2018/2019 Annual Report

Southeastern Coastal Center for Agricultural Health and Safety

Southeastern Coastal
Center for Agricultural
Health and Safety

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Section I – Who We Are

Center Summary

The **Southeastern Coastal Center for Agricultural Health and Safety** (SCCAHS) explores and addresses the occupational safety and health needs of people working in agriculture, fishing, and forestry in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Puerto Rico, and the U.S. Virgin Islands.

The University of Florida is the lead institution of this center, partnering with the University of South Florida (USF), Florida State University (FSU), Florida A&M University (FAMU), Georgia Southern University (GSU), Emory University, and the University of the Virgin Islands. These universities are working together on a range of interdisciplinary research and educational projects designed to promote occupational health and safety among the 240,000 farms — estimated by U.S. Department of Agriculture — to be operating in the region, their operators, families, employees, and contractors, as well as those in the forestry and fishery industries.

Our Focus Areas

- Coastal fishery worker safety and health
- Heat stress and related illness
- Pesticide/herbicide exposure
- Opioid epidemic impact on farming communities
- Disaster vulnerability of migrant and seasonal farmworkers
- Feasibility of using electronic health records to describe the health of migrant and seasonal farmworkers, inform research and measure impact of interventions.
- Geospatial Analysis of agricultural worker and fisher health: Partnering to map regional clinical indicators and neighborhood environments
- Development and implementation of training programs.
- Innovative approaches to foster research to practice

Goals of the Center

- Provide occupational safety and health education and training to the agriculture, fishing, and forestry workforce.
- Bring evidence-based, safety and health programs, developed through the other NIOSH-funded agricultural centers into the southeastern coastal region.
- When appropriate, translate programs into Spanish, and assist in supporting multilingual training efforts throughout the region.
- Conduct research to practice projects focused on:
  - Evaluating whether safety and education materials produce changes in safety behaviors.
  - Documenting hazards and risks in fishery worker populations; testing training materials aimed at reducing injuries.
  - Utilizing remote sensing technology to map pesticide uses.
  - Looking at heat stress tolerance.
- Conduct further research and applied projects based on needs as they arise.

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Pilot/Feasibility Program

Pilot study of the acute psychological and health impacts of Hurricane Irma in UFAS extension workers
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Uncovering patterns of mental, physical, and occupational health issues among migrant farmworkers with different socio-cultural networks: A pilot study among Haitian and Mexican farm workers in Immokalee, FL
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Chronic low back pain in seafood workers: a pilot intervention study to identify modifiable work and movement solutions
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Pilot study of mobile app monitoring to prevent heat-related symptoms among Hispanic farmworkers
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Understanding the scope of the opioid epidemic for agricultural industries
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A novel approach (sweat patches) to monitoring pesticide exposure in farmworkers
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Agro-ecological practices in the face of climate change: Resilience, sustainability, and preparedness in Puerto Rico
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Key Personnel

Pilot/Feasibility Program

Field evaluation of N95 filtering facepiece respirators against airborne dust and microorganisms during cotton harvest
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A pilot study to assess personal PM2.5 exposure and respiratory virus Infections among farmworkers in the Southeast
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Section II – Research Projects

Heat Stress and Biomarkers of Renal Disease

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Overview

In recent years there has been a marked increase in the occurrence of Chronic Kidney Disease (CKD) in agricultural workers in Mesoamerica. The potential mechanism for this increase in this occupational population remains elusive, but is thought to possibly be associated with working in hot environments causing recurrent dehydration leading to decreased renal blood flow, high demands on tubular reabsorption and increased levels of uric acid or perhaps activation of the fructokinase pathway in the kidney resulting in chronic tubular injury resulting in fibrosis. In this exploratory study we will measure physiological indicators of heat stress in farmworker populations in Florida and incorporate a metabolomics approach to enhance our understanding of the pathways through which perturbation of renal function occurs in farmworkers working in hot environments. We propose to investigate whether the biomarkers of renal damage shown in the Mesoamerica region are also present among farmworkers from similar ethnic backgrounds who have immigrated to the U.S. to work in agriculture.

Year 3 Summary. In this study of agricultural workers in Florida, the Emory investigative team found evidence of significantly elevated levels of urinary biomarkers of acute kidney injury prior to the workday in the heat exposed group as compared to non-heat exposed controls. Participants in the heat-exposed group also started the workday more dehydrated and consumed more sugary beverages during the workday. Findings from this study also included sets of metabolites that were from a variety of metabolic pathways and were associated with heat exposure and levels of wet-bulb globe temperature. The results of this study serve as a basis for implementing larger studies that have a longitudinal design which will allow our research team to better examine the interrelationships between chronic heat exposure and acute kidney injury over time while providing the opportunity to determine if metabolic pathways that are perturbed by heat are associated with pathways that are related to the development of acute kidney injury.

