Revista de Ensino de Ciências e Matemática
ONLINE ISSN 2178-7727
ULBRA

INVESTIGATION OF THE VARIED RISK FACTORS FOR CHRONIC KIDNEY DISEASE, INCLUDING ATHLETIC GROUPS

Keisham Alex Singh
Department of Physical Education and Sports Science, Manipur University
Prof. Maibam Chourjit Singh
Department of Physical Education and Sports Science, Manipur University
Dr. Langonjam Chingkheinganba Meitei
Department of Education, Manipur University

Received: 10th July, 2025
Revised &Accepted: 15th November 2025
Published: December, 2025
DOI: https://doie.org/10.65985/AS.2026928910

Abstract: Chronic Kidney Disease (CKD) represents a significant global health burden, with a complex interplay of factors contributing to its development and progression. This paper examines the multifaceted nature of CKD, encompassing lifestyle, social, environmental, and occupational influences. Globally, CKD prevalence is substantial, with notable regional variations. Established risk factors such as hypertension, acute kidney injury, and diabetes mellitus are explored, alongside emerging concerns like the impact of SARS-CoV-2 infection on renal function. A significant focus is placed on modifiable lifestyle factors, including dietary habits (high sodium and animal protein intake), smoking, alcohol consumption, and physical activity. Social determinants, encompassing socioeconomic status, access to healthcare, and environmental conditions, are also examined, highlighting their crucial role, particularly in vulnerable populations. The impact of environmental nephrotoxicants, including heavy metals, air pollution, and PFAS chemicals, is discussed, emphasizing the need for public health interventions. Furthermore, this paper addresses the specific risks faced by athletes, where high-intensity training, rapid weight loss practices common in combat sports, high-protein diets, and the use of performance-enhancing substances can significantly increase the risk of acute kidney injury and long-term renal damage (*gym nephropathy*). The paper concludes by underscoring the need for comprehensive strategies that address the diverse risk factors for CKD, including targeted interventions for specific populations like athletes, to mitigate the global burden of this disease.

Keywords: Chronic kidney disease, risk factors, environment, athletes, nephrotoxicity.

Introduction:

A number of conditions affecting the structure and function of the kidney are collectively referred to as chronic kidney disease (CKD). The highest prevalence of chronic kidney disease was found in Eastern and Central Europe (12.8%, 11.9–14.1), with a global median prevalence of 9.5% (Interquartile Range 5.9–11.7) (Bello, A. K., et al., 2024). Kidney disease is one of the most common health problems, it is associated with extreme pain and discomfort in patients. Kidney failure can be fatal. Globally, >10% of the general population is affected by chronic kidney disease (CKD), and millions die. The most recent available data indicates that CKD is the direct cause of one (1) out of 57 fatal outcomes and has caused approximately one million fatalities globally, totalling around 800 million people (Kovesdy C. P., 2022). Chronic kidney disease (CKD) is influenced by a multitude

ISSN:1517-4492 | **E-ISSN**:2178-7727

of factors, including lifestyle choices, social determinants, environmental influences, and specific health conditions (Lv, J. C., & Zhang, L. X., 2019; Elshahat, S., et al., 2020; Wong, G., Bernier-Jean, A., et al. 2024; Francis, A., Harhay, et al. 2024).

The following sections outline some key aspects affecting kidney health:

Factors affecting kidney health include a history of hypertension, acute kidney disease, renal stones, and anemia (Ameer O. Z., 2022; De Bhailis, Á. M., & Kalra, P. A., 2022; Anand, S., et al. 2025). Additionally, procedures like open kidney surgery and extracorporeal shock wave lithotripsy can decrease kidney function, increasing the likelihood of chronic kidney disease (Sabri, N. W., et al., 2022).

The novel coronavirus (SARS-CoV-2) primarily targets the respiratory system but also significantly impacts the kidneys due to the presence of angiotensin-converting enzyme type 2 (ACE2) and transmembrane serine protease 2 (TMPRSS2) in kidney tissues. The mechanisms of kidney damage include direct cytopathic effects of the virus on kidney cells, cytokine storms, damage to the renin-angiotensin-aldosterone system, and *immunothrombosis* (Utkina et al., 2023). The study emphasizes the need for further research to understand these mechanisms and develop effective treatments.

Lifestyle Factors

Lifestyle factors affecting kidney health include diet (high sodium and protein from animal sources worsen function, while plant-based diets may protect), smoking, excessive alcohol consumption, and chronic stress, which can all exacerbate kidney disease. (Anandh, U., et al. 2022;). Smoking and excessive alcohol consumption are significant contributors to CKD progression (Sahu et al., 2024). High sodium and protein intake, particularly from animal sources, worsen kidney function, while plant-based diets may offer protective benefits (Cirillo et al., 2023; Sahu et al., 2024). Factors affecting kidney function include lifestyle habits such as smoking, which increases the risk of reduced estimated Glomerular filtration rate (eGFR), and physical exercise, which is associated with decreased odds of reduced eGFR in older adults (Chang, H. J., et al., 2020). Regular exercise improves kidney function, whereas a sedentary lifestyle is linked to decline (Cirillo, M., et al., 2023; Sahu et al., 2024).

