering education and SES in this population's care and treatment (Pitino, 2024).

Pitino et al. focused on a validated composite SES indicator that significantly influenced health outcomes in patients with CKD and reiterated the importance of healthcare providers considering educational and socioeconomic factors within treatment plans (Pitino, 2024). Likewise, studies have also demonstrated that children with CKD have cognitive and academic difficulties that are closely associated with their SES, highlighting the need to integrate SES into clinical assessment (Kim et al., 2022; Khalid et al., 2022).

In children with CKD, SES continues to play a powerful role in determining cognition and academic performance (Kim et al., 2022).

These results indicate that a broad measurement of SES may translate into better health interventions for CKD patients. QoL is an important outcome in CKD, which is conditioned by SES. Researchers have shown that hemodialysis patients with lower SES reported poorer QoL than patients with higher SES (Floria et al., 2022), underscoring the necessity to frequently evaluate QoL in this vulnerable group.

Moreover, a separate study on children with CKD suggested that children with lower SES had significantly lower QoL scores, highlighting the impact of socioeconomic vulnerabilities on HRQoL (Chaichana, 2024).

These studies underscore the importance of standardizing SES measurements to ensure that healthcare providers can identify at-risk populations and implement targeted interventions. SES among CKD patients may be assessed in various ways, and in some studies, SES was controlled for using multivariable linear regression models when studying health outcomes (Kim et al., 2022). SES has also been shown to influence the health of adults. Kim et al. reported that socio-economic factors were significantly associated with the risk of impaired QoL in patients with diabetic nephropathy and highlighted the need for integrating SES in clinical evaluations and management for the CKD population (Kim et al., 2022).

This approach enables a more nuanced understanding of how SES interacts with other variables, like age and gender, to shape health outcomes. Furthermore, the implementation of QoL evaluations is being integrated into data collection to enhance patients' HRQoL (Sala and Rodrigues, 2022), making it all the more interesting to be able to measure the outcomes myself in daily care routines.

Such standardized SES measurement across diverse healthcare settings will allow for improved comparisons and a better understanding over time of the influence of SES on CKD outcomes. Standardizing SES measurements helps not only individual patient care but also guide healthcare policies and resource allocation. An example of this is the interplay between CKD and SES factors as prognostic factors, such as the study of the association of CKD with all-cause mortality among patients hospitalized for atrial fibrillation, which observed that the SES factors significantly contributed to the relationship (Bao et al., 2022).

Standardization of SES measurements allows policymakers to more easily identify at-risk populations,

enabling more effective allocation of resources intended to address disparities in CKD outcomes. Additionally, the incidence of CKD is often greater among those with lower SES; this has been documented in studies that establish a relationship between socioeconomic factors and CKD incidence (Kampmann et al., 2023).

This relationship requires a standardized approach to implement the measurement of SES to ensure that interventions are targeted correctly. One study conducted in Brazil, for instance, found that health indicators and CKD were significantly associated with socioeconomic factors, highlighting the necessity to use standardized SES methods to derive public health strategies (Sousa et al., 2023). Likewise, a study by Stoecker et al. found that lower annual household income was statistically significantly associated with increased peripheral artery disease in cases of CKD, elucidating the interaction between socioeconomic determinants and health (Stoecker et al., 2022). These observations have implications in CKD epidemiology and targeted interventions, in which standardized measures of SES may provide valuable insight into CKD risk.

The relevance of SES to CKD is supported by the study done in Egypt by Nagib et al., which evaluated the prevalence of CKD in hypertensive patients without diabetes (Nagib et al., 2023). This adds further strength to the theory that SES is an important predictor of health outcomes in patients with CKD, which in turn warrants standardized methods of measurement and assessment. Furthermore, the study on the burden of CKD in Mexican women published by Dávila-Cervantes underscores the necessity of designing specific interventions that take into account the socioeconomic determinants of health disparities (Dávila-Cervantes, 2024).

SES impacts not only health outcomes but also access to healthcare services. Variation in the rates of laboratory testing for CKD patients across general practitioner practices suggests that long-term conditions are not consistently monitored, contributing to health inequities (Jones et al., 2022).

Setting universal SES metrics will allow healthcare providers to enable equitable access to appropriate monitoring and treatment for CKD patients. In addition, the link between SES and multiple comorbidities among patients with CKD is complex and multifactorial. Low SES individuals are more likely to have comorbidities that may complicate CKD management (Zeidalkilani, 2024).

There is great potential for improving care, resource allocation, and disease comprehension for CKD patients with SES data improved by standardization. A standardized measure of SES enables more accurate identification of at-risk populations, targeting of interventions, and ultimately, the reduction of disparities. At present, methods of evaluating SES in CKD patients are varied enough to make it difficult to compare findings between studies, making it hard to say most definitively about the relationship between SES and CKD outcomes. Standardization would allow researchers to aggregate data from different studies,

greatly enhancing the understanding of how SES impacts the prevalence, progression, and outcomes of CKD.

Standardized SES measurements lead to more precise risk assessments. One of the biggest advantages of standardized SES measurements is the enhanced ability to conduct risk assessments. Measuring SES repeatedly also allows healthcare providers to identify individuals who are at a higher risk of developing CKD or experiencing worse outcomes of CKD, such as disease progression or cardiovascular complications. This enables prevention approaches, including lifestyle counseling, pharmacotherapy, and early specialist referral. Moreover, standardized data may allow accurate assessment of the magnitude of SES and CKD inequities in health and care, which will be vital to developing policies to reduce these inequities. This knowledge can be utilized to request policies that encourage services that provide fundamental access to care, target social determinants of health, and champion the timely identification of CKD among high-risk groups.

Direct patient care benefits from standardizing the SES measurements. Similar interventions can be performed if a patient is of lower SES; identifying patients as having lower SES would also allow for targeted interventions, as this population may have needs greater than those of their more affluent counterparts (food access, transportation, medication assistance, etc.). Patients who are struggling financially may need help with the cost of drugs or transportation for regular dialysis. Standardized assessments can also facilitate more consistent tracking of CKD progression and associated complications among at-risk populations. It can facilitate the prevention or delaying of serious complications, including end-stage renal disease (ESRD), and allow the best possible outcomes for patients.

However, the repercussions of standardizing SES measurements would go beyond individual patient care. Uniform SES data is essential for helping inform sound policies and public health programs. Data on SES-related disparities can inform policies to facilitate access to care, mitigate socioeconomic disparities, and promote early detection of CKD. Robust SES data would give policymakers the necessary tools to better target resources by allocating funding or services to programs and interventions that account for some of the social determinants of health and potential root causes of SES disparities in CKD. Standardized SES will also have applications in public health programs, as it can be used to design and evaluate CKD prevention and management programs for vulnerable populations.

Although the advantages of harmonizing SES measures are evident, multiple issues must be overcome. It is important to reach consensus on the best and most comprehensive way to measure SES among patients with CKD. These can include income, education, occupation, neighborhood characteristics, and access to resources. Collecting standardized SES information across heterogeneous healthcare settings may face substantial complexity and resource demand. Promotion of SES data within electronic health records is also important for translational and population studies. Lastly, SES initiatives require a culturally sensitive and tailored approach to address population diversity. Establishing standardized SES measurements would enable healthcare providers to overcome such barriers, which would lead to achieving health equity and improved outcomes for all patients with CKD.

The Complex Relationship Among Various Factors in CKD Patients

The interactions between different factors in CKD patients are a complex issue that consists of many clinical, socio-economical, and lifestyle components. These interactions are important in optimizing patient outcomes and guiding targeted interventions. This synthesis aims to explore these variations by integrating findings from multiple studies that highlight the impact of SES, comorbidities, and demographic factors on CKD patients.

Comorbidities are among the most critical determinants of CKD progression and outcomes. Research has consistently demonstrated that comorbid conditions, including hypertension, diabetes mellitus, and cardiovascular disease (CVD), are common in patients with CKD and contribute substantially to disease severity and progression. For example, Sousa et al. showed that chronic hypertension causes nephrosclerosis and aggravates the decline of renal function over time (Sousa, 2023). Similarly, Patel (2023) reported that conditions such as obesity and type 2 diabetes mellitus (T2DM) are risk factors for CKD, but they also complicate the disease management of CKD patients with COVID-19. This interplay indicates that the optimal management of these comorbidities is of great importance for CKD outcomes. A study by Joshi et al. reported a worryingly high prevalence (86.6%) of CKD among patients with type 2 diabetes in their study (Joshi et al., 2023). These results are in agreement with those of Nagib et al., who reported a high prevalence of CKD among hypertensive non-diabetic patients in Egypt, highlighting the role of the socioeconomic conditions in which these patients live (Nagib et al., 2023). Therefore, by integrating SES into public health planning, stakeholders can enhance their ability to allocate resources effectively and design interventions that are tailored to the needs of the population. It has also been shown that multi-morbidities are often present in CKD patients. CKD patients from lower SES backgrounds have higher rates of comorbidities, making their treatment more challenging (Kampmann et al., 2023; Stoecker et al., 2022).