Key Accomplishments in 2018-2019

Specific Aim 1. **Characterize the occupational environment of these workers including work practices, workplace heat exposure and work intensity.**

Data collection is complete. Baseline, pre-work, post-work, and osmolarity/renal function data from treatment and comparison groups in Homestead, FL were collected between April and August 2018. Sixty-three agricultural workers were recruited along with 28 non-agricultural workers from the comparison group. Frozen samples were obtained for analysis. We integrated the Florida Automated Weather Network (FAWN) environmental data with survey data, physiologic biomonitoring data (i.e. heart rate, activity, urinalysis, basic metabolic panel), and kidney biomarker data. Analysis of data pertaining to this aim is complete.

Specific Aim 2. **Characterize the physiologic profile of these workers including body anthropometrics, dehydration, and self-reported health-related illness symptoms.**

Self-reported heat-related illness symptoms, dehydration, and anthropometric data were integrated with environmental, survey, physiologic biomonitoring, and kidney biomarker data. Analysis of data pertaining to this aim is complete.

Specific Aim 3. **Determine if biomarkers indicating kidney injury are present (kidney injury molecule – 1 (KIM-1), Beta-2 microglobulin (B2M), neutrophil gelatinase-associated lipocalin (NGAL), elevated blood urea nitrogen (BUN), creatinine, uric acid, uromodulin, and decreased glomerular filtration rate (GFR) and if the presence and levels of these biomarkers in agricultural workers differ from controls who are not employed in agriculture.**

September – November 2018, biological samples were inventoried and prepped for the analysis of kidney biomarkers and metabolomics. The kidney biomarker lab analysis kits were received and the study team organized kidney biomarker samples for analysis. Sample manifests were prepared and close oversight of laboratory testing and processing of kidney biomarker tests in the Emory Multiplex Immunoassay Core (EMIC) were prioritized. Analysis of data pertaining to this aim took place from June-August 2019 and is complete.

Specific Aim 4. **Use non-targeted metabolomics analysis of blood plasma to explore the molecular mechanisms of renal dysfunction associated with occupational heat exposure.**

September – November 2018, biological samples were inventoried and prepped for metabolomics. The study team worked on the assembly and testing of an analytical pipeline to analyze the pending metabolomics data in RStudio.

January 2019-February 2019, under close oversight of the investigative team, the Emory Metabolomics Core competed laboratory testing and processing to generate metabolomics data by from the analysis of plasma samples.

August-September 2019, preliminary data analysis pertaining to this aim took place. The study team worked with the Emory Multiplex Immunoassay Core (EMIC) and the Clinical Biomarkers Laboratory's Bioinformatics analytic team lead by Karan Uppal to complete the preliminary analysis for Aim 4.

Kidney Biomarker Analysis

Kidney biomarker lab analysis kits were ordered, plasma and urine samples for analysis were organized, and the investigative team prepared sample manifests and oversaw laboratory testing and processing of kidney biomarkers in urine. Beta-2 microglobulin (B2M), cystatin C, neutrophil gelatinase-associated lipocalin (NGAL/Lipocalin-2), Osteopontin (OPN) and uromodulin (UMOD) were measured in pre and post-workday urine samples using the QuickPlex instrument (MesoScale Diagnostics, LLC; Rockville, MD) in the Emory Multiplexed Immunoassay Core (EMIC). The EMIC lab uses MesoScale Diagnostics QuickPlex electrochemiluminescence instrumentation, which has < 10% variability within and between plates. All testing was done in duplicate. Kidney injury molecule – 1 (KIM-1), creatinine, and uric acid biomarker testing of pre- and post-workday urine was completed at the school of nursing biobehavioral laboratory. Pre- and post-workday serum samples were assembled into a biobank for future analysis. These activities occurred during October-December 2018.

Biomonitoring Data

Data cleaning was performed on the biomonitoring data to ascertain any missing data. The Florida Automated Weather Network (FAWN) environmental data was integrated with survey data, physiologic biomonitoring data (i.e. heart rate, activity, urinalysis, basic metabolic panel), and kidney biomarker data. This activity began in December 2018 and was completed in August 2019. Eighty-four participants had pre- and post-workday biomarker samples, while 6 had only one time point. Biomarker values missing due to being below the lowest detectable limit (bdl) were assigned the value bdl/2. Three uric acid values were not recorded due to being above the detection curve; to preserve information, they were assigned the highest observed value since it was not possible to rerun a diluted sample. Each biomarker is reported as creatinine-normed (value/mg creatinine) and as non-normed. Due to non-normal distributions and/or outliers, the non-parametric Wilcoxon rank-sum test was used to examine evidence of group differences. For the same reason, we report medians for central tendency and the first and third quartiles as indicators of distribution spread. The two groups were compared on biomarkers pre-workday, post-workday, and change over the workday.

