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## **Residential greenness improves clinical outcomes of patients with chronic kidney disease**

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**Objectives:** As industrialization has progressed, green areas have been decreasing. The association between the distribution of green spaces and health outcomes is becoming global issues, especially regarding cardiovascular and respiratory diseases. However, little is known for relationship between residential greenness and survival of patients with chronic kidney disease (CKD).

**Methods:** 64,565 patients who visited 3 medical centers (Seoul National University Hospital, Seoul National University Bundang Hospital, and Seoul National University Boramae Medical Center) from January 2001 to December 2016 were enrolled in the cohort study. Cox proportional hazard models were used to identify the association between long-term exposure of green space and mortality of patients with CKD and occurrence of end-stage renal disease which were adjusted by age, sex, estimated glomerular filtration rate, hemoglobin, mean particulate matter < 10 µm in aerodynamic diameter (PM<sub>10</sub>) and geographical variables. Green space was defined as average normalized difference vegetation index (NDVI) in summer (Jun-Aug) around patients' residence within 250m and 1250m radius measured by MODIS satellite.

**Results:** The mean age of patients was 54 years, and 49 % of them were male. During the mean 6.75 follow-up years, 8,543 deaths (13%) and 5,512 ESRD (9%) occurred. 10% increase of residential greenness within 1250m and 250m radius had lower HRs for all-cause mortality (HR 0.948, CI 0.917-0.981) and progression to ESRD (HR 0.946, 0.912-0.981) respectively, which were adjusted by PM<sub>10</sub> of observation stations within 5km around the residence. In addition, protective associations between both clinical outcomes and NDVI were found in those who had BMI lower than 25. In stratified analysis, non-metropolitan residents who did not smoke and drink alcohol without hypertension and diabetes had positive association between greenness and occurrence to ESRD.

**Conclusions:** CKD patients who lived in areas with higher levels of greenness had reduced risks of all-cause mortality and progression to ESRD.