


Chapter 6

Systematic Review of Medical Imaging and Clinical Data in CKD Prediction Using Deep Neural Networks

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ABSTRACT

The global healthcare problem of chronic kidney disease (CKD) requires accurate predictions in the early stages to achieve appropriate treatment and management

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strategies. Deep learning through deep neural networks (DNNs) has received rising interest for CKD prediction systems because it effectively combines medical images with clinical information. The review investigates the implementation of deep neural networks for predicting CKD by uniting medical imaging approaches with clinical database information. Medical imaging techniques using ultrasound as well as CT scans and MRI, together with clinical datasets, generate important information regarding the initial development stages of CKD. The enormous computing ability of DNNs makes them perfect for detecting intricate patterns that standard evaluation techniques typically overlook. The article investigates multiple DNN structures predicting CKD, system performance levels, obstacles, and possible future enhancements.

1. INTRODUCTION

The main characteristic of CKD as a global health concern is progressive deterioration or complete loss of kidney function over time (Islam et al., 2023). The condition includes structural defects, persistent urine abnormalities, and excretory renal dysfunction from lost functional nephrons (Debal & Sitote, 2022). The sustained decline of glomerular filtration rate below 60 mL/min/1.73 m² for three months or more suggests both impairment and improper functioning of the kidneys (George et al., 2022). The worldwide distribution of CKD extends from every corner of the earth. Yet, low- and middle-income countries bear maximum disease intensity, and they have minimal capacity to fight this condition. According to reports, 800 million people experience this ailment in every part of the world (Pal, 2023). The prevalence rate of CKD has increased by 29.3% for all age groups throughout three decades. The age-standardized DALYs rate steadily rose at a rate of 0.30 EAPC up to 514.86/100,000 by 2019, alongside an increasing age-standardized incidence rate reaching 233.65/100,000 through a 0.69 EAPC by 2019 (Sawhney et al., 2023). The World Health Organization (WHO) has forecasted that CKD will become one of the five most widespread persistent conditions in 2040. The condition now ranks among the primary sources of mortality because it has caused increased death tolls during the previous two decades (Antony et al., 2021).

The progression of CKD results in end-stage renal disease, which medical professionals consider an individual risk factor for heart disease and accelerated mortality patterns (Ramspek et al., 2021). Glomerulonephritis, along with diabetes mellitus type 1 and hypertension, make significant contributions to worldwide increases in CKD development (Khalid et al., 2023). The functional decline of kidneys observed in older adults constitutes a considerable risk factor because aging involves cellular changes such as telomere attrition, genomic instability, autophagy, inflammation, modifications to Sirtuin and Klotho signaling pathways, and mitochondrial function

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