Metabolomics Data Analytics

The investigative team worked on the assembly and testing of an analytical pipeline to analyze the pending metabolomics data in R Studio with the xmsPANDA package. This activity occurred from October to December 2018.

Raw metabolomics data. Raw data was generated from the analysis of pre- and post-workday plasma samples in January/February 2019. Workday plasma samples were analyzed in batches of 20 using the high-resolution metabolomics platform of the Emory Metabolomics Core. Plasma samples were treated with acetonitrile (2:1, v/v), spiked with internal standard mix, and centrifuged at 14,000× g for 5 min at 4°C to remove proteins. A Thermo Scientific Q Exactive HF Quadruple-Orbitrap mass spectrometer (Thermo Fisher, San Diego, CA) was used while an Orbitrap Fusion Tribrid mass spectrometer. Samples were analyzed in triplicate to evaluate reproducibility for each metabolite in each sample and samples were randomized to minimize batch effects. Rigorous standard operating procedures were implemented and provided detection of >20,000 m/z features.

Preliminary Analysis of Metabolomics Data. Preliminary analysis was completed September/ October 2019. Non-targeted metabolomics analysis of plasma obtained from 63 heat-exposed

agricultural workers [average maximum outdoor Wet-Bulb Globe temperature of 84°F [82°F, 87°F] and 27 non-heat exposed controls [working in jobs that were indoors with air conditioning available] were completed by ultra-high resolution mass spectrometry. Data were extracted using apLCMS v6.3.3 and xMSanalyzer v2.0.8. Data from both HILIC positives and C18 negative columns were used for analysis. Biological response to occupational heat exposure was determined using a metabolome-wide association study (MWAS) framework, with metabolic changes evaluated by pathway enrichment. Data pre-processing steps included median summarization of technical replicates, filtering of features based on missing values cut-offs (overall 30%n and group-wise 80%) and relative standard deviation across all samples to remove features with a constant signal across all samples. Log2 transformation was used to reduce heteroscedasticity and normalize the data. Quantile normalization of samples was performed to minimize between sample variability.

Results

Specific Aim 1 Results. Workday data was collected from 63 agricultural workers and 27 non-heat exposed controls (Table 1). Compared to the controls, the agricultural worker sample was on average 8 years older, had more males (35% vs.19%), a similar percentage of married participants (40 vs. 46%), and was less educated (8 v 11 years). About half of the agricultural workers reported Mexican nationality (vs. 27% of controls) and were more likely to report their immigration status as being undocumented; however, a third of the controls did not indicated their immigration status. Obesity was nearly twice as likely (40% vs. 23%) in the agricultural worker sample. Forty percent of agricultural workers worked in nurseries and 83% were paid by the hour. Controls worked in a variety of non-agricultural settings, with 58% paid by the hour. Agricultural work hours were somewhat longer (8.5 vs. 8 hrs; 25th percentile, 7.8 vs. 6 hrs).

TABLE 1. Socio-demographic, Health, and Work Characteristics of Agricultural and non-Agricultural (control) Participants. Homestead, Florida; April and August 2018.

	Working Condition			
	Agricultural Workers (n = 63)		Controls (n =27)	
	Mean (SD), Median [q1, q3], or n (%)			
Socio-Demographic Characteristics				
Age (years)	41.9	(8.1)	34.2	(10.2)
Gender				
Male	22	35%	5	19%
Marital Status				
Married	25	40%	12	46%
Education (years),	8	(3.8)	11.1	(3.2)
Nationality				
Mexico	35	56%	7	27%
Other non-US Hispanic	26	41%	13	50%
United States	2	3%	6	23%
Immigration Status				
US-born or Naturalized Citizen	12	23%	6	24%
Permanent Resident	8	15%	1	4%
Status pending/temp. work permit	2	4%	5	20%
Undocumented	26	49%	4	16%
No response	5	9%	9	36%
Health Characteristics				
Body fat %				
Male	25	[19, 28]	13	[8, 22]
Female	35	[31, 37]	33	[29, 38]
Body mass index (kg/m2)	29.3	[26.7, 31.4]	26.0	[24.1, 29.9]
Body mass index categories				
Normal (18.5 – <25)	9	15%	9	35%
Overweight (25. – <30)	28	45%	11	42%
Obese (≥30)	25	40%	6	23%
Work Characteristics				
Years in Agriculture	13	[3, 18]	--	--
Primary type of work				
Nursery	44	70%	--	--
Fruits/Vegetables	10	16%	--	--
Yard work	8	13%	--	--
Cleaning	--	--	5	19%
Office	--	--	4	15%
Other	0	0%	8	30%
Unknown	1	2%	9	33%
Payment				
Piece rate	5	8%	2	8%
By the hour	51	83%	14	58%
Salary	3	5%	6	25%
Other	3	5%	2	8%
Hours worked per day	8.5	[7.8, 10.0]	8	[6, 9.4]