Cirillo et al. (2023) investigates the impact of various modifiable factors on kidney function over time. The study included 3039 adult participants from the Gubbio study, who were assessed at baseline and after a 15-year follow-up. The factors analyzed were physical activity, alcohol intake, protein intake, sodium intake, and potassium intake, with kidney function measured as estimated glomerular filtration rate (eGFR). The results were consistent across various subgroups, including different age groups, genders, and health statuses (Kuma, A., & Kato, A., 2022; Mallamaci, F., & Tripepi, G., 2024).

Social Determinants

Key factors affecting kidney health include socioeconomic status, housing conditions, access to healthcare, education, environmental conditions, and legal framework (Zeng, X., et al. 2018; Quiñones, J., & Hammad, Z., 2020; Anandh, U., et al. 2022;). Additionally, political stability and climate change significantly influence the prevalence and progression of kidney diseases, particularly in lower-income settings. Factors such as income, education, and housing conditions significantly impact kidney health, especially in vulnerable populations (Plantinga L. C., 2013; Zeng, X., et al, 2018). Legal frameworks ensuring universal healthcare and equitable treatment are vital for effective kidney care (Anandh et al., 2022).

ISSN:1517-4492 | **E-ISSN**:2178-7727

Aoun, M., & Chelala, D. (2022) examine the impact of geographic location on the environment and its potential implications for kidney health. They demonstrate that the epidemiology of chronic kidney disease (CKD), healthcare accessibility, and outcomes for CKD patients differ based on their geographical location. Residing at elevated altitudes has been linked to proteinuria, hypertensive crises, acute kidney injury (AKI), and the progression of chronic kidney disease (CKD). Exposure to low temperatures elevates the risk of hypertensive incidents and indirectly impacts renal function, while exposure to high temperatures heightens the risk of dehydration and acute kidney injury (AKI). Seasonality and climate change are significant emerging factors that affect kidney health and exacerbate kidney diseases, including lupus nephritis. The influence of occupation on the renal health of workers was examined in relation to social, temporal, and geographical factors. The association of nephrotoxins, infections, and pollutants as risk factors for the development of kidney disease was well established. A novel form of occupational kidney disease, referred to as CKD of non-traditional origin (CKDnT), has been identified in agricultural workers exposed to contaminated water, as observed in Sri Lanka, or to heat stress and dehydration in Central America. Comparable forms of occupational kidney disease have been documented in other regions.

Environmental nephrotoxic factors affecting kidney health include metals (like arsenic, cadmium, lead, mercury, and uranium), air pollution, and exposure to non-metals. These factors can lead to chronic kidney disease (CKD) and other adverse kidney outcomes. Exposure to nephrotoxic substances, including heavy metals and air pollutants, is associated with increased CKD risk (Kikvadze & Gorgadze, 2023). Hot climates exacerbate kidney disease prevalence, with environmental changes leading to higher rates of acute kidney injury (Anandh et al., 2022). Factors affecting kidney health include age, dyslipidemia, diabetes mellitus, uncontrolled blood pressure and blood sugar levels, excessive salt intake, non-steroidal anti-inflammatory drug use, lack of exercise, consumption of toxic herbal plants, edema, foamy urine, and nocturia

Exposure to chemical

Exposure to PFAS (*perfluoroalkyl or polyfluoroalkyl substances*) chemicals in young adulthood has been associated with poor kidney function and kidney disease (Niu, Z., et al., 2024). Commonly referred to as "forever chemicals" due to their prolonged persistence in both the human body and the environment, these substances are extensively utilized in everyday items such as food packaging, paint, cookware, and stain- and water-repellent textiles

In recent years, PFAS has emerged as a critical global public health concern, by various health agencies including the World Health Organization (WHO). Multiple studies have demonstrated that PFAS can negatively affect human health, studies revealed that those with increased PFNA exposure exhibited significantly higher uric acid levels (Yang, Z., et al., 2023; Niu, Z., et al., 2024), encompassing metabolic disorders (Wen, F., et al., 2023), neurodevelopmental concerns (Zhou, Y., et al., 2023), cancer (Steenland, K., & Winquist, A., 2021), reproductive system issues (Rickard, B. P., et al., 2022), and epigenetic alterations, cardiovascular disease, mental health disorders (Kim, S., et al., 2021; Brown-Leung, J. M., & Cannon, J. R., 2023; Dunder, L., et al., 2023).

Hydrocarbon exposure has been linked to non-communicable diseases, including CKD, mostly as an occupational risk. The risk of presenting CKD by the environmental exposure to hydrocarbons link to kidney disease (Okoye, O. C., & Awunor, N., 2022). Exposure to environmental chemicals has significant implications for kidney health,

ISSN:1517-4492 | **E-ISSN**:2178-7727

particularly through mechanisms of nephrotoxicity and chronic kidney disease (CKD). Various studies highlight the detrimental effects of toxicants such as phthalates, bisphenol A, and heavy metals on renal function, emphasizing the need for awareness and preventive strategies.

Common nephrotoxicants include phthalates, microplastics, and bisphenol A, which can accumulate in the kidneys and lead to inflammation and oxidative stress (Yadav et al., 2024). Acute high-level exposures, such as lead poisoning, can cause immediate kidney injury, while chronic low-level exposures are linked to the progression of CKD (Weidemann, D. K., et al., 2024). Endocrine Disrupting Chemicals (EDCs) like MEHP have been associated with increased urinary albumin-to-creatinine ratios, indicating renal impairment (Chen, Chun-Yu., et al., 2024). They can also alter gut microbiota, exacerbating kidney inflammation (Ramya, Ranjan, Nayak, S. P., et al., 2023). Research indicates that exposure to organic pollutants correlates with declining kidney function over time, particularly in individuals with pre-existing CKD (Charytan, D. M., et al., 2023).

