

Chronic Kidney Disease of Unknown Etiology

NIOSH Pesticide Exposure Study in El Salvador Sugarcane Workers

NIOSH Board of Scientific Counselors

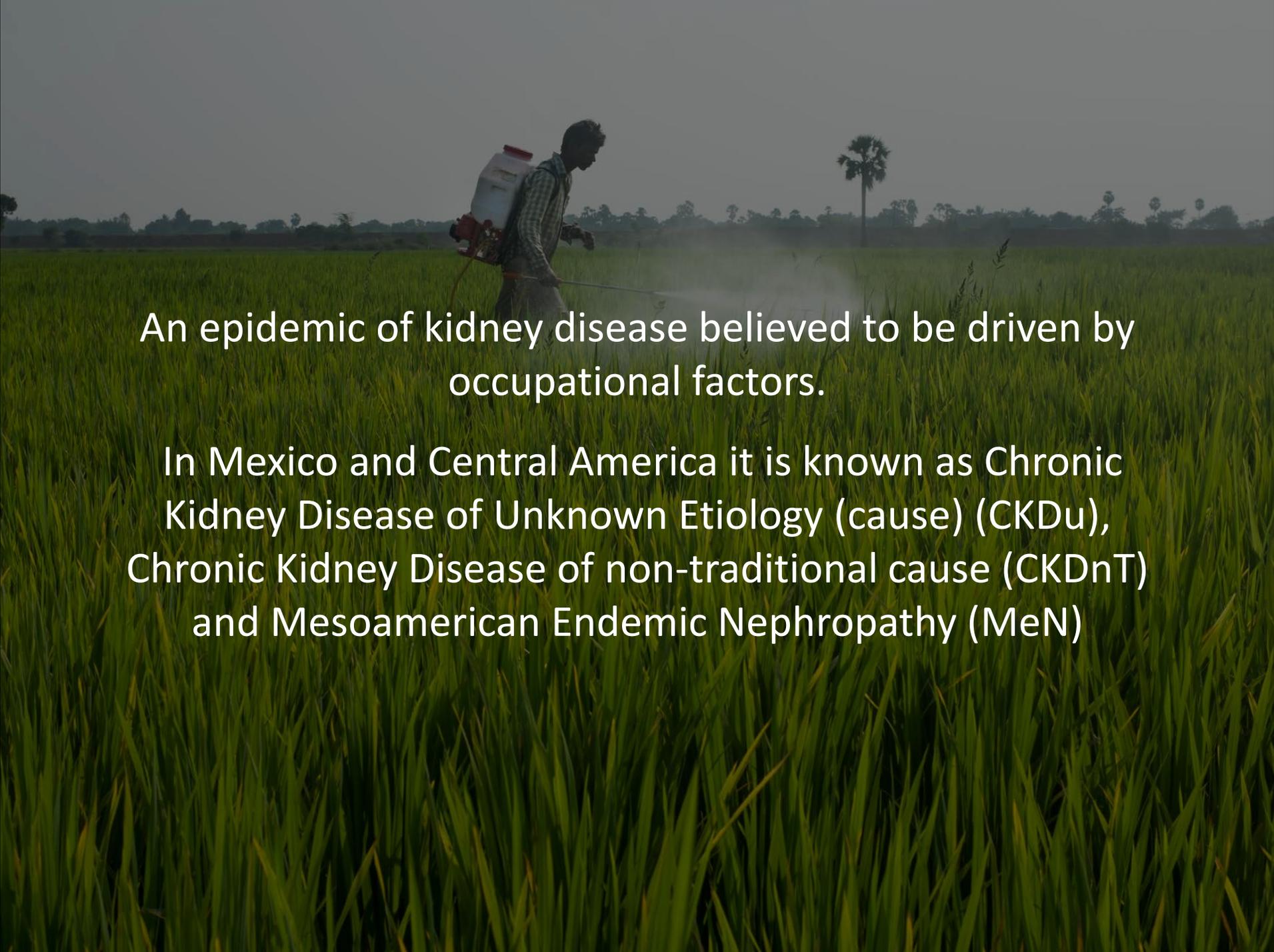
September 27, 2016

Brian Curwin, PhD



The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health





An epidemic of kidney disease believed to be driven by occupational factors.