Ambient weather conditions during work hours are reported in Table 2. Data for controls reflect conditions they would have experienced if they had been working outdoors. All median average and maximum heat index and WBGT values are in the caution or extreme caution range.

TABLE 2. Regional Weather Characteristics during Work Hours. Agricultural and Non-Agricultural (Control) Participants. Homestead, Florida; April and August 2018.

Weather Conditions (based on participant's work hours[1])	**Agricultural Workers (n = 63)**		**Controls[2] (n =27)**	
	Median	[Q1, Q3]		
Ambient Temperature (°F), average	83	[81, 87]	84	[82, 88]
Ambient Temperature (°F), max	87	[83, 90]	88	[85,90]
Relative Humidity (%), average	70	[65, 78]	67	[65, 77]
Heat Index Mean (°F), average	89	[83, 96]	91	[85, 99]
Heat Index Max (°F), max	94	[87, 102]	99	[90, 103]
WBGT (°F), average	82	[79, 85]	83	[81, 86]
WBGT (°F), max	84	[82, 87]	86	[83, 87]

Specific Aims 2 and 3 Results. On average, agricultural workers drank nearly twice the volume of beverages per hour as did control workers (9.5 oz/hour vs. 5 oz/hour; p<0.001) [Table 3; Figure 1]. Median sugary beverage consumption over the course of the workday was substantially higher among agricultural workers (12 oz vs. 0 oz; p=0.001) [Figure 2].

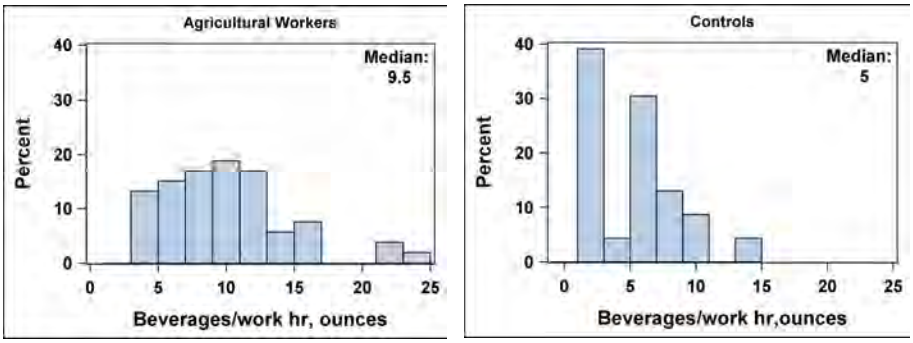

FIGURE 1. Beverage consumption per work hour during the workday.

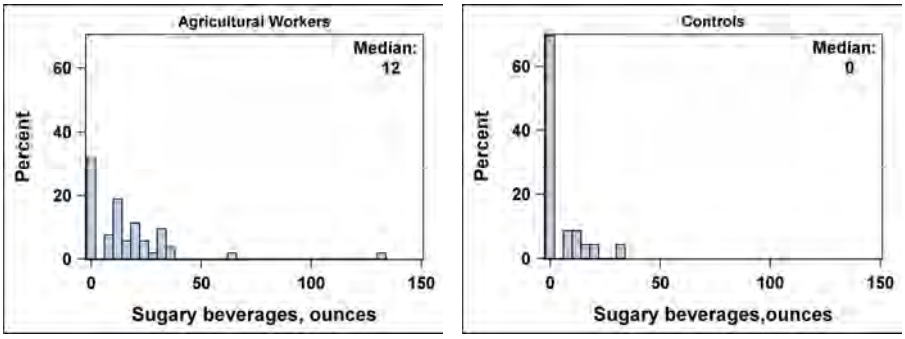

FIGURE 2. Total sugary beverage consumption during the workday.

