Kidney Function Decline Following COVID-19 Infection Among People with HIV

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BACKGROUND

- People with HIV (PWH) are at increased risk of chronic kidney disease (CKD) due to traditional and HIV-related factors; kidney function is monitored using estimated glomerular filtration rate (eGFR)
- COVID-19 is associated with acute kidney injury via direct viral and inflammatory mechanisms.
- Long-term impacts of COVID-19 remain unclear in aging PWH with multimorbidity

OBJECTIVES:

1) Identify factors associated with post-COVID eGFR decline and ≥25% decline among PWH with COVID-19.

2) To evaluate the impact of COVID-19 (vs no COVID-19) on kidney function among PWH

METHODS

Participants are from the **DC Cohort**, an observational study of approximately 13,200 PWH receiving care in Washington, DC.

Inclusion Criteria: One pre- and One post-COVID eGFR using an index date of March 15, 2020.
Exclusion Criteria: Preexisting CKD (stages III-V), eGFR <60mL/min/1.73m², or less than 1 month follow-up.

COVID-19 cases: SARS-CoV-2 infection based on PCR or antigen testing, antibody evidence of prior infection, or ICD-10 codes.
Controls: absence of SARS-CoV-2 during observation.

Outcomes (Changes in eGFR following COVID):

1) Incident CKD (stages III-V), end-stage kidney disease, dialysis or kidney transplant.

2) Absolute change in eGFR over 24 months (6-month intervals).

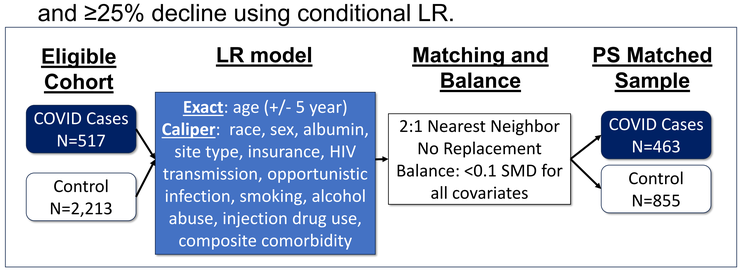
3) ≥25% decline eGFR over 24 months.

Statistical Analysis (COVID-19 cases):

- Demographic Comparisons among COVID-19 cases were made using Chi-square and Wilcoxon Rank Sum.
- Longitudinal eGFR change was modeled with linear mixed-effects models (LME; random intercept/slope; β per 6-month intervals).
- ≥25% eGFR decline was assessed using logistic regression (LR; Odds Ratio (OR)).

(COVID-19 Cases and Controls):

- ***Propensity score (PS)*** matching (2:1)
- Covariate balance using standard mean difference (SMD).
- Within PS matched sample, eGFR trajectories modeled using LME and ≥25% decline using conditional LR.



Among PWH and COVID-19 coinfection, COVID-19 was independently associated with an additional eGFR loss of -5.3 ml/min/1.73m² over 24 months compared to PWH without COVID-19.

RESULTS

- Among 517 PWH with COVID-19, 37 (7.2%) developed CKD (Stages III–V)
- CKD cases were older (median 59.6 vs 53.7 years) and more likely to have diabetes (56.8% vs 33.1%; p=0.006) and current/former injection drug use (18.9% vs 7.1%; p<0.001); [**Table 1**].
- Other characteristics were similar (most commonly public insurance and viral load <200 copies/mL at diagnosis, all p>0.05).

Table 1. Demographics and Clinical Characteristics for Participants with COVID-19 Diagnosis by Status of at Least Moderate CKD (Stages III-V), N=517

Characteristics		Overall N (%) N=517	CKD (Stages III-V) No, N (%) N=480	CKD (Stages III-V) Yes, N (%) N=37	p-value
Age at COVID-19 Diagnosis, median (years) (IQR)		54.0 (44.7-62.2)	53.7 (44.1-61.9)	59.6 (53.9-65.8)	**0.004**
Race	Black	365 (70.6)	336 (70.0)	29 (78.4)	0.69
	White	86 (16.6)	80 (16.7)	6 (16.2)	
	Hispanic	43 (8.3)	42 (8.8)	1 (2.7)	
	Other/Unknown	23 (4.5)	22 (4.6)	1 (2.7)	
Sex at Birth					0.53
	Male	359 (69.4)	335 (69.8)	24 (64.9)	
	Female	158 (30.6)	145 (30.2)	13 (35.1)	
Insurance Status[1]					0.66
	Public	365 (70.6)	341 (71.0)	24 (64.9)	
	Private	135 (26.1)	123 (25.6)	12 (32.4)	
	Other/Unknown	17 (3.3)	16 (3.3)	1 (2.7)	
Time Since HIV Diagnosis, N=552		17.7 (12.4-25.3)	17.5 (12.2-25.0)	19.8 (15.5-26.0)	0.16
History of Opportunistic Infection[2]					0.55
	No	276 (53.4)	258 (53.8)	18 (48.7)	
	Yes	241 (46.6)	222 (46.3)	19 (51.4)	
CD4 (cells/μL) Nadir[2]		309 (143-483)	310 (149-485)	230 (74.0-464)	0.11
CD4 (cells/μL)[3]		668 (464-905)	673 (464-908)	591 (485-840)	0.22
Viral Load < 200 copies/mL at COVID-19[3]		469 (90.7)	436 (90.8)	33 (89.2)	0.77
Smoking Status[2]					0.58
	Current/Former	272 (52.6)	254 (52.9)	18 (48.7)	
	Never	201 (38.9)	184 (38.3)	17 (46.0)	
	Missing	44 (8.5)	42 (8.8)	2 (5.4)	
History of IV Drug Use[2]					**<0.001**
	Current/Former	41 (7.9)	34 (7.1)	7 (18.9)	
	Never	277 (53.6)	252 (52.5)	25 (67.6)	
	Missing	199 (38.5)	194 (40.4)	5 (13.5)	
History of Alcohol Abuse[2]					0.07
	Current/Former	131 (25.3)	122 (25.4)	9 (24.3)	
	Never	270 (52.2)	245 (51.0)	25 (67.6)	
	Missing	116 (22.4)	113 (23.5)	3 (8.1)	
Diabetes (*Prior to COVID-19*)		180 (34.8)	159 (33.1)	21 (56.8)	**0.006**
Hepatitis B (*Prior to COVID-19*)		35 (6.8)	31 (6.5)	4 (10.8)	0.30