In Mexico and Central America it is known as Chronic Kidney Disease of Unknown Etiology (cause) (CKDu), Chronic Kidney Disease of non-traditional cause (CKDnT) and Mesoamerican Endemic Nephropathy (MeN)

In the most studied region, Mesoamerica, **at least 20,000 people have died in the last 10 years alone.**

Cases: young, non-diabetic, non-hypertensive men



WHO IS AFFECTED AND WHERE?



SUGARCANE



RICE



COCONUT



NUTS



MINING &
CONSTRUCTION

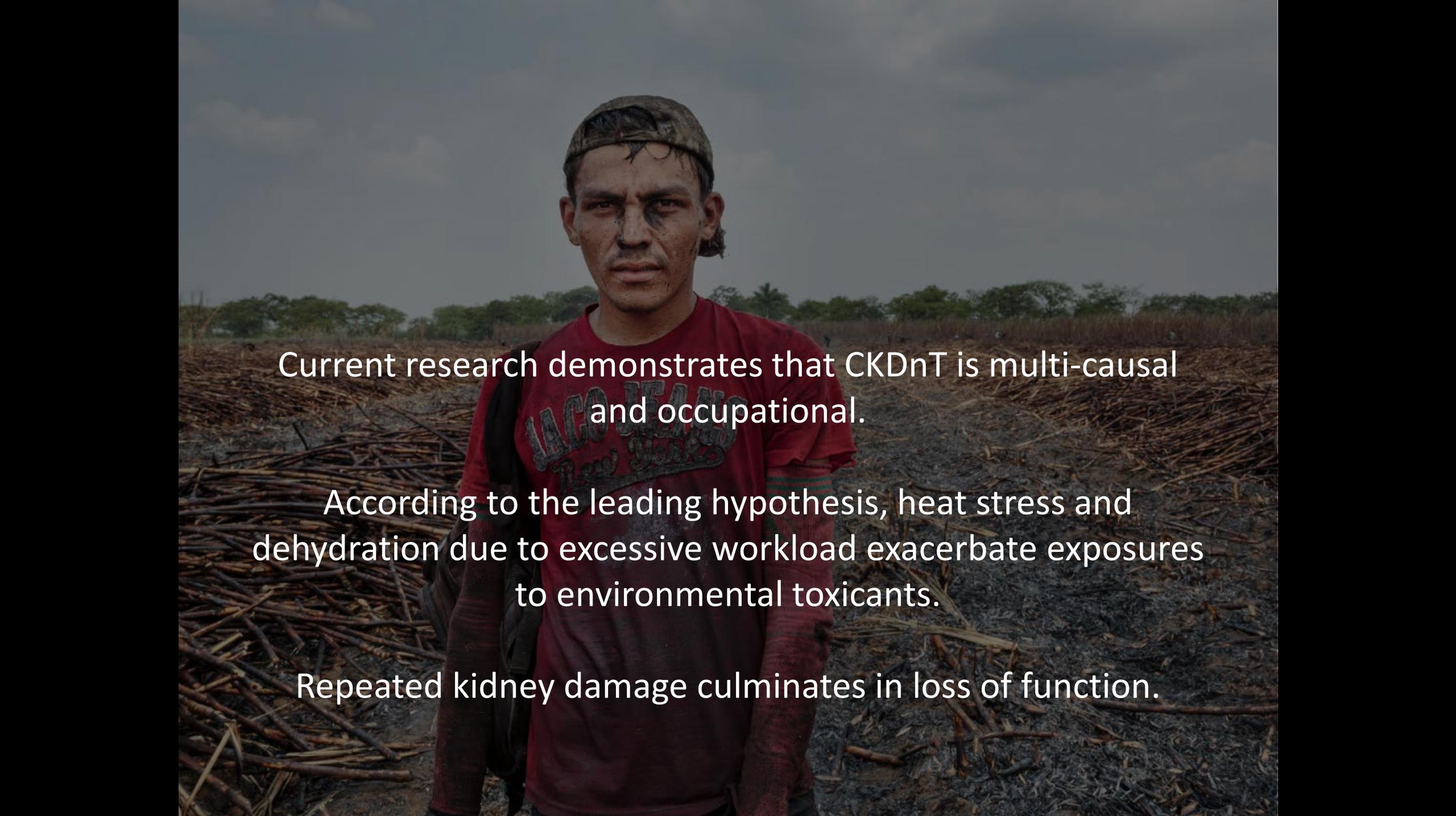


Latin America: The most impacted group are sugarcane workers. Mining and construction workers are also affected.