When comparing pre-work to pre-work readings and post-work to post-work readings, hydration and kidney function markers differed little between the two groups. The majority of both types of workers were dehydrated (usg≥ 1.020) before work, and approximately seven out of 10 after work. Average serum osmolality was similar and in the high normal range in both groups, as was eGFR. The proportion with post-workday eGFR<90 was somewhat higher, but not significantly higher, in the control group (19% vs. 33%; p=0.152). Acute kidney injury occurred at nearly identical rates (15% vs. 17%; p=0.775). Two differences of note were that severe dehydration (usg>1.030) occurred in 11-14% of the agricultural group but not at all among controls (p_{pre}=0.077; p_{post}=0.053) and that post-work serum potassium was modestly lower in the agricultural group (3.9 vs. 4.1; p=0.024).

TABLE 3: Hydration and Kidney Function Markers among Agricultural and Non-Agricultural workers.[1]

	Agricultural Workers		Controls			
	Pre-shift	**Post-shift**	**Pre-shift**	**Post-shift**	**Pre v Pre p-value[2]**	**Post v Post p-value[2]**
	Mean (SD), Median [q1,q3], or n (%)					
Beverages/work hour (oz)	9.5 [6.3, 12.0]		5.0 [2.7, 7.2]	--		**<0.001**
Hydration Markers						
Urine specific gravity (USG)	1.023 [1.017, 1.027]	1.024 [1.017, 1.029]	1.021 [1.017, 1.024]	1.022 [1.020,1.024]	**0.039**	0.352
USG ≥ 1.020	36 (64%)	41 (69%)	15 (57%)	19 (76%)	0.444	0.546
USG > 1.030	6 (11%)	8 (14%)	0 (0%)	0 (0%)	0.077	0.053
Serum Osmolality	296 (4)	295 (4)	294 (3)	295 (4)	0.077	0.843
Kidney Function Markers						
Serum Creatinine (mg/dL)	0.60 [0.50, 0.70]	0.70 [0.60, 0.80]	0.60 [0.50, 0.70]	0.70 [0.50, 0.85]	0.803	0.760
eGFR (mL/min/1.73m²)	117 [107, 124]	112 [99, 119]	119 [110, 128]	118 [88, 126]	0.262	0.754
eGFR < 90 mL/min/1.73m²	3 (5%)	10 (19%)	1 (4%)	8 (33%)	0.866	0.152
Urine Protein >= 30 mg/dL	10 (18%)	12 (20%)	9 (33%)	8 (30%)	0.106	0.251
BUN (mg/dL)	13.2 (4.7)	14.5 (5.2)	12.9 (4.3)	14.1 (5.2)	0.741	0.989
BUN > 20 mg/dL	5 (8%)	9 (16%)	1 (4%)	2 (8%)	0.498	0.342
Serum Potassium (mmol/L)	4.2 [4.0, 4.4]	3.9 [3.8, 4.2]	4.2 [4.1, 4.4]	4.1 [3.9, 4.4]	0.869	**0.024**
Serum Sodium (mmol/L)	141 (2)	141 (2)	140 (1)	141 (1)	0.097	0.611
Acute Kidney Injury (AKI)[3]	--	8 (15%)	--	4 (17%)		0.775

[1] n for serum, morning (agric=62 and controls=25) and afternoon (54 and 24); n for urine, morning (56 and 27) and afternoon (59 and 25).
[2] two-independent group t-test, Wilcoxon rank sum test, or chi-square test, as appropriate.
[3] Based on KDIGO criteria

The incidence of self-reported heat-related symptoms were consistently similar between the heat-exposed agricultural worker group and the control group [Table 4]. The most common symptoms were heavy sweating and headache, reported by about 1 in 4 and 1 in 5 participants, respectively. Confusion, nausea, and dizziness were reported by about 1 in 10 participants. On average, approximately one symptom was reported. Average heart rate during the workday was marginally higher in the agricultural group (95 vs. 87; p=0.060], with few in either group having an average heart rate >115 bpm.

TABLE 4. Heat-related illness (HRI) symptoms and continuously monitored heartrate among Agricultural and Non-agricultural workers.

