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The Impact of Greenness on Graft Outcomes and Mortality in Kidney Transplant Recipients: A Longitudinal Study from South Korea

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Objectives : Recent studies are expanding their focus from internal to external determinants of disease, specifically examining the role of environmental factors. There's a growing interest in the role of green spaces, referred as "Greenness", moving beyond the well-documented effects of air pollution. Studies notably reveal that higher greenness positively affects chronic kidney disease patients. However, the impact of greenness on kidney transplant recipients (KTRs) remains underexplored. We aim to fill this gap by analyzing the effect of greenness on KTRs, specifically in terms of death-censored graft failure (DCGF) and all-cause mortality.
Methods : The study population consisted of KTRs from three tertiary referral centers in South Korea, followed up for more than one year (n=5,266). Greenness was assessed using the annual average Enhanced Vegetation Index (EVI) based on the residential ZIP codes of participants. Time-varying Cox analysis was used to account for changes in EVI during the follow-up period.
Results : During the median follow-up of 72 months for DCGF and 80 months for all-cause mortality, graft failure occurred in 425 patients, and 388 patients died. At the time of transplantation, the average age was 46.4 ± 11.9 years, with 25.5% of patients having diabetes and 85.7% having hypertension before the transplant. 75.5% was living kidney transplantation and 15.1% was ABO incompatible kidney transplantation. The adjusted hazard ratio (aHR) indicated that increased greenness was associated with improved graft outcomes and reduced all-cause mortality, particularly in patients older than 40 years. In particular, the increase in greenness showed the most significant benefits for graft outcomes in patients over 60 years of age. As the follow-up period lengthened, the benefits of greenness on graft survival increased, but its advantages regarding all-cause mortality decreased. (Table 1)
Conclusions : Our findings suggest that higher residential greenness is associated with improved graft outcomes and lower all-cause mortality in KTRs.

Greenness_Table1.png

	DCGF			All-cause mortality		
	aHR	95% CI	p-value	aHR	95% CI	p-value
Age group						
40≤Age<60	0.82	0.755–0.882	<0.001	0.86	0.770–0.959	0.007
60≤Age	0.86	0.763–0.965	0.010	0.86	0.763–0.965	0.010
Follow up duration						
3-year≤	0.54	0.466–0.631	<0.001	0.86	0.786–0.998	0.047
5-year≤	0.53	0.444–0.633	<0.001	0.87	0.766–0.988	0.032
10-year≤	0.47	0.336–0.658	<0.001	1.09	0.904–1.309	0.373
Sex						
Male	0.79	0.728–0.862	<0.001	0.83	0.775–0.918	<0.001
Female	0.75	0.680–0.819	<0.001	0.94	0.812–1.080	0.369
Diabetes						
Yes	0.74	0.669–0.811	<0.001	0.81	0.723–0.900	<0.001
No	0.79	0.733–0.859	<0.001	0.94	0.834–1.067	0.355
Hypertension						
Yes	0.76	0.711–0.809	<0.001	0.85	0.782–0.920	<0.001
No	0.91	0.736–1.131	0.401	1.05	0.761–1.445	0.772

Abbreviation: DCGF, death-censored graft failure; aHR, adjusted hazard ratio; CI, confidence interval