There are also several ways that environmental exposures can affect kidney health, both directly and indirectly. Ingestion or breathing of pollutants from the air, water, and soil through the skin. When These contaminants enter the bloodstream to varied degrees, then they reach the kidneys and cause direct harm. Certain substances enter the bloodstream through the gastrointestinal tract and then go through metabolism in the liver. By resulting in diseases like diabetes and hypertension, which are known risk factors for incident or progressive CKD, certain exposures may also indirectly cause kidney disease. Diabetes mellitus (Kshirsagar, A. V., et al. 2022).

Chronic kidney disease (CKD) is linked to exposure to environmental pollutants, especially metals like cadmium and mercury, as well as perfluoroalkyl substances (PFAS). This underscores the necessity of public health initiatives to counteract these cumulative effects on kidney health (Haruna, I., & Obeng-Gyasi, E., 2024). Exposure to environmental chemicals during pregnancy, such as BPA, PFAS, and dioxins, impacts kidney development, resulting in fewer nephrons and higher risks of kidney disease and hypertension in the offspring (Hsu, C.-N., & Tain, Y.-L., 2021; Bello, A. K., et al., 2024). Despite the established links between chemical exposure and kidney health, some argue that the effects may vary based on individual susceptibility and environmental factors, necessitating further research to understand these complex interactions.

Global incidence on Kidney related cases:

Figure 1. (A) Incidence of kidney transplantation, (B) Incidence of deceased-donor kidney transplantation. (C) Incidence of living-donor kidney transplantation. (D) Incidence of pre-emptive kidney transplantation is reported as cases pmp per year (pmp=per million population).

ISSN:1517-4492 | **E-ISSN**:2178-7727

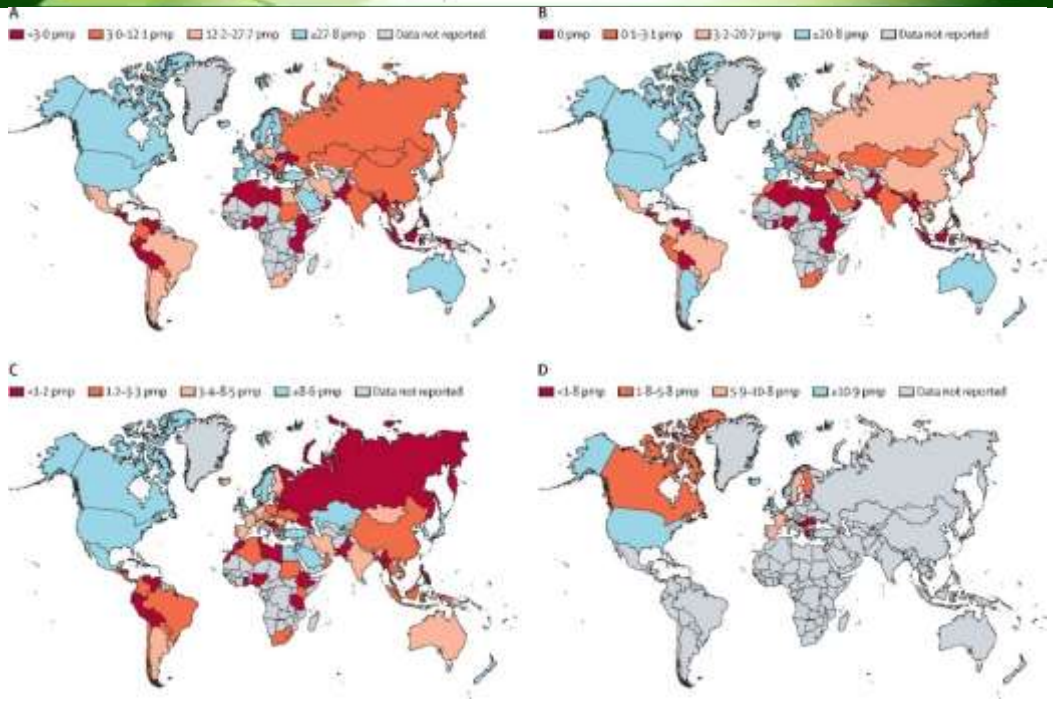

Figure 1: *Global incidence on kidney related cases.*
Credit: Stanifer, J. W., Muiru, A., Jafar, T. H., & Patel, U. D. (2016). Chronic kidney disease in low-and middle-income countries. *Nephrology Dialysis Transplantation, 31*(6), 868-874.

Figure 2: Global rate of death due to chronic kidney disease, it's prevalence and incidence rate of all ages and also from both genders.