	Agricultural Workers		Controls		
	n, % or mean (SD)				
HRI Symptoms					
Heavy Sweating	14	25%	7	29%	0.666
Headache	9	16%	5	21%	0.561
Confusion	7	12%	2	8%	0.622
Nausea	6	10%	3	13%	0.776
Dizziness	5	9%	3	13%	0.591
Muscle Cramps	4	7%	2	8%	0.820
Fainting	1	2%	0	0%	0.518
Reporting ≥2 symptoms	12	21%	5	21%	0.982
Reporting ≥3 symptoms	4	7%	3	13%	0.423
Mean # of HRI symptoms	0.8	(1.3)	0.9	(1.4)	0.686
Heart rate[1]					
Mean, bpm	95	[89, 106]	87	[79, 100]	0.060
Mean >115 bpm	5	9%	1	6%	0.636

[1] Agricultural workers n= 55, and Controls n=18; missingness due to missing or unusable monitor files.

Biomarkers of kidney injury are reported in Tables 5a and 5b. Table 5a has comparisons of agricultural and control workers for pre-workday, post-workday, and the change over the workday. Note that values are medians; median change will not equal the change in pre and post medians. Creatinine-normed values are preferred for spot urine samples as they correct for changes in urine concentration due to urinary concentration or dilution related to fluid intake. With the exploratory nature of this study, which took place in an understudied population, we elected to show both creatinine-normed and non-normed values for reference.

As shown in Table 5a, nearly all the significant differences observed between groups were for pre-work comparisons, with higher medians for agricultural workers for creatinine, Beta 2 microglobulin, Cystatin C, EGF, KIM-1, Osteopontin, and uric acid (all $p<0.05$); albumin was marginally significantly higher (2.73 µg/ml vs. 2.03 µg/ml; $p=0.08$). Post-workday albumin for agricultural workers was higher than for controls (4.48 µg/ml vs. 2.85 µg/ml), but was also considerably more variable (IQR 7.2 vs. 3.8). As compared to controls, agricultural workers were more likely to have a decrease in markers by post-workday for KIM-1 (ng/dl change = -0.214 vs. +0.055; $p=0.039$) and Uromodulin (-2.6 µg/ml vs. +0.9 µg/ml; $p=0.078$). Table 5b has comparisons for creatinine-normed values of the same biomarkers. Of 27 comparisons, only one showed a significant difference between the two groups. Pre-workday Osteopontin was higher among agricultural workers (0.743 µg/mg vs. 0.557 µg/mg; $p=0.048$).

TABLE 5a. Kidney injury biomarkers in urine samples: comparing Agricultural and Non-Agricultural workers.[1]

		Agricultural Workers			Controls			Wilcoxon rank-sum test p-value
Biomarker	**time**	**median**	**q1**	**q3**	**median**	**q1**	**q3**	
Creatinine, mg/dl	am	**118**	90	178	**91**	52	131	**0.012**
	pm	**152**	77	203	**126**	101	154	0.268
	change	**24**	-37	81	**34**	-9	72	0.560
Albumin, µg/ml	am	**2.73**	1.64	5.22	**2.03**	1.20	3.39	0.080
	pm	**4.48**	2.12	9.31	**2.85**	1.59	5.39	0.225
	change	**0.10**	-1.39	3.66	**0.22**	-0.83	3.51	0.761
Beta2 microglobulin, µg/ml	am	**0.125**	0.084	0.192	**0.073**	0.033	0.094	**0.0003**
	pm	**0.110**	0.042	0.169	**0.082**	0.037	0.120	0.204
	change	**-0.024**	-0.086	0.045	**-0.003**	-0.041	0.062	0.111
Cystatin C, µg/ml	am	**0.054**	0.033	0.078	**0.039**	0.022	0.051	**0.010**
	pm	**0.061**	0.026	0.102	**0.051**	0.039	0.064	0.346
	change	**-0.002**	-0.026	0.041	**0.007**	-0.009	0.035	0.348
EGF, µg/ml	am	**0.018**	0.012	0.026	**0.013**	0.006	0.021	**0.045**
	pm	**0.022**	0.010	0.036	**0.018**	0.011	0.027	0.532
	change	**0.002**	-0.007	0.014	**0.003**	-0.003	0.012	0.467
Kim 1, ng/dl	am	**1.001**	0.592	1.709	**0.532**	0.286	1.111	**0.023**
	pm	**0.750**	0.315	1.350	**0.709**	0.287	1.277	0.996
	change	**-0.214**	-0.857	0.395	**0.055**	-0.210	0.430	**0.039**
NGAL, µg/ml	am	**0.058**	0.027	0.111	**0.046**	0.019	0.103	0.313
	pm	**0.055**	0.027	0.123	**0.060**	0.034	0.109	0.953
	change	**-0.004**	-0.035	0.024	**0.004**	-0.001	0.019	0.450
Osteopontin, µg/ml	am	**0.955**	0.474	1.524	**0.463**	0.138	0.883	**0.003**
	pm	**1.067**	0.400	2.217	**0.810**	0.377	1.408	0.146
	change	**0.106**	-0.570	1.302	**0.060**	-0.126	0.822	0.718
Uric acid, mg/dl	am	**55**	43	74	**45**	30	55	**0.004**
	pm	**66**	42	92	**58**	39	73	0.146
	change	**14**	-10	34	**13**	-2	26	0.806
Uromodulin, µg/ml	am	**14.4**	8.7	23.8	**12.4**	6.2	16.6	0.327
	pm	**9.3**	5.6	17.5	**14.5**	6.9	25.5	0.159
	change	**-2.6**	-10.4	3.7	**0.9**	-4.5	10.6	0.078