1: Public Funding includes: DC Alliance, Medicaid, Medicare, Ryan White/ADAP, and Other public funding
2: Closest measure prior to DC Cohort Enrollment.
3: Closest laboratory measure prior to initial COVID-19 diagnosis.

RESULTS (Continued)

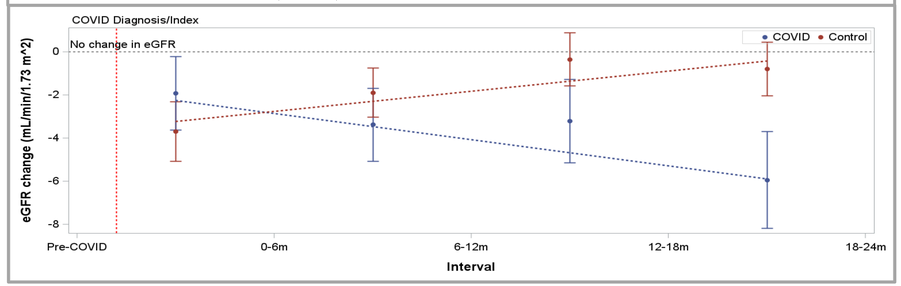
Table 2. Adjusted Associations Between Baseline Characteristics and Kidney Function Decline Among Participants With COVID-19, N=517

	Change in eGFR[1] β (95% CI)	p-value	≥25% Decline[2] aOR (95% CI)	p-value
Albumin, per 1 g/dL	4.89 (1.03, 8.75)	0.013	–	–
Creatinine, per 1 mg/dL	0.99 (0.40, 1.59)	0.001	1.43 (1.20–1.70)	<0.001
Age at COVID (per yr)	0.05 (–0.06, 0.16)	0.36	1.02 (0.99–1.05)	0.19
Race Black (ref White)	–1.34 (–4.84, 2.16)	0.45	1.09 (0.38–3.15)	0.87
Race Hispanic/Other (ref White)	–0.46 (–5.17, 4.25)	0.85	0.87 (0.18–4.07)	0.85
Female Sex (vs Male)	–	–	4.26 (1.80–10.1)	0.001
CD4 200–500 cells/μL, at COVID, (ref <200)			0.43 (0.13–1.40)	0.16
CD4 ≥500 cells/μL, at COVID (ref <200)	–	–	0.22 (0.07–0.68)	0.009
Viral load ≥200 copies/mL, (ref <200)	–4.24 (–8.78, 0.31)	0.07	–	–
Diabetes Mellitus (Yes vs. No)	–	–	2.00 (1.01–3.94)	0.046
Hepatitis B (Yes vs. No)	–9.32 (–14.34, –4.29)	<0.001	–	–

Model 1 (absolute eGFR) adjusted for age, race/ethnicity, serum albumin, serum creatinine, HIV RNA viral load, hepatitis B, and CD4 count. **Model 2** (≥25% eGFR decline) adjusted for age, race/ethnicity, serum creatinine, sex at birth, diabetes, and CD4 count. Reference categories are shown in parentheses.

- Models [**Table 2**] show that lower albumin and higher creatinine at the most recent pre-COVID lab, and any prior chronic hepatitis B, were associated with eGFR decline.
- Female sex, diabetes, and higher creatinine at COVID diagnosis were associated with ≥25% decline, while CD4 ≥500 cells/μL was protective.

Figure 1. Mean eGFR (95% CI) Change Over Time in PS-Matched Participants With and Without COVID, N=1,318



- After PS match, COVID-19 was associated with an additional −1.3 mL/min/1.73m² eGFR decline per 6 months [**Figure 1**];
- By 24 months, cases had ~5.3 mL/min/1.73m² greater eGFR loss than controls.
- Similar ≥25% decline (9.0% vs 8.4%; OR=1.0, 0.6-1.4) for cases and controls

CONCLUSIONS

- Potential limitations include missing vaccination data and possible COVID-19 misclassification among controls.
- Findings suggest COVID-19 may contribute to sustained kidney function decline among PWH, supporting routine post-COVID kidney monitoring in HIV care.
- Results highlight the need to identify PWH at higher risk, such as those with comorbidities or coinfections for targeted follow-up and kidney-protective care.
- Prospective studies should clarify mechanisms and test interventions, including vaccination, to reduce infection-associated CKD in PWH.

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