Furthermore, the application of SES in clinical settings is essential for understanding the needs of varied populations. For instance, Matłosz et al. stated that continued reliance on outdated equations for estimating glomerular filtration rate (eGFR) across the majority of centers in Central/Eastern Europe may fail to account for the potential SES-related factors impacting kidney health (Matłosz et al., 2022). Such studies underscore the need for commonly employed SES measures to ensure that clinical practices are consistent with

current evidence and respond to the needs of the entire patient population.

In addition, SES and CKD are not only correlated but also causative. The Mendelian randomization analysis by Qing revealed that albuminuria is a key factor affecting SES in CKD patients and that biological markers of kidney function can have socioeconomic implications (Qing, 2024). This finding underscores the necessity of integrating biological and socioeconomic data in CKD research to develop comprehensive models that can predict health outcomes more accurately. These findings emphasize the benefits of integrating biological and socioeconomic data in CKD studies to construct more sophisticated and informative models regarding health outcomes. This has numerous implications in that it highlights that a one-size (or rather, treatment) fits all approach to CKD management may not suffice. Rather, interventions need to be tailored; having detailed insight into the socioeconomic context is critical toward that end. Research by Stoecker et al. on peripheral artery disease in patients with CKD showed that lower income and racial differences were important predictors of health outcomes, with potential for direct interventions to mitigate the differences (Stoecker et al. 2022). This supports the case for using a standardized SES measure to ensure that interventions are fair and impactful.

In addition, SES is associated with CKD patients' health. Pitino et al. stressed that disadvantaged SES leads to adverse CKD clinical outcomes such as increased mortality and cardiovascular incidences (Pitino, 2024). This aligns with Huang's research showing a strong relationship between SES and metabolic syndrome, a major risk factor for CKD (Huang, 2024). When access to health and education service resources is insufficient, this will result in worse health conditions for people with low SES backgrounds. Additionally, the data from Kim et al. demonstrated how SES affects risk perception and health behaviors in CKD patients, showing that patients from lower socioeconomic backgrounds are more likely to worry about their health (Kim et al., 2022). Such a dynamic relationship between SES and health outcomes underscores the need to consider the social determinants of health in the management of CKD. Standardization in SES measurement may enable researchers to obtain better results, which would improve the capacity for interventions. For example, Kim et al. on patients with diabetic nephropathy showed that SES was a significant risk factor for impaired QoL, indicating the potential to develop targeted interventions using SES data (Kim et al., 2022). Likewise, the findings of the KNOW-CKD cohort study showed that understanding the determinants of health, including those in the social-socioeconomic domain, helps achieve better clinical outcomes for people with diabetic nephropathy (Khalid et al., 2022).

Lifestyle-related factors, such as dietary and physical activities, also have a major impact on the progression of CKD. Patel et al. found an association between the severity of CKD in patients and dietary habits and physical activity levels (Patel, 2024). Interventions targeting lifestyle choices may have the potential to intervene in the progression of kidney disease. The role of obesity as a risk factor for CKD is also highlighted in the work of Sahi et al., who showed that obesity is more prevalent among CKD patients, particularly in the advanced stages of the disease (Sahi, 2024). This highlights the need for lifestyle management of CKD. Research by Roddy et al. suggested that dietary interventions can improve glycaemic control in diabetic patients and may also slow CKD progression (Roddy et al., 2022).

Patient involvement in healthcare is another important predictor of CKD2 outcomes. Indeed, according to research led by Zeidalkilani, increased levels of patient engagement tended to correlate with improved health outcomes, especially in patients battling diabetes on hemodialysis (Zeidalkilani, 2024). This means that engaging patients and enabling them to participate in the management of their health by involving them in decisions can improve compliance with treatment regimens and, in fact, their overall health outcomes.

Healthcare access and quality have not been discussed enough in the context of CKD. Jones et al. identified major discrepancies in laboratory testing and monitoring for CKD patients across different levels of healthcare facilities, implying that inequitable outcomes can arise from differential access to healthcare (Jones et al., 2022). In addition, the study of Bao et al. highlights the role of early and effective medical care and treatment in decreasing the mortality of patients with CKD and comorbidities (Bao et al., 2022). This suggests that better healthcare delivery and access are needed to achieve better outcomes in CKD populations.

The psychological and cognitive factors of CKD also need to be included. Research by Viriyapak et al. showed that cognitive dysfunction is common in children with CKD and may impact their overall QoL and the management of their disease (Viriyapak et al., 2021). This underscores the importance of holistic care that meets both the physical and mental health needs of patients with CKD.

Finally, environmental factors, such as air quality, are being more widely acknowledged as contributing to CKD. The study led by Kim highlighted the impact of long-term exposure to ambient ozone on mortality in CKD patients, indicating that the effects of environmental health factors extend to the pathway to CKD as well (Kim, 2024). This adds another level of complication to the interaction of factors influencing CKD patients. CKD outcomes can also be influenced by the geographical and cultural context. Sukana group's research has found that SES and health service conditions are statistically significant factors in the prevalence of CKD in Thailand, demonstrating how locally rooted conditions can influence population health outcomes (Sansuk, 2024). This is a reminder of the importance of tailoring CKD interventions to the populations involved and accounting for the local determinants of health.

Behavioral factors, including lifestyle choices, play an important role in CKD progression and determine patient QoL. For example, Kim et al. reported dietary and physical activity patterns to be important factors in

health conditions in CKD patients independent of coexisting problems such as diabetes (Kim et al., 2022). Also, in light of Strasma's research, obesity is a risk factor for CKD, so weight management should be a priority in the care of these patients (Strasma, 2023). Such evidence from the relationship between lifestyle factors and CKD outcomes exemplifies the need for a bio-psycho-social approach to care that combines medical and behavioral interventions.

Sex and gender differences in CKD outcomes have also garnered attention. Wu's meta-analysis found that smoking is an important risk factor for CKD (Wu, 2024). Understanding these differences is essential for informing gender-sensitive interventions that cater to the specific needs of CKD patients.

The utilization of patient-reported outcome measures (PROMs) in clinical practice is increasingly recognized for assessing the effects of clinical and non-clinical determinants on HRQoL in patients with CKD. It was in this context that Sala and Rodrigues called for the implementation of validated PROMs, highlighting their potential to help us capture patient experiences to drive care strategies (Sala and Rodrigues, 2022). This is also in accordance with the need for the assessment of CKD because it is multifactorial and so complicated that it requires holistic care.

Furthermore, one important factor affected by the interplay of many factors is QoL in CKD patients. Research by Floria et al. demonstrated that socioeconomic, anthropometric, and nutritional variables were associated with the QoL of hemodialysis patients (Floria et al., 2022). Chaichana's effect correlates with these findings, establishing an inverse relationship between QoL and socioeconomic criteria of age, income, and education (Chaichana, 2024). This correlation between well-being and QoL emphasizes the importance for healthcare providers to incorporate socioeconomic factors into treatment recommendations whenever possible.

Additionally, the connection between CKD and CVD deserves special mention. Zhou's multiple-adjusted analysis demonstrated a nonlinear association between eGFR and CVD risk, revealing a significant increase in cardiovascular burden with decremental levels of kidney function, particularly in certain subgroups (Zhou, 2024). This association is aggravated by other comorbidities such as hypertension and diabetes, which are common in CKD cohorts. Results implicate that control of cardiovascular risk factors is an important part of improving outcomes in CKD patients.

CKD, driven by a multitude of contributing factors, is a multifactorial problem facing patients and healthcare systems. These include not only the well-established physiological mechanisms but also the often-ignored effects of SES, lifestyle choices, access to quality healthcare, and environmental exposures. This creates a complex system where the effects of one can reinforce or cancel out the effects of another. For instance, limited access to health care may delay diagnosis and treatment, enabling the disease to advance and interact with other diseases such as diabetes and hypertension, triggering a cascade of negative health outcomes. These intricate relationships are important for tailoring treatments and boosting the overall standard of a particular patient.

Recognizing that CKD involves a myriad of physiological interactions, this conjecture is typically precipitated by one or more comorbidities, including diabetes and hypertension. Increased blood glucose and blood pressure destroy the kidney's fine filtration units, causing gradual loss of kidney function. This decline prompts additional physiological changes, such as mineral metabolism, fluid balance, and cardiovascular function disruption, creating a vicious cycle. The chronicity of kidney disease adds complexity to their clinical picture, as CKD itself may also worsen any comorbidities or contribute additional new complications. Therefore, the requirement of integrated CKD management addresses the physiological changes that cause CKD and its complications. Emphasizing the role of laboratory testing and monitoring, underline the significance of timely medical actions to slow CKD progression and prevent complications.

Social determinants significantly impact CKD outcomes. A lower SES is associated with restricted access to healthy food, secure housing, and quality health care. They may also drive the development of other risk factors for CKD, including obesity, hypertension, and diabetes. In addition, financial challenges can hinder access to required medications, transportation to health care visits, and compliance with prescribed dietary limitations. This generates a disparity in health outcomes, with patients from lower socioeconomic strata having more severe disease progression and complications. This has vital implications; addressing these socioeconomic disparities is key to ensuring equitable access to care and ultimately improving CKD outcomes. Socioeconomic and health service determinants influencing the prevalence of CKD in Thailand require place-based thinking in disease management.