India: Sugar, rice, coconut, and cashew farmers are most affected.

Sri Lanka: Rice and sugarcane workers show the highest prevalence.

Southeast Asia: Industry and clinicians report sugar workers affected with what appears to be a similar disease.

A man with a dirt-covered face and a red t-shirt stands in a field of harvested sugarcane stalks. The background shows a line of trees under a cloudy sky. The man is looking directly at the camera with a serious expression.

Current research demonstrates that CKDnT is multi-causal and occupational.

According to the leading hypothesis, heat stress and dehydration due to excessive workload exacerbate exposures to environmental toxicants.

Repeated kidney damage culminates in loss of function.

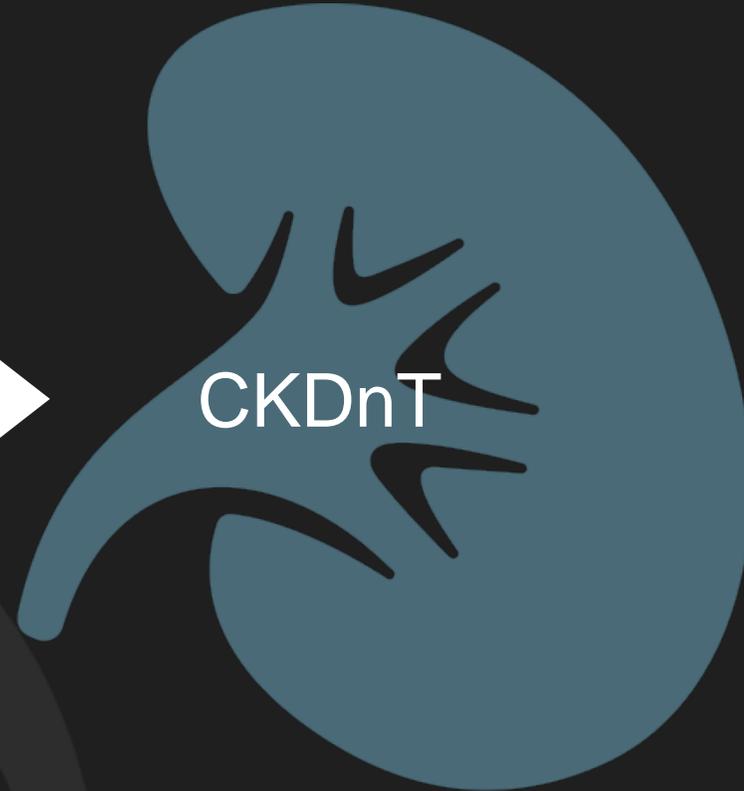
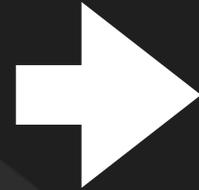
The Worker Health and Efficiency (WE) Program was born out of studies looking at heat stress and other risk factors for CKDnT.

It is executed in coordination with the following institutions:



THE *WE PROGRAM* ADDRESSES KNOWN RISK FACTORS FOR CKDU.

- Dehydration
- Excessive workload and heat stress
- Toxicant Exposures
- Anti-inflammatory consumption
- Infectious disease



In El Salvador, the *WE* program is focusing on preventing heat stress and dehydration through work, rest and shade, and worker efficiency interventions.

HYDRATION:

ACCESS TO WATER IS AS
IMPORTANT AS
QUANTITY

Workers receive:

3-liter insulated thermos or a 2-
liter CamelBak backpack and
a daily electrolyte solution



Heat Stress:

Mandatory rest breaks under mobile shade tents using OSHA guidelines





Exertion:

Improved cutting practices and a new machete



Findings:

- self-reported water consumption increased 25%.
- Heat Stress & dehydration symptoms decreased
- Positive perception of new machete
- Individual daily production increased

Chronic and severe dehydration can amplify the impact of toxicants. Proper hydration gives the kidneys a chance to do their job.

El Salvador legislature proposed banning 53 pesticides.