[1]Agricultural workers n: am=58, pm=63
Controls n: am=27, pm=26

TABLE 5b. Kidney injury biomarkers, normed to creatinine, in urine samples: comparing Agricultural and Non-Agricultural workers.

		Agricultural Workers			Controls			Wilcoxon rank-sum test p-value
Biomarkers[1]	**time**	**median**	**q1**	**q3**	**median**	**q1**	**q3**	
Albumin	am	**2.39**	1.44	3.69	**2.01**	1.35	4.53	0.936
	pm	**3.03**	2.08	6.17	**2.59**	1.54	4.42	0.253
	change	**0.11**	-0.76	1.24	**-0.07**	-1.06	0.53	0.491
Beta2 microglobulin	am	**0.106**	0.072	0.157	**0.082**	0.065	0.109	0.085
	pm	**0.079**	0.051	0.117	**0.070**	0.050	0.089	0.172
	change	**-0.019**	-0.062	0.005	**-0.012**	-0.055	0.004	0.725
Cystatin C	am	**0.048**	0.030	0.069	**0.039**	0.030	0.067	0.438
	pm	**0.049**	0.035	0.067	**0.040**	0.035	0.050	0.091
	change	**-0.002**	-0.014	0.012	**0.000**	-0.021	0.014	0.981
EGF	am	**0.016**	0.010	0.020	**0.015**	0.010	0.018	0.717
	pm	**0.016**	0.011	0.020	**0.015**	0.011	0.020	0.729
	change	**0.001**	-0.003	0.002	**-0.001**	-0.002	0.002	0.881
Kim 1	am	**0.767**	0.496	1.208	**0.750**	0.427	1.059	0.444
	pm	**0.555**	0.368	0.798	**0.694**	0.379	0.891	0.276
	change	**-0.241**	-0.500	-0.028	**-0.110**	-0.310	0.059	0.107
NGAL	am	**0.044**	0.024	0.081	**0.046**	0.017	0.231	0.869
	pm	**0.047**	0.027	0.118	**0.044**	0.028	0.098	0.925
	change	**-0.008**	-0.024	0.008	**-0.002**	-0.026	0.010	0.904
Osteopontin	am	**0.743**	0.588	1.030	**0.557**	0.219	0.804	**0.048**
	pm	**0.779**	0.606	1.072	**0.752**	0.370	0.901	0.184
	change	**-0.024**	-0.262	0.315	**0.005**	-0.183	0.244	0.813
Uric acid	am	**0.460**	0.382	0.666	**0.541**	0.346	0.723	0.789
	pm	**0.519**	0.399	0.813	**0.496**	0.382	0.563	0.181
	change	**0.024**	-0.157	0.248	**-0.025**	-0.190	0.154	0.190
Uromodulin	am	**13.0**	6.7	21.6	**17.1**	8.1	27.3	0.247
	pm	**8.8**	4.1	20.4	**12.9**	6.4	19.9	0.288
	change	**-3.0**	-7.9	4.2	**-0.4**	-21.7	11.9	0.896

[1]KIM-1 units=ng/mg creatinine; uric acid units= mg/mg creatinine; all others are µg/mg creatinine

Specific Aim 4 Results. To examine differentially express metabolomics features between the heat-exposed group and the controls and the effect of environmental heat (within the exposed group) on metabolites, we ran four linear regression models that adjusted for the possible confounding effects of age, gender, body mass index (BMI), country of origin (Mexican vs all others), and workday length. The sampling time and main effect of interest for the models are:

- Model 1: pre-work, heat-exposed v controls
- Model 2: post-work, heat-exposed v controls
- Model 3: pre-work exposed, maximum wet bulb globe temperature (WBGT) on previous day
- Model 4: post-work exposed, maximum wet bulb globe temperature (WBGT) during working hours

We examined each model with hilicpos and c18neg columns, yielding 8 models in total. Significant metabolites were selected using permutation methods [Table 6]. Data for the hilicpos and c18neg columns are expected to overlap for some pathways, but each provides detection ability for distinctly different pathways as well.