Diet, physical activity, and smoking habits are important factors that indirectly affect CKD disease progression. Diets consisting of high amounts of processed foods, saturated fat, and sodium can worsen hypertension and lead to obesity, the two single greatest contributing factors of CKD. A balanced diet, rich in fruits, vegetables, and whole grains, can help manage these risk factors and slow disease progression. Exercise is known to have numerous cardiovascular enhancing effects, such as lowering blood pressure and improving insulin sensitivity, all of which are helpful in CKD patients. Quitting smoking is vital because it damages blood vessels and speeds up kidney damage. Educating and supporting patients to make healthy lifestyle choices is the key to ensuring better health outcomes. Dietary habits and physical activity levels play a role in CKD management, especially with comorbidities like diabetes.

The interplay of these factors underscores the complexity of CKD and the need for a comprehensive, patient-centered approach to its management. Interventions need to target not just the biology of the

disease but also the elements of life that drive the risk of socioeconomic drivers of health, lifestyle risk factors, and access to quality healthcare. This means fostering environments that enable people to make those choices and obtain the care they require, and it calls for collaboration among health care providers, policymakers, and community organizations. Further studies are needed to better understand the complex interplay of these factors and to design tailored interventions for diverse CKD populations. The need for PROMs that may also reflect care experiences and guide care strategies, emphasizing the importance of obtaining a holistic understanding of CKD, which is multifactorial in nature.

Diverse Populations in Chronic Kidney Disease Patient

CKD is a complex health problem that cuts across different population groups within the demographic, socioeconomic, and clinical spectrums. Because the two underlying drivers of CKD, diabetes and hypertension, affect 538 million and 1.2 billion people, respectively, understanding how CKD differs among populations is essential. These variations are evaluated in this synthesis by absorbing evidence from multiple relevant studies that detail the influence of SES, comorbidities, and demographic factors on CKD patients.

First, SES has been recognized as an important predictor of health outcomes in patients with CKD. Pitino et al. created a straightforward indicator of SES based on income and educational attainment to show that lower SES is associated with worse clinical outcomes among patients with CKD (Pitino, 2024). The above-mentioned result agreed with another research conducted by Floria et al.; the authors proved the significance of the socioeconomic factor among hemodialysis patients in Greece, as they stated that patients from lower socioeconomic strata have a greater burden of diseases (Floria et al., 2022). Furthermore, Khalid et al. found that children and adolescents with CKD from lower SES backgrounds encounter extra challenges that can affect their academic performance and overall health (Khalid et al., 2022). These studies combined highlight the ways in which socioeconomic disparities may impact health outcomes in populations with CKD and why addressing these disparities must be a part of the solution.

Additionally, CKD is highly prevalent in various ethnic and demographic groups. According to Patel's research, African American persons have CKD at a disproportionately higher rate and are at risk of renal failure more than three times the rate of White persons (Patel, 2024). These end-points complement those reported in the study by Zhou showing the relationship of eGFR and CVD in which Black individuals were also at an increased risk to both (Zhou, 2024). These findings require targeted public health interventions that take into account the unique challenges of these populations. For populations with a high prevalence of comorbidities, such as diabetes or hypertension, this association remains particularly relevant. For example, Bao et al. demonstrated that CKD significantly increased the risk of all-cause mortality in patients admitted for atrial fibrillation (Bao et al., 2022). Regarding therapy modalities, either conservative management or renal replacement therapy (RRT) choice is an important decision point for CKD patients. Patients diagnosed with ESRD are presented with challenging decisions regarding RRT with different levels of effectiveness that vary significantly by individual patient clinical health profiles and socioeconomic environments, as per evidence documented by Bundó (2023, p. 2) (Kim et al., 2023), which separate access to healthcare resources. The QoL in patients with diabetic nephropathy was primarily determined by socioeconomic factors (Kim et al., 2022).

Patient engagement in the management of CKD is also of note. A study conducted by Zeidalkilani on hemodialysis patients with diabetes found that higher levels of patient engagement were correlated with improved HRQoL and added that empowering patients, through providing education and support, has the potential to enhance outcomes (Zeidalkilani, 2024). Such a focus is consistent with the general movement toward more patient-centered healthcare, which is especially important in the context of managing chronic illnesses such as CKD.

Comorbidities are also important contributors to the progression and management of CKD, in addition to socioeconomic and demographic factors. Joshi et al. reported a significant prevalence of CKD in patients with type 2 diabetes mellitus in Nepal, where 86.6% of the diabetic population had indicators of CKD (Joshi et al., 2023). This underscores the link between diabetes and CKD, indicating that the correct management of diabetes could reduce the risk of CKD. This is consistent with Gao's own findings, who reported an association between CKD and osteoarthritis, suggesting that common risk factors, e.g., obesity and diabetes, contribute to the high burden of CKD in many settings (Gao, 2023). In agreement, the literature supports hypertension as a common comorbidity in the CKD population, contributing to the deterioration of kidney function (Nagib et al., 2023). However, the comorbidity between CKD and other diseases suggests that more integrated clinical management of different diseases at the same time may be required. In addition, CKD is often co-managed with other health conditions that influence the management and prognosis. Specific health conditions may also be common, such as evidence linking metabolic syndrome with an elevated risk of CKD (especially among low SES groups) (Huang, 2024). This is reinforced by a study by Wu, who reported smoking as an important risk factor for CKD with major differences between sex and SES (Wu 2024). The medical and social determinants of health must intersect to create solutions that address the barriers within the healthcare and community systems of the populations most affected.

Furthermore, the demographic characteristics of patients with CKD showed racial and gender disparities in the prevalence of the disease, as well as differences in outcomes. For instance, Wolf et al. emphasized that Black patients are at a greater risk of developing CKD

and its comorbidities, and that factors such as polypharmacy and poorly managed comorbidities compound this risk (Wolf et al., 2023). Additionally, Stoecker et al. reported associations of lower annual household income and Black race with the prevalence of peripheral artery disease among CKD patients, adding to our understanding of the interplay between race, income, and health outcomes as a likely contributing factor (Stoecker et al., 2022). Moreover, Patel's study on comorbidities related to more severe outcomes of COVID-19 in CKD patients highlights the importance of personalized healthcare strategies that address these demographic differences (Patel, 2023).

Moreover, it is not possible to ignore the role of lifestyle factors in the progression of CKD. Research by Liu et al. showed that an inverted relationship between healthy lifestyle scores, including diet and physical activity, and CKD could indicate that lifestyle modification could be performed as preventive measures (Liu et al., 2022). Moreover, Patel's investigation into cardiorenal protective diets among African American adults suffering from CKD highlights the role of dietary modifications in CKD management, especially among underprivileged communities (Patel, 2024).

It applies especially to obesity-prone populations, as also pointed out by Sahi in their study that highlights a remarkably strong link between high body mass index (BMI) and the prevalence of CKD (Sahi, 2024). Therefore, encouraging healthy lifestyle choices is crucial for decreasing CKD risk in different populations. The psychological and cognitive aspects of CKD also deserve attention. Kim et al. stated that cognitive and academic challenges in children with CKD can also be exacerbated by their SES (Kim et al., 2022). This emphasizes the necessity for holistic and integrated care paradigms that encompass both the physical health of CKD patients and their mental and cognitive health. Moreover, as the QoL among CKD patients also demonstrated via Chaichana, it depends on the disease progression (Chaichana, 2024). Therefore, some interventions have to have developed so that the QoL could be improved for these patients (Chaichana, 2024). Additionally, the CKD prevalence has notable geographical disparities. In Thailand, a study showing spatial correlations for CKD and socioeconomic factors (Sansuk, 2024) illustrated the suggestion that areas with lower health resources endure CKD to a greater extent. This spatial analysis highlights that resource allocation and healthcare accessibility are significant factors for CKD control among the population. Likewise, Dávila-Cervantes highlighted the burden of CKD in Mexican women and the necessity of sex-specific health system strategies, noting that women often have different health outcomes and barriers to care compared with men (Dávila-Cervantes, 2024).

CKD is a complex health problem that impacts different populations along multiple demographic, socioeconomic, and clinical gradients. Data on CKD in different populations expose major differences regarding prevalence, prognosis, and risk factors. This synthesis seeks to elucidate these variations by combining the results and interactions between the

findings from several studies examining the effects of SES, comorbidities, and demographic characteristics on CKD patients.

The first one is SES, which has been recognized as an important risk factor for health outcomes in CKD patients. Pitino et al. proposed a simple SES composite index that accounts for both income and education highlights ideology, showing associations with worse clinical outcomes in patients with CKD (Pitino, 2024). This is in line with the research by Floria et al. that showed that socioeconomic factors are strong predictors of QoL among hemodialysis patients in Greece, according to which patients with a low socioeconomic position experience more difficulties regarding the management of their disease (Floria et al., 2022). Furthermore, Khalid et al. noted that children and adolescents with CKD who come from suboptimal SES face barriers in addition to the CKD-induced challenges that could potentially impact their educational performance and long-term well-being (Khalid et al., 2022). Together, these studies highlight the need to address socioeconomic disparities in efforts to improve health outcomes in CKD populations.