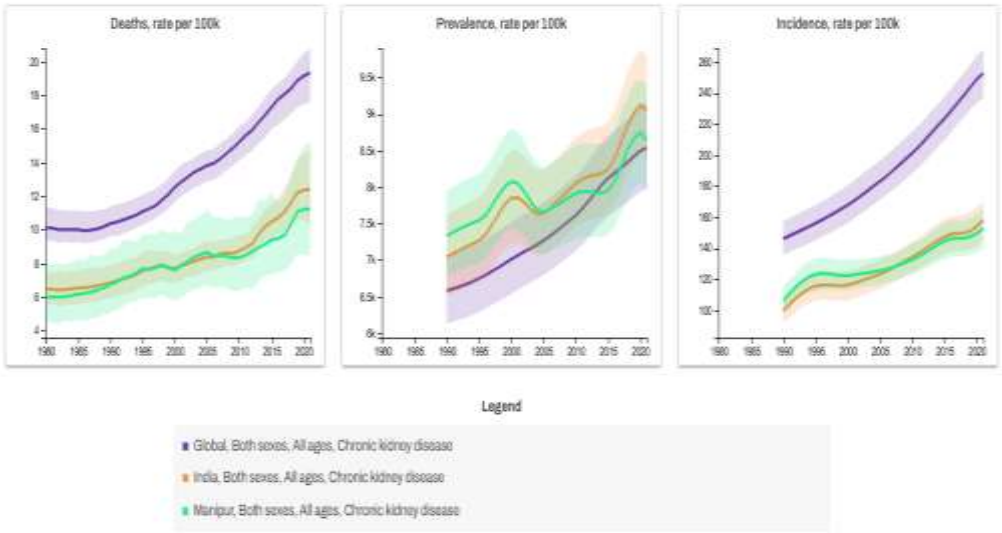

Figure 2 Global rate of death due to chronic kidney disease, it's prevalence and incidence rate.
Global Burden of Disease Collaborative Network. (2022). *Global Burden of Disease Study 2021 (GBD 2021) results*. Institute for Health Metrics and Evaluation (IHME). Available from https://vizhub.healthdata.org/gbd-results/.

ISSN:1517-4492 | **E-ISSN**:2178-7727

Table 1: Rate of death due to chronic kidney disease.			
Causes	Location	Year	Value
Chronic kidney disease	Global	2019	18.88461
	Global	2020	19.16875
	Global	2021	19.35839
	India	2019	12.21194
	India	2021	12.41695
	India	2020	12.36959
	Manipur	2019	11.08354
	Manipur	2021	11.23757
	Manipur	2020	11.21679

Table 1 showing the Global, India and Manipur rate of death due to chronic kidney disease.

Table 2: Prevalence of chronic kidney disease			
	Location	Year	Value
Chronic kidney disease	Global	2019	8421.767
	Global	2020	8496.9
	Global	2021	8537.48
	India	2019	9011.085
	India	2020	9124.345
	India	2021	9051.422
	Manipur	2019	8661.514
	Manipur	2020	8750.513
	Manipur	2021	8641.05

Table 2 showing the Global, India and Manipur rate of prevalence of chronic kidney disease.

Table 3: Incidence of chronic kidney disease			
Causes	Location	Year	Value
Chronic kidney disease	Global	2019	243.7516
	Global	2020	248.8985
	Global	2021	252.6187
	India	2019	151.1021
	India	2020	154.2115
	India	2021	158.07
	Manipur	2019	147.5071
	Manipur	2020	149.5509
	Manipur	2021	152.7848

Table 3 showing the Global, India and Manipur rate of chronic kidney disease incidence.

ISSN:1517-4492 | **E-ISSN**:2178-7727

The global prevalence of chronic kidney disease (CKD) is significantly increasing. Studies reveals significant disparities in availability, accessibility, quality, and affordability of kidney care, including medicines, kidney replacement therapy (KRT), and conservative kidney management (CKM). The need for equitable access to kidney care is highlighted, with policy implications for achieving this goal. The highest prevalence of chronic kidney disease was found in Eastern and Central Europe (12.8%, 11.9–14.1), with a global median prevalence of 9·5% (Interquartile Range 5.9–11.7) (Bello, A. K., et al., 2024).

Athletes and kidney problems:

High-intensity training, dietary habits, and substance use are some of the factors that put athletes at risk for kidney-related problems. Maintaining kidney health in athletes requires an understanding of these risks. High-intensity training, dietary habits, and substance use put athletes at serious risk for kidney-related problems. Acute kidney injury (AKI) and other renal complications can result from these factors, especially in bodybuilding, combat sports, and ultra-endurance events.

Athletes are much more likely to develop kidney-related issues if they engage in high-intensity training (HIT), have poor eating habits, or use drugs. According to research, acute kidney injury (AKI) can result from rapid weight loss, which is typical in combat sports, because it raises renal function markers like creatinine and blood urea nitrogen (Drid, P., et al., 2023). A significant portion of athletes experienced AKI after engaging in high-intensity workouts like CrossFit, which have also been connected to temporary renal impairment (Nunes Filho, J. C. C., 2022; Kodikara, P., 2023). Additionally, through processes like glomerular hyperfiltration, high-protein diets—which are common among athletes—cause long-term kidney damage (Cho, E., et al., 2022). Risks associated with ultra-endurance events also include kidney injury exacerbated by non-steroidal anti-inflammatory drug use and dehydration (Tidmas, V., et al., 2022).

Rapid weight loss (RWL) is prevalent among combat athletes, with studies showing a 5% average weight loss linked to increased kidney function markers such as blood urea nitrogen and creatinine. High-intensity training combined with RWL significantly elevates the risk of kidney function decline (Drid, P., et al., 2023).

