HIV and Aging Are Associated with Cardiovascular-Kidney-Metabolic Syndrome Burden Among People Who Inject Drugs

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AIDS Linked to the IntraVenous Experience

Introduction

- Cardiovascular–Kidney–Metabolic (CKM) Syndrome is a new framework that captures the interconnected burden of obesity, diabetes, kidney disease, and cardiovascular disease along a continuum of five stages, from no cardiovascular disease (CVD) risk factors to clinical CVD and kidney failure.
- HIV infection represents a risk-enhancing factor in increase burden and fast progression in this framework.
- We estimated the prevalence and longitudinal trajectories of CKM Syndrome in PWH, particularly in persons who inject drugs (PWID).

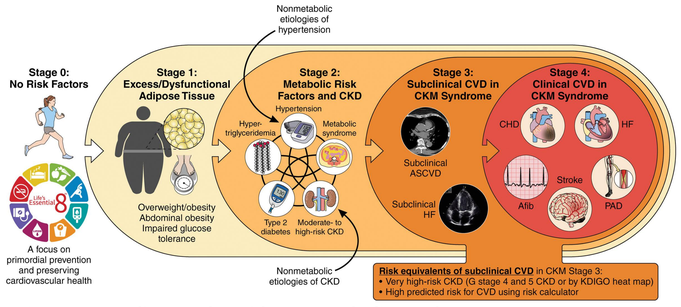


Figure 1. Cardiovascular-Kidney-Metabolic Syndrome

Methods

Study Design and Population

We included participants from the AIDS Linked to the Intravenous Experience (ALIVE) cohort, a prospective, community-based cohort of PWID in Baltimore, Maryland, between 2005 and 2019.

Measurements

- We adapted the CKM Syndrome Stages based on the American Heart Association:
  - **Stage 0**: No CKM risk factors
  - **Stage 1**: Excess adiposity and/or prediabetes without cardiometabolic or kidney disease
  - **Stage 2**: Metabolic risk factors and/or moderate-to-high–risk CKD
  - **Stage 3+**: Subclinical or clinical cardiovascular and kidney disease *(Stages 3 and 4 were grouped due to small sample size)*

Statistical Analysis

- Multinomial mixed-effects logistic models to evaluate the association of HIV with odds of each CKM stage.
- Mixed-effects logistic models with random intercepts to evaluate progression vs. no progression over time.
- Models were adjusted for demographics, substance use, hepatitis C, and non-CKM comorbidities.

HIV was associated with a tenfold higher burden of Cardiovascular-Kidney-Metabolic (CKM) Syndrome Stage 3 and above. Older age and HIV infection were identified as independent risks for poor CKM health (Stages 2–3+) among individuals who inject drugs.

Results

- A total 1,700 participants from the ALIVE cohort with 10,239 person-years of follow-up were included.
- HIV infection was associated with a 10-fold higher burden of Stage 3+ ($p < 0.001$), and older age was associated with greater burden of both Stage 2 (per 1-year increase: RRR 1.08) and Stage 3+ (RRR 1.40; both $p<0.001$). Female sex and self-identify Black were consistently associated with higher stages.
- At younger ages, PWH progressed more slowly than PWoH; however, this trend reversed after age 47, with progressively larger differences between PLWH and PWoH ($P_{Interaction}$ <0.05; Figure 3).

Table 1. Baseline Characteristics of ALIVE participants, 2005 - 2020

	PWoH (n = 1,216)	PWH (n = 484)	Overall (n = 1,700)
Age, year, median (IQR)			
Biological Sex, n (%)			
Male	840 (69)	335 (69)	1,175 (69)
Race, n (%)			
Black	885 (73)	436 (90)	1,321 (78)
Non-Black	331 (27)	48 (10)	379 (22)
Cigarette pack/day (last 6 months), n (%)			
Non-smoker	165 (14)	83 (18)	248 (15)
< 1 pack per day	668 (56)	297 (63)	965 (58)
≥ 1 pack per day	371 (31)	95 (20)	466 (28)
Alcohol use (last 6 months), n (%)			
No alcohol use	506 (42)	247 (51)	753 (44)
< once a day	631 (52)	217 (45)	848 (50)
Daily	77 (6)	20 (4)	97 (6)
Injection drug use (last 6 months), n (%)	689 (57)	196 (41)	885 (52)
HCV Infection, n (%)	914 (75)	435 (90)	1,349 (79)
HBV infection, n (%)	20 (2)	19 (4)	39 (2)

Results (cont.)

Figure 2. Predicted Probability of CKM Stage by HIV Status and Age

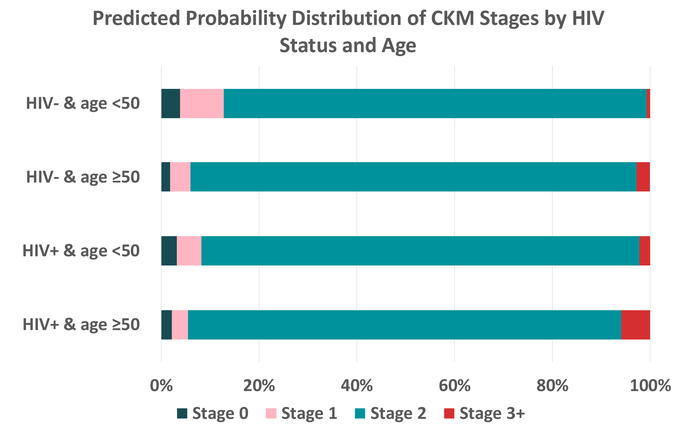
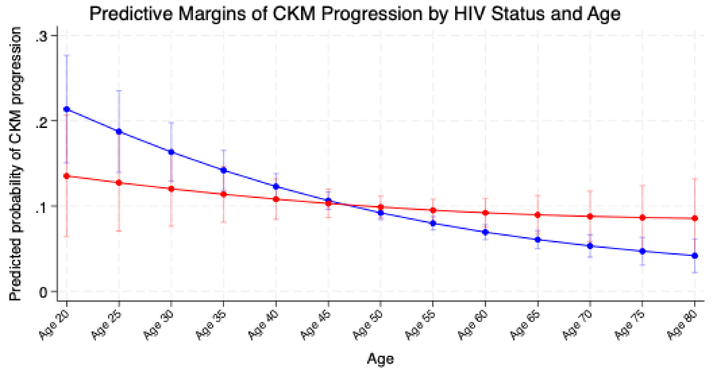


Figure 3. CKM Stage Progression by HIV Status and Age



Conclusion

- HIV infection and older age was independently associated with advanced CKM Syndrome. PWH experienced more rapid progression with age.
- Understanding the underlying mechanisms is key to improve risk stratification and developing mechanism-informed interventions (see poster 672).

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