In addition, the prevalence of CKD differs greatly by ethnicity and other demographic factors. Patel's research suggests that African American individuals are more likely to develop CKD and are three times more likely than White individuals to require kidney replacement (Patel, 2024). This discrepancy mirrors the findings of Zhou, who explored the correlation between eGFR and CVD, finding that Black individuals have an increased risk of both diseases (Zhou, 2024). The key takeaways from these findings are the need for interventions at the public health level that would specifically address the unique challenges faced by these populations. This correlation between CKD and increased mortality in patients with common conditions, such as individuals with diabetes or patients with hypertension, is emphasized by the research of Bao et al., who showed that in patients treated for atrial fibrillation, those with CKD had a markedly raised risk of total mortality (Bao et al. 2022).

Regarding treatment modalities, conservative management versus RRT is still an important decision point in the management of CKD patients. Patients at the late stage of CKD encounter complex decisions involving RRT based on their health profile and socioeconomic background (Bundó, 2023). To add complexity, this is complicated by inequities in access to healthcare assets, as noted by Kim et al. on the QoL in patients with diabetic nephropathy, which was significantly affected by socioeconomic factors (Kim et al., 2022).

Patient engagement in the management of CKD is also of importance. For instance, Zeidalkilani's research focused on dialysis patients with diabetes and showed that improved HRQoL was linked to higher patient engagement levels, suggesting that empowering patients via education and support can improve outcomes (Zeidalkilani, 2024). This paradigm shift reflects the general trend within healthcare of moving toward treatment plans that embed patient-centered approaches,

which are critical elements in treating chronic, manageable but ultimately incurable disease states, such as CKD.

Comorbidities are one of the important determinants of the progression and management of CKD as well as socioeconomic and demographic factors. Joshi et al. reported a disturbing prevalence of CKD among type 2 diabetes mellitus patients in Nepal, with 86.6% of the diabetic population showing signs of CKD (Joshi et al., 2023). CKD and diabetes This reflects the intricate relationship between diabetes and CKD; control of diabetes would be expected to reduce the risk of CKD development. Similar to the results by Gao, who evaluated the relationship between CKD and osteoarthritis and found that risk factors common to both osteoarthritis and CKD, such as obesity and diabetes, contribute to the high prevalence of CKD in populations worldwide (Gao, 2024). In line with this, hypertension has been found to be the most common comorbidity in patients with CKD, and it was associated with the loss of kidney function (Nagib et al., 2023). A high prevalence of comorbidity is seen with CKD, and care strategies need to consider the need for treating comorbid diseases. CKD care often overlaps with other medical conditions, which can make the treatment more challenging and contribute to clinical outcomes. Metabolic syndrome has been associated with a higher risk of CKD, especially in low SES populations (Huang, 2024). This is consistent with Wu's findings, which show that smoking is a clear risk factor for CKD with important differences by sex and SES (Wu, 2024). An understanding of this intersection emphasizes the importance of targeted interventions to work both from a medical and a social determinant of health approach.

In addition, the demographic profile of CKD patients showed differences in prevalence and outcomes along the lines of race and sex. For instance, Wolf et al. identified that Black patient populations are at increased risk for CKD and its complications and that these populations have polypharmacy, undertreatment, and lack of screening for comorbidities (Wolf et al., 2023). The study by Stoecker et al. expanded our knowledge base by revealing a new relationship that included lower annual household income and Black race, significantly associated with increased prevalence of peripheral artery disease among patients with CKD as an example of the multifactorial knotted interplay between race, income, and health outcomes (Stoecker et al., 2022). Patel's exploration of other comorbidities that modify COVID-19 severity in patients with CKD draws attention to the need for healthcare strategies that are tailored to the demographic and clinical differences that characterize individuals with CKD (Patel, 2023).

Moreover, the role of lifestyle factors in the progression of CKD should not be neglected. Research by Liu et al. showed that a healthy lifestyle score, including diet and physical activity, is inversely associated with CKD risk and could guide prevention strategies (Liu et al., 2022). In addition, Patel's aforementioned study on the impact of a cardiorenal protective diet in adults with CKD, particularly among African American adults who are seen as particularly vulnerable to CKD, reinforces

the role dietary intervention may play in CKD management (Patel, 2024).

This is particularly important in populations that have an obesity epidemic, as demonstrated by Sahi's study, which showed a significant association between elevated BMI and CKD prevalence (Sahi, 2024). Hence, efforts to promote healthy lifestyle choices are important in decreasing the risk of CKD in different populations.

The psychological or cognitive aspects of CKD also deserve attention. Kim et al. reported that the academic and cognitive difficulties experienced by children with CKD were potentially worse in children from lower SES backgrounds (Kim et al., 2022). These findings underscore the need for integrated care pathways that address both physical and mental health and cognitive well-being concerns in CKD patients. Moreover, the QoL among CKD patients has shown variation according to the stages of CKD in the study, necessitating targeted and individualized interventions to improve patient experiences (Chaichana et al., 2024).

In addition, the prevalence of CKD varies significantly geographically. A study performed in Thailand by Sansuk showed spatial associations between CKD and socioeconomic factors, indicating that areas with fewer health resources are more affected by CKD (Sansuk, 2024). The spatial analysis highlights the need for resource allocation and access to healthcare for the effective management of CKD. These disparities highlight the necessity for gender-specific healthcare strategies, as women may have different health outcomes and face different barriers to care than men, as discussed in the recent study by Dávila-Cervantes on the burden of CKD in Mexican women (Dávila-Cervantes, 2024).

The impact of CKD is a considerable global health challenge that impacts heterogeneous populations in multifaceted ways. The description of CKD with respect to different demographics is a complex emerging relationship with socioeconomic, clinical, and lifestyle factors that impact the course and outcomes of the disease. Examining these factors in more depth will be important for creating targeted interventions and enhancing patient care.

One important topic of research is the role of socioeconomic differences in CKD. Although income is a significant component, the level of education, occupation, and healthcare resources also have a substantial impact on health outcomes. Limited education affects health literacy, which can interfere with the capacity of a patient to grasp and control his or her condition. Workplace risks, especially within sectors facing nephrotoxins, can lead to CKD. Furthermore, barriers to accessing high-quality medical care, including early detection and management of disease, can further worsen disparities and worsen outcomes. The complex manifold of intersectionality and its tapestry of overlapping social identifiers, including (but certainly not limited to) race, class, and gender, paints an even more complicated picture, producing distinct challenges for certain subpopulations of people with

CKD. For instance, people from marginalized communities may have to deal with several barriers to care, such as systemic racism and discrimination, as well as cultural insensitivity in the medical system.

Demographic characteristics are another determinant of CKD prevalence and outcomes. Certain racial/ethnic groups (e.g., Black and Indigenous people) are overrepresented among persons with CKD and complications. Contributing factors include genetic predisposition, environmental exposure, and systemic inequities in access to and quality of health care. There are also gender-related aspects of CKD that deserve mention. Men have a higher tendency to develop CKD, whereas different presentations of the disease, hormonal changes, and pregnancy can contribute to specific challenges for women living with CKD. Age is a vital demographic determinant, as CKD prevalence is higher in older populations. These demographic subtleties are crucial for targeting interventions and offering culturally appropriate care.

Lifestyle factors and comorbidities make it more difficult to manage CKD. Coexisting conditions (such as diabetes, hypertension, and CVD) are frequently reported with CKD, accelerating the disease's progress and increasing the risk of adverse outcomes. These comorbidities often have overlapping risk factors, including obesity and poor lifestyle behavior. Risk factors for developing CKD and its progression include smoking, poor dietary habits, and lack of physical activity. These modifiable risk factors emphasize the importance of lifestyle alterations, including healthier dietary habits, increased physical activity, and avoidance of tobacco, in the prevention of CKD and enhancement of patient QoL. In addition, the psychological and cognitive components of CKD cannot go unnoticed. CKD patients frequently suffer from depression, anxiety, and cognitive impairment, which can lead to QoL deterioration and poor treatment adherence. It is critical to integrate mental health support with CKD care for holistic patient management.

Geographic differences add another layer of complexity to CKD. Spatial analysis shows that the levels of CKD often relate to socioeconomic factors, in that those areas with lower income, education, and access to healthcare had higher rates of CKD. Disparities that need describing, data-crunching, and resource allocation to ensure equal access to quality care regardless of where the patients are located. Additionally, targeted interventions, including mobile health (mHealth) clinics and community-based programs, may help reach underserved populations and improve the outcomes for patients with CKD. In addition, knowing the exact environmental determinants of CKD risk according to geographic location (for example, exposure to industrial waste, pesticides, and other chemicals) would be essential for targeted prevention measures.

Examining Conflicting Points of View

Assessing opposing perspectives in the setting of CKD and related determinants may not be straightforward, considering the multitude of factors that lead to health inequities. In this synthesis, we will examine aspects of CKD epidemiology, comorbidities, socioeconomic factors, and cultural influences from diverse literature to highlight some polarized perspectives and emerging evidence as to the state of the art.