Athletes frequently consume high-protein diets (HPDs), which may cause glomerular hyperfiltration and chronic kidney damage, according to research (Cho, E., et al., 2022). Due to their dietary habits and substance use, bodybuilders are especially susceptible to diseases like focal segmental glomerulosclerosis and acute tubular necrosis (Tidmas, V., et al., 2022). By stimulating the renin-angiotensin-aldosterone system, dehydrating the body, and causing renal inflammation, high-intensity exercise, high-protein diets, and substance use, such as anabolic steroids and diuretics, can all lead to gym nephropathy and raise the risk of kidney-related issues (Moonesan, M. R., 2023). Anabolic steroids and non-steroidal anti-inflammatory drug (NSAID) use are also associated with a higher risk of AKI, especially in ultra-endurance athletes. Kidney health problems are made worse by dehydration and the abuse of diuretics (Tidmas, V., et al., 2022; Tidmas, V., et al., 2024).

Athletes who engage in high-intensity training and misuse nutritional and nonnutritional supplements, such as vitamins and anabolic steroids also develop kidney damage, known as "gym nephropathy," underscoring the grave dangers of these behaviors (Gawad, M., & Kalawy, H., 2019). Studies also highlights the substantial risks for kidney-related issues resulting from bodybuilders' use of growth hormone (GH), anabolic androgenic steroids

ISSN:1517-4492 | **E-ISSN**:2178-7727

(AAS), and high-protein diets. These practices are also linked to a number of renal diseases (El-Reshaid, W., et al. 2018; Ali, A. A., et al. 2020; Ozkurt, S., et al. 2023).

The fact that some athletes may also be able to maintain kidney health through appropriate hydration and customized nutritional strategies, despite the significant risks associated with these factors, underscores the importance of personalized approaches to athlete care.

Conclusion:

To reduce the worldwide burden of CKD, it is imperative to underline the need of thorough programs that handle the several risk factors for this condition, including focused interventions for certain groups. Healthcare professionals and legislators must work together to create customized treatment and preventive strategies and requirements into account. Athletes can keep their performance standards and general health by supporting early CKD diagnosis and management. Athletes can also lower their risk of CKD by increasing knowledge of the need of routine renal tests and by changing their lifestyles.

References:

Ahmed, M. M., & Singh, K. P. (2011). Traditional Knowledge of Kidney Stones Treatment by Muslim Maiba (Herbalists) of Manipur, India. *Notulae Scientia Biologicae*, *3*(2), 12–15. https://doi.org/10.15835/nsb325735

Ali, A. A., Almukhtar, S. E., Sharif, D. A., Saleem, Z. S. M., Muhealdeen, D. N., & Hughson, M. D. (2020). Effects of bodybuilding supplements on the kidney: A population-based incidence study of biopsy pathology and clinical characteristics among middle eastern men. *BMC nephrology*, *21*(1), 164. https://doi.org/10.1186/s12882-020-01834-5

Ameer O. Z. (2022). Hypertension in chronic kidney disease: What lies behind the scene. *Frontiers in pharmacology*, *13*, 949260. https://doi.org/10.3389/fphar.2022.949260

Anand, S., Thomas, B., Remuzzi, G., Riella, M., El Nahas, M., Naicker, S., & Dirks, J. (2025). Kidney Disease. In Cardiovascular, Respiratory, and Related Disorders (3rd ed.). NCBI Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK525140/

Anandh, U., Meena, P., Karam, S., & Luyckx, V. (2022). Social, political and legal determinants of kidney health: Perspectives from lower- and middle-income countries with a focus on India. *Frontiers in nephrology*, *2*, 1024667. https://doi.org/10.3389/fneph.2022.1024667

Aoun, M., & Chelala, D. (2022). Where do you live and what do you do? Two questions that might impact your kidney health. *Frontiers in Nephrology*, *2*, 1011964. https://doi.org/10.3389/fneph.2022.1011964

Arazi, H., Mohabbat, M., Saidie, P., Falahati, A., & Suzuki, K. (2022). Effects of Different Types of Exercise on Kidney Diseases. *Sports (Basel, Switzerland)*, *10*(3), 42. https://doi.org/10.3390/sports10030042

Ayajuddin, M., et al., (2016). Plant products and fermented foods as nutrition and medicine in Manipur state of Northeast India: Pharmacological authenticity. In J. Purkayastha (Ed.), *Bioprospecting of Indigenous Bioresources of North-East India* (pp. 165-179). Springer. https://doi.org/10.1007/978-981-10-0620-3_10

ISSN:1517-4492 | **E-ISSN**:2178-7727

Bello, A. K., et al. (2024). An update on the global disparities in kidney disease burden and care across world countries and regions. *The Lancet. Global Health*, *12*(3), e382–e395. https://doi.org/10.1016/S2214-109X(23)00570-3

Brown-Leung, J. M., & Cannon, J. R. (2023). Neurochemical mechanisms of perfluoroalkyl substances (PFAS) neurotoxic action. In P. R. S. Kodavanti, M. Aschner, & L. G. Costa (Eds.), *Advances in Neurotoxicology* (Vol. 10, pp. 367–398). Elsevier.