NIOSH is working to identify if pesticides are a danger to sugarcane workers.



CHRONIC & SEVERE
DEHYDRATION



OCCUPATIONAL
PESTICIDE EXPOSURE

NIOSH was asked to participate with the WE program through a technical assist request from PAHO.



IN REPLY REFER TO: SDE

14 January 2016

Dr. Margaret Kitt
Deputy Director
National Institute
of Occupational Health and Safety
PAHO/WHO Collaborating Center
for Occupational Health (USA-150)
Building 2400 Room 4411
Atlanta, GA 30329

Subject: Request for Technical Assistance for Chronic Kidney Disease of Non-traditional Origin (CKDnT)

Dear Dr. Kitt:

This letter intends to follow up on the agreements made during the meetings held at the Centers of Diseases Control and Prevention in 2015; the Global Meeting of World Health Organization (WHO) Collaborating Centers on Occupational Health held in Jeju, Korea; and the Pan American Health Organization/Sustainable Development and Health Equity (PAHO/SDE) Meeting held in Montreal, Canada, in 2015.

Continuing PAHO's efforts to provide technical assistance to those Member States affected by the epidemics of CKDnT, we kindly request technical assistance from the National Institute of Occupational Health and Safety (NIOSH) to conduct pilot intervention projects aimed to prevent and mitigate CKDnT in El Salvador.

The previous studies supported by NIOSH had great results for improving working conditions and well-being of agricultural workers in the sugar cane industry. Now we would like to advance by increasing coverage for a larger group of agricultural workers with the Water, Rest, Shade and the Work Efficiency (WE) strategies. Findings of NIOSH field work/research would be disseminated and published in the same manner as other NIOSH research, in accordance with NIOSH and PAHO policies.

We thank you for your support and collaboration.

Isabella Danel, M.D., M.S.
Deputy Director

Sugarcane Harvesting Process

- Typical harvest (zaffra) in El Salvador is November to March
- Harvesting is done manually
- Glyphosate may be applied to sugarcane prior to harvest to speed up sugarcane ripening and increase sugar content.
 - In the U.S. it is advised to apply glyphosate as a ripening agent 28-49 days prior to harvest.
- Sugarcane is burned just prior to harvesting, from a few days to the night before.



Recent Research

- One occupational risk considered by some to be a potential etiologic factor in CKDu in Sri-Lanka and Central America, is pesticide exposure. (Jayasumana, et al., 2014a; Ordunez, et al., 2014a; Ordunez, et al., 2014b)
- One hypothesis is that glyphosate in conjunction with arsenic and hard water, may be a potential cause of CKDu among agricultural workers in Sri Lanka. (Jayasumana, et al., 2014b)
- Self-reported carbamate pesticide use was more common among workers with a decrease in eGFR (74% versus 29% of the remaining workers). (García-Trabanino, et al., 2015)
- In the United States, a recent study found positive exposure response trends between exposure to six pesticides and end-stage renal disease. (Lebov, et al., 2015)

Environmental Research ■■■■■ ■■■■■ ■■■■■

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Heat stress, dehydration, and kidney function in sugarcane cutters in El Salvador – A cross-shift study of workers at risk of Mesoamerican nephropathy

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ARTICLE INFO	ABSTRACT
<p>Article history: Received 4 June 2015 Received in revised form 7 July 2015 Accepted 8 July 2015</p>	<p>Background: An epidemic of progressive kidney failure afflicts sugarcane workers in Central America. Repeated high-intensity work in hot environments is a possible cause. Objectives: To assess heat stress, dehydration, biomarkers of renal function and their possible associations. A secondary aim was to evaluate the prevalence of pre-shift renal damage and possible causal factors. Methods: Sugarcane cutters (N=189, aged 18–49 years, 168 of them male) from three regions in El Salvador were examined before and after shift. Cross-shift changes in markers of dehydration and renal function were examined and associations with temperature, work time, region, and fluid intake were assessed. Pre-shift glomerular filtration rate was estimated (eGFR) from serum creatinine. Results: The mean work-time was 4 (1.4–11) hours. Mean workday temperature was 34–36 °C before noon, and 39–42 °C at noon. The mean liquid intake during work was 0.8 L per hour. There were statistically significant changes across shift. The mean urine specific gravity, urine osmolality and creatinine increased, and urinary pH decreased. Serum creatinine, uric acid and urea nitrogen increased, while chloride and potassium decreased. Pre-shift serum uric acid levels were remarkably high and pre-shift eGFR was reduced (< 60 mL/min) in 23 male workers (14%). Conclusions: The high prevalence of reduced eGFR, and the cross-shift changes are consistent with recurrent dehydration from strenuous work in a hot and humid environment as an important causal factor. The pathophysiology may include decreased renal blood flow, high demands on tubular reabsorption, and increased levels of uric acid.</p>
<p>Keywords: Chronic kidney disease Heat stress Dehydration Specific gravity eGFR Sugarcane work Mesoamerican nephropathy Uric acid</p>	<p>© 2015 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).</p>