CKD is a major public health problem, with millions of people affected worldwide. The higher prevalence of CKD among certain populations points to CKD epidemiology that varies with explanations potentially including ethnicity, SES, and healthcare access. For example, according to Dhital's study on patients with systemic lupus erythematosus, Hispanic and Asian patients had a greater probability of being hospitalized than other ethnic groups, indicating that ethnicity can impact health outcomes in CKD patients (Dhital, 2023). In the UK, Patel's research found that comorbidities like obesity and hypertension constitute significant risk factors for CKD severity, especially amongst diverse ethnic groups (Patel, 2023). These results highlight the need to consider ethnic disparities when assessing CKD outcomes.

Furthermore, the associations between SES and CKD are well known. Research shows that decreased SES correlates with worse CKD outcomes. For example, Kim et al.'s socioeconomic characteristics are closely associated with the QoL in patients with diabetic nephropathy, thus highlighting the potential impact of such factors on the QoL in patients with diabetic nephropathy (Kim et al., 2022). Likewise, Pitino's findings reveal the substantial impact of a validated composite SES indicator on the health of CKD patients, underscoring the need to incorporate SES information in clinical settings (Pitino, 2024). A defining facet of CKD is its correlation with SES, which has been shown to affect health outcomes and care access. Studies have shown that individuals from lower SES backgrounds present a higher prevalence and severity of CKD, as reflected in studies quantifying the relationship between income and health status of CKD patients (Pitino, 2024; Kampmann et al., 2023).

Overall, these studies point to the importance of targeting SES disparities to enhance the management and outcomes of CKD. Similarly, Zhou et al. (2024) demonstrated a strong association between eGFR and CVD risk, whereas socioeconomic factors were found to be major contributors to various CVD risk factors, underpinning the need to acknowledge SES in the management of CKD. In addition, spatial associations between CKD prevalence and socioeconomic factors have been shown in studies from Thailand and Nicaragua, which suggest that health inequalities might be compounded by geographic and economic inequalities (Sansuk, 2024; Strasma, 2023). Moreover, we cannot ignore the role of environmental factors in CKD. The study by Kim regarding the effects of long-term ozone exposure and mortality in a cohort of CKD patients strongly suggests the importance of environmental health in chronic disease management (Kim, 2024).

Cultural perceptions and behaviors are also critically important in the management of CKD. Kim et al. investigated the effect of cultural and social factors on CKD patients' perception of their risk during the

COVID-19 pandemic, suggesting that people suffering from chronic diseases may be more anxious about the health risks they are facing (Kim et al., 2022). This cultural context has a significant impact on the engagement of patients with the available healthcare services as well as adherence to treatment regimens. Conversely, Sousa et al. highlighted the physiological dimensions of CKD, describing how chronic high blood pressure causes nephrosclerosis and deterioration of kidney function, positioning the disease within a biomedical model (Sousa et al., 2023). These diversions in the cultural and biomedical framework are cracking the nut in the organization of CKD, whereby the instance of where two frameworks meet requires the consideration of both the health-related and psychosocial aspects of cases for a comprehensive assessment.

Another contentious area is the relationship between lifestyle factors and CKD. Research by Liu et al. shows that a healthy lifestyle from childhood through adolescence is associated with a lower risk of subclinical kidney damage during midlife, providing evidence that early interventions might mitigate CKD risk (Liu et al., 2022). Furthermore, varying dietary approaches are being explored for promoting kidney health among subgroups, such as Patel's investigation of a cardiorenal protective diet in African American adults with CKD (Patel, 2024). This evidence highlights the potential role of lifestyle modifications in CKD management, which we believe should be included in the CKD management strategy to enhance patient outcomes.

Other evidence, such as that from Gao, may suggest otherwise by emphasizing an association between obesity and CKD, especially among women, indicating that lifestyle changes may be ineffective to reverse the underlying disease based on inherited susceptibility (Gao, 2024). These opposing views ⎵ highlight that integrated approaches targeting both lifestyle and intrinsic risk factors are required to implement CKD prevention and management targeting intrinsic and lifestyle risk factors.

Additionally, comorbidities have a profound effect on the progression of CKD. Diabetes and hypertension, both of which are common presentations of CKD, have been previously shown to greatly worsen CKD outcomes. For instance, Joshi et al. identified advancing age and the presence of hypertension, alone and in conjunction, as significant predictors of CKD prevalence in a Nepalese population, further supporting the concept that comorbidities are critical components of CKD risk assessments (Joshi et al., 2023). Another factor that has been studied is the relationship between obesity and CKD, with a higher BMI being associated with the risk of CKD, specifically at its higher stages (Sahi, 2024). Another point of contention is the influence of lifestyle factors on CKD progression. Other research has proposed lifestyle changes as an initial approach in tackling CKD, as it has been shown that dietary changes and physical activity have the potential to greatly enhance kidney function and general health (Kim et al., 2022; Roddy et al., 2022).

Moreover, the relationship between SES and health practices (i.e., diet and physical activity) adds a layer to the complexity of controlling CKD. Moreover, lower socioeconomic groups are often less able to access resources that promote a healthy lifestyle—though lifestyle is known to significantly predict better health outcomes for the kidneys (Liu et al., 2022; Huang, 2024). Moreover, SES and health behaviors, like diet and physical activity, interact with one another in a way that adds more complexity when trying to manage CKD. In addition, healthy determinants have been aligned with enhanced kidney health; however, lower socioeconomic groups may have poor income access to lifestyle-promoting resources (Liu et al., 2022; Huang, 2024). In contrast, Wu showed sexually dimorphic responses related to tobacco use in CKD in this ultimate disease outcome, where clinical factors related to tobacco risk must be interpreted with gender in mind (Wu, 2024). This diversity in emphasis highlights the multifaceted nature of CKD and the need for personalized strategies that align with each patient's unique attributes.

CKD management is also heavily influenced by cognitive and psychological factors. Patients with CKD may face challenges such as anxiety and depression, with negative impacts on compliance with therapeutic regimens and patient outcomes (Viriyapak et al., 2021). These differences also apply to healthcare access and quality in CKD care and outcomes. Research has demonstrated that racial and ethnic minorities are often less likely to receive optimal care, including underdiagnosed and less effective treatment (Matłosz et al., 2022). For example, the equations for eGFR for some populations are outdated, leading to the misclassification of kidney function and health disparities (Matłosz et al., 2022). The imperative to diverge from this approach originates from a need to address this kalash in clinical practice to ensure they are based on the best available evidence and specific to different populations.

Access to and quality of healthcare are also critical to consider in CKD outcome assessments. Previous studies suggest that inequities in healthcare access contribute to subdiagnosis and poor kidney health in patients with CKD. For example, Wolf et al. examined the risks of polypharmacy for geriatric patients with a focus on the need for individualized pharmacotherapy management to minimize renal impairment (Wolf et al., 2023). Conversely, Dávila-Cervantes' research demonstrates the toll of CKD in certain populations like Mexican women and indicates that cultural and systemic barriers to healthcare access exacerbate disparities (Dávila-Cervantes, 2024). The diversity of these findings highlights the complex and multifactorial nature of access to healthcare and management of CKD. NSAIDs and other drugs that can cause kidney harm significantly increase the risk of acute kidney injury (AKI) (Lin et al., 2021). Other studies have suggested the incorporation of PROMs into CKD care provision, where the dynamics of patient experience and QoL are captured to inform clinical management. Sala and Rodrigues assert that moving the focus toward validated PROMs can vitally improve the quality of care delivered

to CKD patients, thereby altering the paradigm of care to patient-centered (Sala and Rodrigues, 2022). This is consistent with the findings of Kim et al., who reported a relationship between QoL and different variables such as SES and comorbidities in patients with diabetic nephropathy (Kim et al., 2022).

In addition, the psychosocial and cognitive consequences of CKD are important areas of focus that could be addressed. Research has demonstrated that CKD negatively impacts cognitive ability and HRQoL, especially in children and adolescents. For instance, work by Kim et al. reported that pediatric patients with CKD have considerable cognitive and academic difficulties, which may be aggravated by socioeconomic deprivation (Kim et al., 2022). To address the necessity of multidimensional care approaches that consider not only the physical but also the psychological and educational requirements of CKD individuals.

One important component of CKD is its relationship with SES, which is associated with health outcomes and access to care. Lower SES is associated with greater prevalence and severity of CKD (Pitino, 2024; Kampmann et al., 2023). The relationship between SES and health outcomes is mediated by other factors, including education and income, that can modulate health literacy and access to preventive care (Stoecker et al., 2022).

Additionally, patient engagement is gaining attention in the management of CKD. Exemplifying the benefits of enhanced patient engagement, a study revealed better health outcomes for patients who are engaged in their treatment than for patients who are passive toward their care (Zeidalkilani, 2024). These views are consistent with the findings of Bundó on the significance of patient-centered care approaches for managing CKD, especially regarding conservative kidney management vs. RRT (Bundó, 2023). The data will simulate a series of treatments to find the optimal regimen that maximizes patient engagement with the treatment and minimizes the duration of the treatment program as a whole.