Chang, H.-J., et al., (2020). Association between lifestyle factors and decreased kidney function in older adults: A community-based cross-sectional analysis of the Taipei City elderly health examination database. *BMC Nephrology, 21*(1), 169. https://doi.org/10.1186/s12882-020-01838-1

Charytan, D. M., et al. (2024). Organic pollutant exposure and CKD: A Chronic Renal Insufficiency Cohort pilot study. *Kidney Medicine*, *6*(3), 100778. https://doi.org/10.1016/j.xkme.2023.100778

Chen, Chun-Yu., et al. (2024). Long-term impacts of endocrine-disrupting chemicals exposure on kidney function: A community-based cohort study. *Environmental Toxicology and Pharmacology*, *106*(104379), 104379. https://doi.org/10.1016/j.etap.2024.104379

Cho, E., et al. (2022). Revisiting glomerular hyperfiltration and examining the concept of high dietary protein-related nephropathy in athletes and bodybuilders. *Current Opinion in Nephrology and Hypertension*, *31*(1), 18–25. https://doi.org/10.1097/MNH.0000000000000755

Chronic kidney disease: impact on the global burden of mortality and morbidity. (n.d.). Thelancet.Com. Retrieved January 26, 2025, from https://www.thelancet.com/campaigns/kidney/updates/chronic-kidney-disease-impact-on-global-burden-of-mortality-and-morbidity

Cirillo, M., Bilancio, G., et al., (2023). Diet and other modifiable factors in long-term decline of kidney function: Observational and population-based cohort study. *Nutrients, 15*(20), 4337. https://doi.org/10.3390/nu15204337

Das, S., et al. (2006). The effect of Euryale ferox (Makhana), an herb of aquatic origin, on myocardial ischemic reperfusion injury. *Molecular and cellular biochemistry*, *289*(1-2), 55–63. https://doi.org/10.1007/s11010-006-9147-1

De Bhailis, Á. M., & Kalra, P. A. (2022). Hypertension and the kidneys. *British journal of hospital medicine (London, England : 2005)*, *83*(5), 1–11. https://doi.org/10.12968/hmed.2021.0440

Drid, P., Roklicer, R., Zenic, N., Modric, T., Milovancev, A., Maksimovic, N., Bianco, A., Lukic-Sarkanovic, M., & Trivic, T. (2023). Does rapid weight loss provoke acute kidney injury in combat athletes?: 1669. *Medicine and Science in Sports and Exercise*, *55*(9S), 555–555. https://doi.org/10.1249/01.mss.0000985024.42339.28

Dunder, L., et al. (2023). Plasma levels of per- and polyfluoroalkyl substances (PFAS) and cardiovascular disease - Results from two independent population-based cohorts and a meta-analysis. *Environment International*, *181*(108250), 108250. https://doi.org/10.1016/j.envint.2023.108250

El-Reshaid, W., El-Reshaid, K., Al-Bader, S., Ramadan, A., & Madda, J. P. (2018). Complementary bodybuilding: A potential risk for permanent kidney disease. *Saudi journal of kidney diseases and transplantation : an official*

ISSN:1517-4492 | **E-ISSN**:2178-7727

publication of the Saudi Center for Organ Transplantation, Saudi Arabia, *29*(2), 326–331. https://doi.org/10.4103/1319-2442.229269

Elshahat, S., Cockwell, P., Maxwell, A. P., Griffin, M., O'Brien, T., & O'Neill, C. (2020). The impact of chronic kidney disease on developed countries from a health economics perspective: A systematic scoping review. *PloS one*, *15*(3), e0230512. https://doi.org/10.1371/journal.pone.0230512

Francis, A., Harhay, M. N., Ong, A. C. M., Tummalapalli, S. L., Ortiz, A., Fogo, A. B., Fliser, D., Roy-Chaudhury, P., Fontana, M., Nangaku, M., Wanner, C., Malik, C., Hradsky, A., Adu, D., Bavanandan, S., Cusumano, A., Sola, L., Ulasi, I., Jha, V., … International Society of Nephrology. (2024). Chronic kidney disease and the global public health agenda: an international consensus. *Nature Reviews. Nephrology*, *20*(7), 473–485. https://doi.org/10.1038/s41581-024-00820-6

Garcia-Garcia, G., & Jha, V. (2015). Chronic kidney disease in disadvantaged populations. *Indian journal of nephrology*, *25*(2), 65–69. https://doi.org/10.4103/0971-4065.150078

Gawad, M., & Kalawy, H. (2019). Gym nephropathy 'bodybuilding versus kidney damaging.' *Journal of The Egyptian Society of Nephrology and Transplantation*, *19*(4), 124. https://doi.org/10.4103/jesnt.jesnt_32_19

Global Burden of Disease Collaborative Network. (2022). *Global Burden of Disease Study 2021 (GBD 2021) results*. Institute for Health Metrics and Evaluation (IHME).

Haruna, I., & Obeng-Gyasi, E. (2024). Association of combined Per- and Polyfluoroalkyl Substances and metals with chronic kidney disease. *International Journal of Environmental Research and Public Health*, *21*(4), 468. https://doi.org/10.3390/ijerph21040468

Hill, N. R., Fatoba, S. T., Oke, J. L., Hirst, J. A., O'Callaghan, C. A., Lasserson, D. S., & Hobbs, F. D. R. (2017). *Data from: Global prevalence of chronic kidney disease: a systematic review and meta-analysis* [Data set]. Dryad.