NIOSH Pesticide Sampling Among Sugarcane Workers in El Salvador – March, 2016.

Sampling Methods.

- 40 sugarcane cutters (male and female) in 2 locations.
 - Inland and coastal, 20 cutters each location.
- Sampling on 3 consecutive workdays per location.
- Area air, hand wipe, urine, and water samples collected.
- Analyzed for glyphosate and 2,4-D.



Security was an issue.
The State Department required armed guards.



Hand wipe sampling of sugarcane cutters.



Urine collection



Air Sampling



Families often come to the fields to have lunch.



Hard labor and hot conditions.



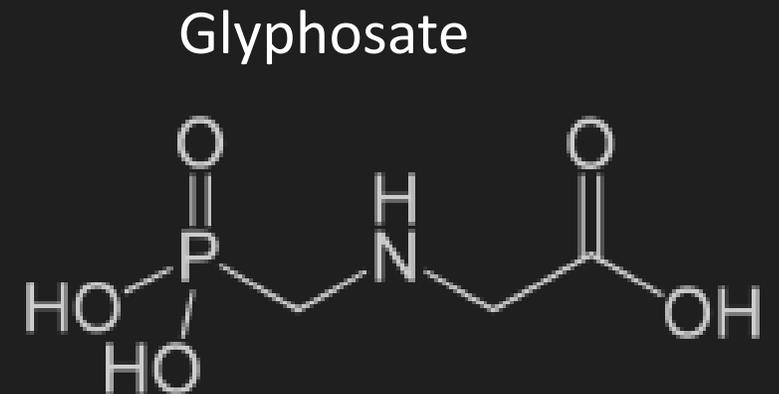
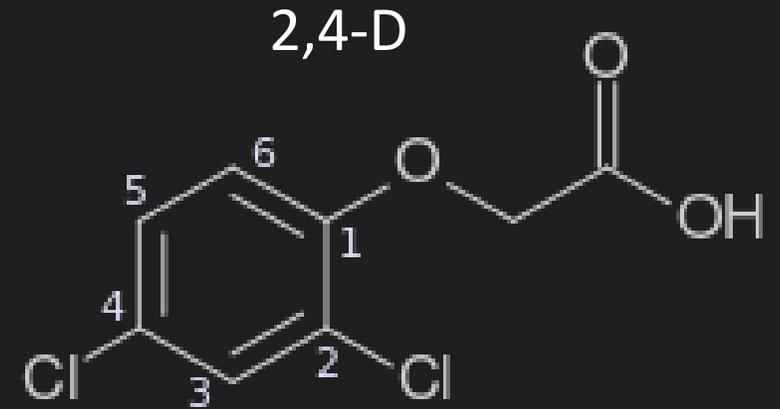






Results

- All air samples were ND for glyphosate and 2,4-D
 - LOD: Gly 0.08 ug/sample; 2,4-D 1 ug/sample
- All air samples were ND for respirable dust
 - LOD: Resp dust 40 ug/sample
- All hand wipe samples were ND for glyphosate and 2,4-D
 - LOD: Gly 0.8 ug/sample; 2,4-D 0.5 ug/sample
- Urine samples still being analyzed.



Next Steps

- Should NIOSH be studying CKDu in the U.S.?
- If so what should we do?
 - Surveillance - Are there any case of CKDu? What is the prevalence?
 - Exposure studies?
- Should NIOSH consider studying heat related illness and climate change?
 - Wildland firefighters



THANK YOU