Additionally, the involvement of the patient and shared decision-making in the management of CKD is gaining recognition. According to Zeidalkilani (2024), this implies that patient active levels are associated with improved health outcomes; thus, it is imperative to design interventions that empower patients to actively participate in their healthcare.

Based on the conclusion, it will help healthcare providers to play a role as a facilitator and be inclined toward patient engagement strategies for self-management and adherence to treatment plans. On the other hand, others claim that concentrating on patient engagement alone can fail to consider the broader system issues that patients deal with, such as limited access and financial burdens, that can drastically influence the patient's ability to actively manage their condition (Qing, 2024).

This perspective aligns with the results of Bundó, who referred to the need for patient-centered care approaches in CKD management, in particular on the topic of conservative kidney management versus therapists

(Bundó, 2023). These findings imply that promoting patient engagement can result in enhanced adherence to treatment protocols and overall health outcomes. This resonates with the findings of Floria et al., who called for the use of PROMs to better identify and address QoL concerns among CKD patients (Floria et al., 2022). Standardized approaches in larger populations can also adjust interventions to best align with varying patient populations.

These obstacles are exacerbated by the complexity of CKD management and the necessity for multidisciplinary care. There is often a need for a collaborative approach involving multiple providers, such as nephrologists, dietitians, and social workers, to meet the various needs of patients with CKD (Guha et al., 2022). Patient navigator programs may serve a unique role to facilitate access to care and have already been shown to improve health outcomes in children with CKD, highlighting the value of comprehensive care models (Zwieten et al., 2022).

Indeed, studies such as Zeidalkilani's imply a relationship between patient involvement and better health outcomes, stressing the importance of empowering patients; however, a counterargument warns against too much emphasis on personal responsibility at the expense of a broader view of what drives health. This perception underplays the role of systemic barriers that could inhibit even the most motivated patient. Bundó's compelling treatise on patient-centered care in the arena of conservative vs. zone kidney management vs. RRT highlights the necessity for a synergistic stance, one that engages patient care as a modification to the renal multitude in RRT clinical practice and that must be articulated as a removal of a systemic element.

An additional critical area of discussion focuses on the role of PROMs in the routine management of CKD. PROMs are patient-reported outcome measures, and proponents like Sala and Rodrigues argue that they provide a more patient-centered approach by shifting the focus of quality of care toward patient experience and QoL. Such a concept concurs with the studies demonstrating a connection between QoL and SES and comorbidity factors, particularly in the field of diabetic nephropathy. This is data that is not purely clinical, which complements the clinical perspective and asserts the perspective of CKD patients in functioning, QoL, experience, etc.

The SES effect is also addressed, highlighting the strong impact SES has on CKD risk, progression, and outcomes. It has been well established in the literature that a lower SES is linked with poor health outcomes in CKD patients. Health literacy and access to preventive care are both dependent on education and income, which makes the SES to health equation more complex. Cumulative health status and health care use by CKD stage underscore the issue of health disparity in patients with CKD, emphasizing the need for interventions and policies that address disparities and ensure equitable access to quality care for all patients with CKD.

In CKD management, which is best done through a multidisciplinary approach with nephrologists,

dietitians, social workers, and others involved in healthcare, its complexity means it should be performed as globally as possible. Another successful strategy to enhance access to care and health outcomes, especially for children with CKD, is the implementation of patient navigator programs. The findings underscore the potential value of integrated care models that coordinate services across multiple domains to address the diverse needs of CKD patients.

Lastly, the text recognizes the psychological and cognitive consequences of CKD, especially for children and adolescents. Studies suggest that CKD impacts cognitive function and QoL, often in a way that is aggravated by socioeconomics. It emphasizes the importance of holistically treating the disease to suit the patients' physical, psychological, and educational needs. It is imperative that we adopt a holistic approach to addressing these many factors relevant to improving outcomes and reducing the overall burden of CKD.

Information Related to Interventions and Policies in CKD Patient

CKD is a major global health problem that is defined as a progressive loss of kidney function over time, which can progress to ESRD requiring RRT. The management of CKD is complex, incorporating individual health, socio-economic, and lifestyle factors, which may affect the outcome of the patients. This synthesis seeks to identify different interventions and policies in relation to CKD management by focusing on recent studies showing how SES and health behaviors impact clinical outcomes.

Particularly important for CKD care is the recognition of SES as a determinant of health outcomes. It acknowledges the significant role educational and economic factors play in determining clinical management and treatment success (Pitino, 2024), highlighting the need for robust SES indicators in assessing CKD patient health outcomes. These findings represent another step in the direction of confirming the results found by Sousa et al., which suggest that the health parameters in the Brazilian population and, in particular, that of hypertensives are inherently tied to socio-economic and surrounding conditions that trigger CKD progression (Sousa et al., 2023). This disparity is an important area of research, as it highlights the need for healthcare policies that promote equitable access to care and resources, thereby reducing the burden of CKD in disadvantaged communities.

QoL is an important factor in the management of CKD. Floria et al. showed that socio-economic, anthropometric, and nutritional factors are statistically significant determinants of the QoL of hemodialysis patients in Greece and concluded that interventions aiming to ameliorate these factors could improve patients' well-being (Floria et al., 2022). Likewise, Korea has recently introduced the Kidney Health Plan 2033 to tackle the growing burden of CKD by introducing prevention and management strategies that reflect socio-economic contexts (Kim, 2024). These types of initiatives are critical as health systems seek to improve patient outcomes and decrease the burden of

CKD-related morbidity and mortality. In addition, the authors cited that the study by Kim et al. in diabetic nephropathy naturally indicates that socioeconomic factors are also related to the QoL for patients with CKD and highlight the importance of comprehensive interventions targeting individual patient conditions (Kim et al., 2022). These findings should be integrated into policies targeting QoL enhancement to provide comprehensive care to CKD patients.

One promising approach to managing CKD, especially among patients with comorbidities such as diabetes, is through interventions that utilize technology, including mHealth applications. Roddy et al. tested the effectiveness of a delivered-by-text-message self-management support intervention, which significantly improved glycemic control in patients with established type 2 diabetes, potentially reducing the progression to CKD (Roddy et al., 2022). This underscores how innovative health technologies can drive improvements in patient engagement and adherence, which are critical for chronic condition management. The management of CKD must include interventions aimed at comorbidities. CKD patients present with comorbidities such as obesity, T2DM, and hypertension, highlighting the significance of developing holistic management approaches that target these co-existing conditions (Patel, 2023).

In addition, lifestyle factors relating to CKD progression cannot be overstated. Research has shown that lifestyle changes such as diet and exercise can greatly affect kidney health. These results highlight culturally sensitive dietary interventions, as they suggest that a cardiorenal protective diet can improve the prognosis of African Americans with CKD (Patel, 2024). This is further corroborated by the findings of Liu et al., which suggest that lifestyle choices made in childhood can have implications for kidney health in adulthood (Liu et al., 2022). This finding highlights the importance of lifestyle interventions woven into CKD management pathways.

Additionally, the geographical disparities in CKD prevalence and management should also be highlighted. Investigations have also found significant spatial associations with CKD and socioeconomic factors in Thailand (Sansuk, 2024), indicating a possible need for targeted interventions in areas with elevated disease burden. By leveraging such data-driven insights, we can develop targeted strategies that address the unique needs of diverse population segments, thereby optimizing interventions and improving resource allocation. These disparities underscore the need for policymakers to focus on equitable access to healthcare services, especially in high-risk, underserved communities, to prevent disparities from persisting. In addition, Kim's studies on long-term ozone exposure and the development of CKD further highlight how environmental health policy can protect kidney health (Kim, 2024).

Comorbidities also play an important role in the management of CKD. The presence of conditions such as hypertension and diabetes will add considerable complexity to the management of CKD and can

cause the outcomes to worsen. Joshi et al. reported a significant burden of CKD in individuals with T2DM and stressed the necessity of targeted screening and intervention strategies among this population (Joshi et al., 2023). In addition, the study from Bao et al. demonstrated the risk of increased mortality in patients with CKD with concurrent atrial fibrillation and highlighted the crucial role of judicious management of comorbid conditions in optimizing survival in patients with CKD (Bao et al., 2022).

The public health campaigns designed to increase awareness and access to care for patients with CKD will be important. Dhital's study on emergency department visits for systemic lupus erythematosus warns of these inequalities among some ethnic groups that often promote CKD outcomes (Dhital, 2023). It necessitates policies that support health equity and ensure that vulnerable populations receive adequate treatment and resources.