Hossain, M. P., Goyder, E. C., Rigby, J. E., & El Nahas, M. (2009). CKD and poverty: a growing global challenge. *American Journal of Kidney Diseases: The Official Journal of the National Kidney Foundation*, *53*(1), 166–174. https://doi.org/10.1053/j.ajkd.2007.10.047

Hsu, C.-N., & Tain, Y.-L. (2021). Adverse impact of environmental chemicals on developmental origins of kidney disease and hypertension. *Frontiers in Endocrinology*, *12*, 745716. https://doi.org/10.3389/fendo.2021.745716

I. S. N. (2023, March 30). *New global kidney health report sheds light on current capacity around the world to deliver kidney care*. International Society of Nephrology. https://www.theisn.org/blog/2023/03/30/new-global-kidney-health-report-sheds-light-on-current-capacity-around-the-world-to-deliver-kidney-care/

Kim, S., et al. (2021). Epigenetic changes by per- and polyfluoroalkyl substances (PFAS). *Environmental Pollution (Barking, Essex: 1987)*, *279*(116929), 116929. https://doi.org/10.1016/j.envpol.2021.116929

Kodikara, P., Walker, R., & Wilson, S. (2023). Renal physiology and kidney injury during intense (CrossFit®) exercise. *Internal Medicine Journal*, *53*(7), 1180–1187. https://doi.org/10.1111/imj.15667

ISSN:1517-4492 | **E-ISSN**:2178-7727

Kovesdy C. P. (2022). Epidemiology of chronic kidney disease: an update 2022. *Kidney international supplements*, *12*(1), 7–11. https://doi.org/10.1016/j.kisu.2021.11.003

Kshirsagar, A. V., Zeitler, E. M., Weaver, A., Franceschini, N., & Engel, L. S. (2022). Environmental exposures and kidney disease. *Kidney360*, *3*(12), 2174–2182. https://doi.org/10.34067/KID.0007962021

Kuma, A., & Kato, A. (2022). Lifestyle-Related Risk Factors for the Incidence and Progression of Chronic Kidney Disease in the Healthy Young and Middle-Aged Population. *Nutrients*, *14*(18), 3787. https://doi.org/10.3390/nu14183787

Lippincott Home. (n.d.). Lww.Com. Retrieved January 19, 2025, from https://lww.com/pages/default.aspx

Lv, J. C., & Zhang, L. X. (2019). Prevalence and Disease Burden of Chronic Kidney Disease. *Advances in experimental medicine and biology*, *1165*, 3–15. https://doi.org/10.1007/978-981-13-8871-2_1

Mallamaci, F., & Tripepi, G. (2024). Risk factors of chronic kidney disease progression: Between old and new concepts. *Journal of Clinical Medicine, 13*(3), 678. https://doi.org/10.3390/jcm13030678

Master Sankar Raj, V., Patel, D. R., & Ramachandran, L. (2017). Chronic kidney disease and sports participation by children and adolescents. *Translational Pediatrics*, *6*(3), 207–214. https://doi.org/10.21037/tp.2017.06.03

Moonesan, M. R. (2023). Renal endocrine aspects of exercise-induced acute kidney injury (gym nephropathy). *Journal of Renal Endocrinology*, *9*(1), e25128. https://doi.org/10.34172/jre.2023.25128

Morton, R. L., Schlackow, I., Staplin, N., Gray, A., Cass, A., Haynes, R., Emberson, J., Herrington, W., Landray, M. J., Baigent, C., Mihaylova, B., & SHARP Collaborative Group (2016). Impact of Educational Attainment on Health Outcomes in Moderate to Severe CKD. *American journal of kidney diseases: the official journal of the National Kidney Foundation*, *67*(1), 31–39. https://doi.org/10.1053/j.ajkd.2015.07.021

Niu, Z., et al. (2024). Kidney function decline mediates the adverse effects of per- and poly-fluoroalkyl substances (PFAS) on uric acid levels and hyperuricemia risk. *Journal of Hazardous Materials*, *471*(134312), 134312. https://doi.org/10.1016/j.jhazmat.2024.134312

Nunes Filho, J. C. C., Gadelha Pereira, D. C. B. H., de Matos, R. S., Pinto, D. V., Vilar Neto, J. O., Meneses, G. C., Martins, A. M. C., Camurça, D. S., Melo, A. H. B., & Daher, E. D. F. (2022). Effects of high-intensity exercise on renal and endothelial function of Crossfit athletes. *Nephrology Dialysis Transplantation, 37*(Supplement_3), gfac066.048. https://doi.org/10.1093/ndt/gfac066.048

Okoye, O. C., & Awunor, N. (2022). Is exposure to hydrocarbons associated with chronic kidney disease in young Nigerians? A case-control study. *Frontiers in Nephrology*, *2*, 1010080. https://doi.org/10.3389/fneph.2022.1010080

Ozkurt, S., Ozakin, E., Gungor, H., & Yalcin, A. U. (2023). Assessment of Renal Function of Bodybuilders Using Anabolic Androgenic Steroids and Diet Supplements. *Cureus*, *15*(8), e43058. https://doi.org/10.7759/cureus.43058

ISSN:1517-4492 | **E-ISSN**:2178-7727

Plantinga L. C. (2013). Socio-economic impact in CKD. *Nephrologie & therapeutique*, *9*(1), 1–7. https://doi.org/10.1016/j.nephro.2012.07.361

Quazi, M., & Molvi, K. (2014). Preliminary phytochemical evaluation of leaves of Meyna Laxiflora. *International Research Journal of Pharmacy*, *5*(9), 676–678. https://doi.org/10.7897/2230-8407.0509138

