Title: Agricultural workers in Guatemala with chronic kidney disease are at increased risk of acute respiratory illness, and COVID-19 vaccination is associated with reduced illness and absenteeism

Authors: Molly M. Lamb[1*], Jenae Stuzman[3*], Diva M. Calvimontes[2], Neudy Rojop[2], Kareen Arias[2], Wanda Mejia,[2] Chelsea Iwamoto[4], Julio del Cid-Villatoro[2], Claudia Paiz[2], Lyndsay Krisher[5], Jose Monzon[6], Blair Weikel,[1] Aditi Bunker[7], Guillermo Antonio Bolanos[2], Ashley Fowlkes[4], Emily Zielinski Gutierrez[6], Eduardo Azziz-Baumgartner[4], Edwin J. Asturias,[1,2,3] Lee S. Newman,[1,5] Daniel Olson[1,2,3]

ABSTRACT

Background. Though chronic kidney disease (CKD) of unknown origin (CKDu) is recognized as an emerging public health concern in Central American agricultural workers, it is unknown whether affected workers are at increased risk of respiratory illness severity, as they are with traditional CKD.

Methods. All eligible workers at a single banana plantation were offered enrollment from June 2020 to September 2024 into a prospective cohort (the AGRI study), then followed for influenza-like illnesses (ILI) through self-reporting to study nurses by phone at weekly worksite visits, or via sentinel surveillance. Workers with ILI were tested for influenza, RSV, and SARS-CoV-2 by RT-PCR testing (Roche cobas Liat), then completed surveys at days 0, 7, and 28 to assess clinical (Flu-iiQ severity) and economic (absenteeism) outcomes. Serum creatinine was collected at enrollment and annually, in addition to acute-illness visits, and used to calculate estimated glomerular filtration rate (eGFR). COVID-19 vaccination data were collected from the Guatemalan national vaccine registry. Descriptive statistics and multivariable regression models were used to calculate CKD prevalence as well as association with ILI, COVID-19, and vaccination in the overall cohort, and a sub-cohort with $\geq$2 eGFR measurements.

Results. From 2020-2024, we enrolled 2,804 workers with $\geq$1 eGFR measurement, of which 139 (5.0%) had Stage 3 CKD. Of the sub-cohort with $\geq$2 eGFR measurements (n=1,875), 318 (17%) had Stage 2 CKD. Risk factors for Stage 2 and Stage 3 CKD included older age, male sex, field worker status, longer job tenure, and living in a municipality with higher mean heat index. In multivariable generalized linear regression models adjusted for significant confounders, participants with Stage 3 CKD were more likely to have ILI (adjusted relative risk [aRR]=1.71, 95% confidence interval [CI]=1.19-2.46) and SARS-CoV-2-positive (SCV2+) ILI (aRR=2.03, CI=1.09-4.88). COVID-19 vaccination was protective against ILI (aRR=0.40, CI=0.34-0.47), and against SARS-CoV-2 (aRR=0.28, CI=0.18-0.42). ILI and SCV2+ ILI were associated with 705 and 381 days of absenteeism, respectively. Flu-iiQ severity score at days 0, 7, and 28 and duration of absenteeism were similar among workers with and without CKD. COVID-19 vaccination was significantly protective against ILI (aRR=0.40, CI=0.34-0.47) and SCV2+ ILI (aRR=0.28, CI=0.18-0.42) overall. We observed a similar protective effect of COVID-19 vaccination on ILI and SCV2+ ILI among workers with Stage 2 (aRR=20.59, CI=0.37-0.95; aRR=0.10, CI=0.03-0.38) and Stage 3 (aRR=0.19, CI=0.09-0.40; aRR=0.25, CI=0.06-1.16) CKD. COVID-19 vaccination was associated with reduced ILI-associated absenteeism in the overall cohort (0 vs 1 day, p-value=0.0003), and among workers with Stage 2 (0 vs 5 days, p=0.001) and Stage 3 (1 vs 3.5 days, p=0.11) CKD. COVID-19 was associated lower risk of prolonged (>5 days) absenteeism (22.1% vs 42.7%, p=0.0014).

Discussion. We found a high burden of CKD in our banana worker cohort. Workers with CKD were more likely to report respiratory illness and COVID-19 than their healthy peers. Work-based COVID-19 vaccination was associated with a significant reduction in all-cause respiratory illness and COVID-19 as well as reduced ILI-associated absenteeism and prolonged absenteeism in the overall cohort, with a larger effect size among workers with CKD.