In addition, patient navigation programs have been identified as a potential mechanism to improve care coordination among patients with CKD. An example of the use of patient navigators for children is shown in the NAVKIDS2 trial (Guha et al., 2022), where the researchers found that patient navigators for children with CKD had a definite impact on children with social disadvantage. These programs can help to mitigate this by providing patients with timely interventions and support throughout their course of treatment. QoL considerations are critical in CKD management. Research by Stoecker et al. showed differences in QoL and health outcomes according to socioeconomic characteristics among CKD patients, suggesting that public health programs aimed at improving care are directed toward these people (Stoecker et al., 2022). QoL considerations are of utmost importance in the management of CKD, especially in its advanced stages. Sala and Rodrigues explain well how the emphasis on HRQoL in dialysis units demonstrates a move to more patient-centered CKD care (Sala and Rodrigues, 2022). This perspective aligns with findings from various studies that advocate for the inclusion of HRQoL measures in routine clinical assessments, ensuring that treatment plans are not solely focused on survival but also on enhancing the patient's overall well-being.

Besides clinical interventions, CKD management must also focus on addressing the social determinants of health. Research by Khalid et al. showcased the strong influence of socioeconomic determinants and their effect on academic performance in the pediatric CKD cohort and suggested that addressing these determinants early on may positively impact long-term health (Khalid et al., 2022). This reinforces the necessity for a holistic approach that not only provides medical treatment but also incorporates educational and community support interventions.

Another important topic is the association between CKD and CVD. Zhou's study highlights the need to pay close attention to cardiovascular risk factors in patients with decreased renal function, specific to notably low eGFR values (Zhou, 2024). These findings highlight the importance of integrated care approaches that target renal and cardiovascular well-being simultaneously, especially in high-risk groups. In addition, the study of Kim et al. emphasized that SES is significantly associated with cognitive and academic outcomes in pediatric patients with CKD, further reiterating that socioeconomic disparity can lead to inferior health outcomes (Kim et al., 2022).

Also, patient engagement has a vital role in CKD management. Zeidalkilani et al. (2024) found that patients with diabetes on hemodialysis, who showed higher levels of engagement, had better health outcomes, implying that patients with diabetes who are well empowered through education and support are engaged in the management of their condition. This reflects a larger movement toward patient-centered care, which emphasizes the need to engage patients in decisions about their treatment. This shows how important it is to empower patients by educating and supporting them, helping them take an active part in the decision-making process of their healthcare. In addition, the NAVKIDS2 trial highlights the role that patient navigator programs can play in aiding children with CKD, particularly those from socially disadvantaged backgrounds (Zwieten et al., 2022). These measures aim to address obstacles to obtaining healthcare services, such as socioeconomic and geographical factors, which in turn contribute to improved health outcomes.

One exposure and its impact on CKD patients underscore the importance of environmental health policies in safeguarding kidney health.

Comorbidities also play a crucial role in CKD management. CKD is further complicated by conditions such as hypertension and diabetes, which can lead to worse outcomes. The prevalence of CKD is particularly high among patients with type 2 diabetes, making this population an ideal target for screening and intervention strategies. Studies show a strong correlation between elevated mortality in patients with atrial fibrillation and CKD, emphasizing the need for careful management of comorbidities alongside the potential for improved prognosis with coexistent CKD.

Public health efforts are key to increasing the awareness and access to care among CKD patients. Research has shown differences in access to healthcare between ethnic groups, which may contribute to worse outcomes in CKD. This requires policies that support health equity, ensuring that vulnerable populations receive appropriate care and resources. Moreover, the establishment of a patient navigation program has been suggested to improve the coordination of care for pediatric patients with CKD who face social disadvantages.

For individuals with comorbid diseases, QoL is essential in the management of CKD. Patients with competing sodium intake and economic characteristics benefit greatly from care, and public health programs should serve this demographic; CKD patients with socioeconomic properties that would likely generate more care prior to research have significantly greater QoL and health outcomes. Focusing on HRQoL in dialysis facilities reflects a widely recognized shift toward patient-centered care. This correlates with

findings supporting the incorporation of HRQoL measures in routine clinical assessments, making certain treatment plans improve overall health, not just survival. The social determinants of health need to be addressed for CKD management to be successful. This study highlights the key role of socioeconomic determinants in the educational performance of children with CKD, emphasizing the importance of monitoring these determinants in early interventions that aim to improve long-term health outcomes in CKD.

CKD is another area of great importance as it relates to CVD. Research highlights the management of cardiovascular risk factors in reduced kidney function, with a focus on patients with low eGFR values. This highlights the necessity of integrated care models focusing on both renal and CVD, particularly in high-risk populations. In addition, studies show that cognitive and academic outcomes in children with CKD are strongly influenced by SES, which further emphasizes the role of SES in determining health outcome disparities.

Patient involvement in the management of CKD is also important. Higher levels of patient engagement are associated with improved health outcomes in hemodialysis patients with diabetes in studies. Well-educated patients with ongoing support can better manage their care. This is in line with a wider trend toward patient-centered care, which focuses on involving patients in treatment decisions. Patient navigator programs are also helpful in children with CKD, especially the socially disadvantaged, by overcoming barriers to healthcare services.

Finally, the management of CKD goes beyond renal issues and must include economic, nutrition, and comorbidity policy considerations. Policies focused on health equity, patient engagement through technology, and supportive care models to integrate need to be considered to optimize outcomes. With the increasing burden of global CKD, our healthcare systems must evolve to integrate evidence-based approaches to tackling the diverse aspects of this chronic disease.

This comprehensive literature review on the socioeconomic determinants of CKD identified key limitations in existing research and proposed a multifaceted approach to address these gaps. Through the utilization of standardized measures, unraveling the tangled web of socioeconomic influences, studying heterogeneous populations, and scrutinizing contrasting viewpoints, this research seeks to offer a more complex and thorough grasp of the socioeconomic determinants of CKD. These insights can guide the design of interventions and policies for the responsibility of the socioeconomic differences in the prevalence, outcomes, management, and progression of CKD and reduce the global burden of this debilitating disease.

Conclusion

The management of CKD requires a multidimensional approach beyond conventional therapy. It is important to do so when tackling the socioeconomic determinants of health, like poverty, education level, and access to resources that can lead to enhanced patient outcomes. These factors directly affect a patient's ability to maintain their condition, follow treatment plans, and access required medical care. The development of patient-centered medical home models that let patients be involved with the decisions about their own care is critical. Such support includes education to improve patient engagement and self-management skills. In addition, the identification and treatment of comorbidities, including hypertension and diabetes, are also important because these factors frequently complicate CKD and lead to poorer outcomes. Public health efforts to increase awareness, enhance access to care, and promote health equity are also vital for addressing disparities in CKD prevalence and outcomes between populations. Finally, applying supportive care models, patient navigation programs in particular, can assist in decreasing barriers to accessing healthcare services, particularly for vulnerable groups, such as children with CKD facing social disadvantage. These vary across nine topics to account for historical aspects, international influences and recommendations, compliance with guidelines, health resources, inequalities, and complexities in care; all contribute to improving QoL and health based on sound clinical therapy.

More research is needed to dissect the socioeconomic determinants and better understand potential confounding factors, as well as to be able to compare findings across studies through standardized measures and to include diverse populations to explore the nuances of the influence of these factors on CKD. Furthermore, discussing opposing views and assessing the available evidence can give a more nuanced view of a multilayered subject. In conclusion, this comprehensive review of the literature provides valuable insight into the socioeconomic factors driving CKD progression and underscores the need to prioritize integrated patient-centered services, with the potential to significantly impact patient outcomes and global health as a whole.

References

1. Bao, M., Shu, G., Chen, C., Chen, Y., Wang, J., and Wang, Y. (2022). Association of CKD with all-cause mortality in patients hospitalized for atrial fibrillation and impact of clinical and socioeconomic factors on this association. Frontiers in Cardiovascular Medicine, 9. https://doi.org/10.3389/fcvm.2022.945106
2. Bundó, D. (2023). Final stage of CKD with conservative kidney management or renal replacement therapy: a primary-care population study. Journal of Clinical Medicine, 12(14), 4602. https://doi.org/10.3390/jcm12144602
3. Chaichana, U. (2024). Quality of life in children at different stages of CKD in a developing country. Pediatric Nephrology, 40(1), 177-187. https://doi.org/10.1007/s00467-024-06442-1
4. Dhital, R. (2023). Epidemiology and outcomes of emergency department visits in systemic lupus erythematosus: insights from the nationwide

emergency department sample (neds). Lupus, 32(14), 1646-1655. https://doi.org/10.1177/09612033231215381

5. Dávila-Cervantes, C. (2024). Revealing the burden of CKD in Mexican women, 1990–2021. BMC Nephrology, 25(1). https://doi.org/10.1186/s12882-024-03797-3

6. Floria, I., Κοντελέ, I., Grammatikopoulou, M., Sergentanis, T., and Vassilakou, T. (2022). Quality of life of hemodialysis patients in Greece: associations with socio-economic, anthropometric and nutritional factors. International Journal of Environmental Research and Public Health, 19(22), 15389. https://doi.org/10.3390/ijerph192215389

7. Gao, K. (2024). Is CKD associated with osteoarthritis? the united states national health and nutrition examination survey 2011–2020. BMC Nephrology, 25(1). https://doi.org/10.1186/s12882-024-03672-1

8. Guha, C., Khalid, R., Zwieten, A., Francis, A., Hawley, C., Jaure, A., and Wong, G. (2022). Baseline characteristics of participants in the navkids2 trial: a patient navigator program in children with chronic kidney disease. Pediatric Nephrology, 38(5), 1577-1590. https://doi.org/10.1007/s00467-022-05772-2