Quiñones, J., & Hammad, Z. (2020). Social determinants of health and chronic kidney disease. *Cureus, 12*(9), e10266. https://doi.org/10.7759/cureus.10266

Ramya, Ranjan, Nayak, S. P., et al. (2023). Toxic ties: Unraveling the complex relationship between endocrine disrupting chemicals and chronic kidney disease. *Environmental Pollution (Barking, Essex: 1987)*, *338*(122686), 122686. https://doi.org/10.1016/j.envpol.2023.122686

Rickard, B. P., et al. (2022). Per- and poly-fluoroalkyl substances (PFAS) and female reproductive outcomes: PFAS elimination, endocrine-mediated effects, and disease. *Toxicology*, *465*(153031), 153031. https://doi.org/10.1016/j.tox.2021.153031

Sabri, N. W., et al., (2022). Risk factors of chronic kidney disease. *International Journal of Health Sciences*, *6*(S8), 1996–2004. https://doi.org/10.53730/ijhs.v6nS8.12381

Santosh Panwar, et al. (2023). A review on Punarnavadi Kwath : An Ayurvedic polyherbal formulation for Chronic Kidney Disease (CKD). *Journal of Ayurveda and Integrated Medical Sciences*, *8*(7), 59 - 65. https://doi.org/10.21760/jaims.8.7.10

Stanifer, J. W., Muiru, A., Jafar, T. H., & Patel, U. D. (2016). Chronic kidney disease in low-and middle-income countries. *Nephrology Dialysis Transplantation*, *31*(6), 868-874.

Steenland, K., & Winquist, A. (2021). PFAS and cancer, a scoping review of the epidemiologic evidence. *Environmental Research*, *194*(110690), 110690. https://doi.org/10.1016/j.envres.2020.110690

Thio, C. H. L., Vart, P., Kieneker, L. M., Snieder, H., Gansevoort, R. T., & Bültmann, U. (2020). Educational level and risk of chronic kidney disease: longitudinal data from the PREVEND study. *Nephrology, Dialysis, Transplantation: Official Publication of the European Dialysis and Transplant Association - European Renal Association*, *35*(7), 1211–1218. https://doi.org/10.1093/ndt/gfy361

Tidmas, V., et al. (2022). Ultra-endurance participation and acute kidney injury: A narrative review. *International Journal of Environmental Research and Public Health*, *19*(24), 16887. https://doi.org/10.3390/ijerph192416887

Tripathy, S., Cai, X., Adhikari, A., Kershaw, K., Peralta, C. A., Kramer, H., Jacobs, D. R., Jr, Gutierrez, O. M., Carnethon, M. R., & Isakova, T. (2020). Association of educational attainment with incidence of CKD in Young Adults. *Kidney International Reports*, *5*(12), 2256–2263. https://doi.org/10.1016/j.ekir.2020.09.015

Utkina, E. V., et al., (2023). Mechanisms of renal damage in patients with new coronavirus infection. *Siberian Scientific Medical Journal, 43*(4), 6-14. https://doi.org/10.18699/SSMJ20230401

Wei, C., et al. (2023). The pharmacological mechanism of Abelmoschus manihot in the treatment of chronic kidney disease. *Heliyon, 9*(11), e22017. https://doi.org/10.1016/j.heliyon.2023.e22017

ISSN:1517-4492 | **E-ISSN**:2178-7727

Weidemann, D. K., Fadrowski, J. J., & Weaver, V. M. (2024). The environment and kidney disease in children. In *Textbook of Children's Environmental Health* (pp. 719–730). Oxford University PressNew York.

Wen, F., et al. (2023). Combined effects of ambient air pollution and PM2.5 components on renal function and the potential mediation effects of metabolic risk factors in China. *Ecotoxicology and Environmental Safety*, *259*(115039), 115039. https://doi.org/10.1016/j.ecoenv.2023.115039

Wong, G., Bernier-Jean, A., Rovin, B., & Ronco, P. (2024). Time for action: recognizing chronic kidney disease as a major noncommunicable disease driver of premature mortality. *Kidney International*, *105*(6), 1144–1146. https://doi.org/10.1016/j.kint.2024.03.020

Yadav, R., et al. (2024). Environmental toxicants and nephrotoxicity: Implications on mechanisms and therapeutic strategies. *Toxicology*, *504*(153784), 153784. https://doi.org/10.1016/j.tox.2024.153784

Yang, Z., et al. (2023). Association between exposure to perfluoroalkyl substances and uric acid in Chinese adults. *Chemosphere*, *312*(Pt 1), 137164. https://doi.org/10.1016/j.chemosphere.2022.137164

Zeng, X., Liu, J., Tao, S., Hong, H. G., Li, Y., & Fu, P. (2018). Associations between socioeconomic status and chronic kidney disease: a meta-analysis. *Journal of epidemiology and community health*, *72*(4), 270–279. https://doi.org/10.1136/jech-2017-209815

Zhou, Y., et al. (2023). Associations of prenatal PFAS exposure and early childhood neurodevelopment: Evidence from the Shanghai Maternal-Child Pairs Cohort. *Environment International*, *173*(107850), 107850. https://doi.org/10.1016/j.envint.2023.107850

ISSN:1517-4492 | **E-ISSN**:2178-7727