9. Huang, S. (2024). Metabolic syndrome and socioeconomic status in association with chronic kidney disease: a cross-sectional study in Ningbo, China. Diabetes Metabolic Syndrome and Obesity Targets and Therapy, Volume 17, 3891-3901. https://doi.org/10.2147/dmso.s473299

10. Jones, T., Patel, R., Elwenspoek, M., Watson, J., Mann, E., Alsop, K., and Whiting, P. (2022). Variation in laboratory testing for patients with long-term conditions: a longitudinal cohort study in UK primary care. BJGP Open, 7(1), BJGPO.2022.0139. https://doi.org/10.3399/bjgpo.2022.0139

11. Joshi, R., Subedi, P., Khadka, S., Rijal, T., Amgain, K., and Rajbhandari, S. (2023). Prevalence and risk factors of CKD among patients with type 2 diabetes mellitus at a tertiary care hospital in Nepal: a cross-sectional study. BMJ Open, 13(2), e067238. https://doi.org/10.1136/bmjopen-2022-067238

12. Kampmann, J., Heaf, J., Mogensen, C., Mickley, H., Wolff, D., and Brandt, F. (2023). Prevalence and incidence of CKD stage 3–5 – results from KIDDICO. BMC Nephrology, 24(1). https://doi.org/10.1186/s12882-023-03056-x

13. Khalid, R., Zwieten, A., Kim, S., Didsbury, M., Francis, A., McTaggart, S., and Wong, G. (2022). Association between socioeconomic status and academic performance in children and adolescents with chronic kidney disease. Pediatric Nephrology, 37(12), 3195-3204. https://doi.org/10.1007/s00467-022-05515-3

14. Kim, D. (2024). Kidney health plan 2033 in Korea: bridging the gap between the present and the future. Kidney Research and Clinical Practice, 43(1), 8-19. https://doi.org/10.23876/j.krcp.23.232

15. Kim, E. (2024). Long-term ozone exposure and mortality in patients with CKD: a large cohort study. BMC Nephrology, 25(1). https://doi.org/10.1186/s12882-024-03500-6

16. Kim, H., Lee, J., Choi, G., Jeong, H., Kim, S., Gu, J., and Oh, K. (2022). Quality of life in patients with diabetic nephropathy: findings from the KNOW-CKD (Korean cohort study for outcomes in patients with chronic kidney disease) cohort. Kidney Research and Clinical Practice, 41(1), 43-57. https://doi.org/10.23876/j.krcp.21.068

17. Kim, S., Zwieten, A., Lorenzo, J., Khalid, R., Lah, S., Chen, K., and Wong, G. (2022). Cognitive and academic outcomes in children with chronic kidney disease. Pediatric Nephrology, 37(11), 2715-2724. https://doi.org/10.1007/s00467-022-05499-0

18. Kim, Y., Lee, I., Lee, J., Park, S., An, J., Yoo, K., and Lee, J. (2022). First snapshot on behavioral characteristics and related factors of patients with CKD in South Korea during the covid-19 pandemic (June to October 2020). Kidney Research and Clinical Practice, 41(2), 219-230. https://doi.org/10.23876/j.krcp.21.065

19. Lin, S., Phillips, T., Culliford, D., Edwards, C., Holroyd, C., Ibrahim, K, and Fraser, S. (2021). Characterising risk of non-steroidal anti-inflammatory drug-related acute kidney injury: a retrospective cohort study. BJGP Open, 6(1), BJGPO.2021.0208. https://doi.org/10.3399/bjgpo.2021.0208

20. Liu, C., Tian, J., Jose, M., He, Y., Dwyer, T., and Venn, A. (2022). Associations of a healthy lifestyle score from childhood to adulthood with subclinical kidney damage in midlife: a population-based cohort study. BMC Nephrology, 23(1). https://doi.org/10.1186/s12882-021-02627-0

21. Matłosz, B., Skrzat-Klapaczyńska, A., Antoniak, S., Balayan, T., Begovać, J., Dragović, G., and Kowalska, J. (2022). CKD and nephrology care in people living with HIV in central/eastern Europe and neighbouring countries—cross-sectional analysis from the ECEE network. International Journal of Environmental Research and Public Health, 19(19), 12554. https://doi.org/10.3390/ijerph191912554

22. Nagib, S., Abdelwahab, S., Amin, G., and Allam, M. (2023). What is the prevalence of CKD among hypertensive non-diabetic Egyptian patients attending primary healthcare? Clinical and Experimental Hypertension, 45(1). https://doi.org/10.1080/10641963.2023.2203411

23. Patel, M. (2024). Metabolomic and physiological effects of a cardiorenal protective diet intervention in African American adults with chronic kidney disease. Metabolites, 14(6), 300. https://doi.org/10.3390/metabo14060300

24. Patel, R. (2023). Comorbidities associated with the severity of covid-19, and differences across ethnic groups: a UK biobank cohort study. BMC Public Health, 23(1). https://doi.org/10.1186/s12889-023-16499-6

25. Pitino, A. (2024). Socioeconomic status and clinical outcomes in chronic kidney disease: bootstrap validation of a simple indicator. Journal of Clinical Medicine, 13(12), 3600. https://doi.org/10.3390/jcm13123600

26. Qing, J. (2024). Mendelian randomization analysis revealed that albuminuria is the key factor affecting socioeconomic status in CKD patients. Renal Failure, 46(2). https://doi.org/10.1080/0886022x.2024.2367705

27. Roddy, M., Mayberry, L., Nair, D., and Cavanaugh, K. (2022). Exploring mHealth potential to improve kidney function: secondary analysis of a randomized trial of diabetes self-care in diverse adults. BMC Nephrology, 23(1). https://doi.org/10.1186/s12882-022-02885-6

28. Sahi, G. (2024). Prevalence, characteristics, and outcomes of people with a high body mass index across the kidney disease spectrum: a population-based cohort study. Canadian Journal of Kidney Health and Disease, 11. https://doi.org/10.1177/20543581241293199

29. Sala, I. and Rodrigues, A. (2022). Eq-5d in dialysis units: a prom with a view. Bulletin De La Dialyse À Domicile, 5(4), 33-41. https://doi.org/10.25796/bdd.v4i4.69733

30. Sansuk, J. (2024). Spatial associations between CKD and socio-economic factors in Thailand. Geospatial Health, 19(1). https://doi.org/10.4081/gh.2024.1246

31. Sousa, L., Silva, N., Azeredo, C., Rinaldi, A., and Silva, L. (2023). Health-related patterns and CKD in the Brazilian population: national health survey, 2019. Frontiers in Public Health, 11. https://doi.org/10.3389/fpubh.2023.1090196

32. Stoecker, J., Cohen, J., Belkin, N., Chen, J., Townsend, R., Xie, D., and Wang, G. (2022). Socioeconomic characteristics of those with peripheral artery disease in the chronic renal insufficiency cohort. Vascular, 31(1), 39-46. https://doi.org/10.1177/17085381211053492

33. Strasma, A. (2023). Kidney disease characteristics, prevalence, and risk factors in León, Nicaragua: a population-based study. BMC Nephrology, 24(1). https://doi.org/10.1186/s12882-023-03381-1

34. Viriyapak, E., Chantaratin, S., Sommai, K., Sumboonnanonda, A., Pattaragarn, A., Supavekin, S., and Chaiyapak, T. (2021). Prevalence of cognitive dysfunction and its risk factors in children with CKD in a developing country. Pediatric Nephrology, 37(6), 1355-1364. https://doi.org/10.1007/s00467-021-05280-

35. Wolf, U., Ghadir, H., Drewas, L., and Neef, R. (2023). Underdiagnosed CKD in geriatric trauma patients and potent prevention of renal impairment from polypharmacy risks through individual pharmacotherapy management (IPM-iii). Journal of Clinical Medicine, 12(13), 4545. https://doi.org/10.3390/jcm12134545

36. Wu, N. (2024). Sexually dimorphic response to tobacco in the development of chronic kidney disease: a systematic review. BMC Nephrology, 25(1). https://doi.org/10.1186/s12882-024-03845-y

37. Zeidalkilani, J. (2024). Factors associated with patient activation among patients with diabetes on haemodialysis: a multicenter cross-sectional study from a developing country. BMC Nephrology, 25(1). https://doi.org/10.1186/s12882-024-03674-z

38. Zhou, C. (2024). The nonlinear relationship between estimated glomerular filtration rate and cardiovascular disease in us adults: a cross-sectional study from NHANES 2007–2018. Frontiers in Cardiovascular Medicine, 11. https://doi.org/10.3389/fcvm.2024.1417926

39. Zwieten, A., Ryan, E., Howard, K., Tong, A., Craig, J., Alexander, S., and Wong, G. (2022). Navkids2 trial: a multi-centre, waitlisted randomised controlled trial of a patient navigator intervention in children with CKD statistical analysis plan and update to the protocol. Trials, 23(1). https://doi.org/10.1186/s13063-022-06783-y