It was key to verify that there were differentially expressed features (metabolites) related to WBGT in the pre-workday and post-workday samples for before performing a combined analysis which will be part of the next phase of the planned analysis using a random effects model.

TABLE 6. Differential Expression Analysis using R package lmreg.

Model	Main Effect[1]	Time	Column type	Number of differentially expressed features from plasma samples
1A	Heat-exposed v Control	pre-workday	hilicpos	303
1B			c18neg	183
2A		post-workday	hilicpos	202
2B			c18neg	119
3A	Heat-exposed participants only:	pre-workday	hilicpos	862
3B	max WBGT on previous day		c18neg	693
4A	Heat-exposed participants only:	post-workday	hilicpos	601
4B	max WBGT during work hours		c18neg	398

[1] covariates taken into consideration included age, gender, body mass index (BMI), country of origin (Mexican vs all others), and workday length. [2]

Figures 3, 4, 5, and 6 display the results visually. Manhattan plots visualize the significant up and down regulated metabolites as they associate with the chemical class distribution based on the m/z (size of the metabolites). Volcano plots show the quantity of significant metabolites and the associated fold change (effect size). Two-way hierarchical clustering analysis (HCA) displays the clustering pattern of discriminatory features (metabolites). This non-targeted metabolomic analysis successfully identified differentially expressed features from the plasma samples ranging from 303 to 862 features for the 8 different models.

Two-way hierarchical clustering analysis (HCA) provided reassuring evidence of clustering of metabolites that are known to be related and had a higher expression in the heat exposed (concentrated areas of red). for models 1A, 1B, 2A, and 2B [Figures 3 and 4]. Clustering was also present for related metabolites that had a higher expression in controls (concentrated areas of blue). Clustering in the HCA visualization was even more pronounced for models 3A, 3B, 4A, and 4B which compared metabolites that had a positive relationship with WBGT (concentrated areas of blue) and those that had a negative relationship with WBGT (concentrated areas of red).

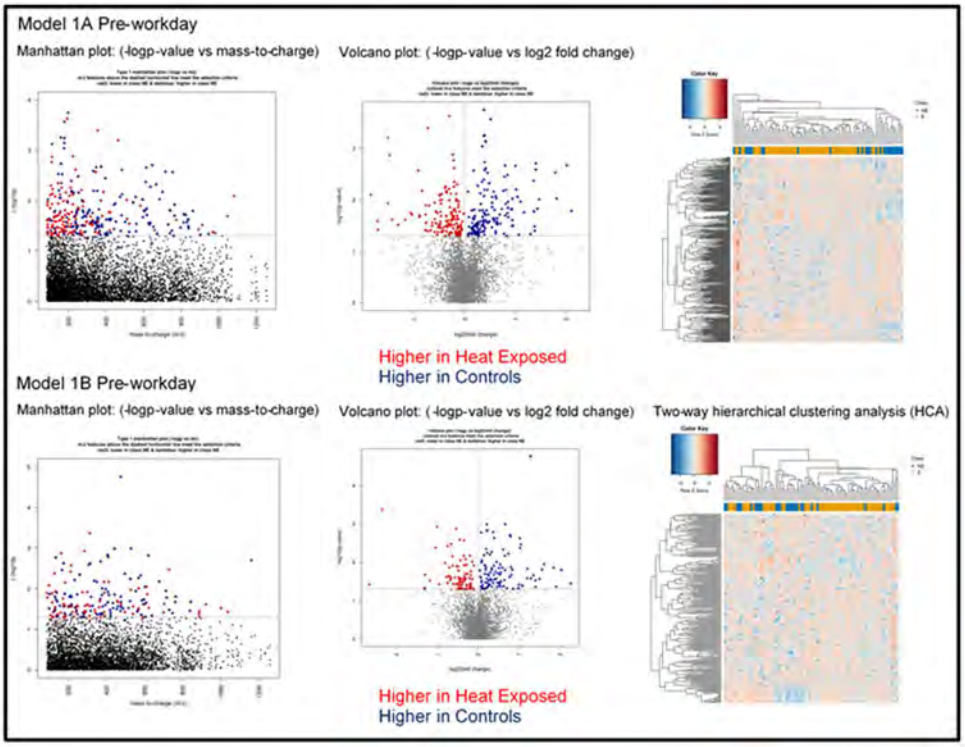

Figure 3. Visualization Summary Diagrams for Heat Exposed vs Controls, Pre-Workday Models 1A and 1B

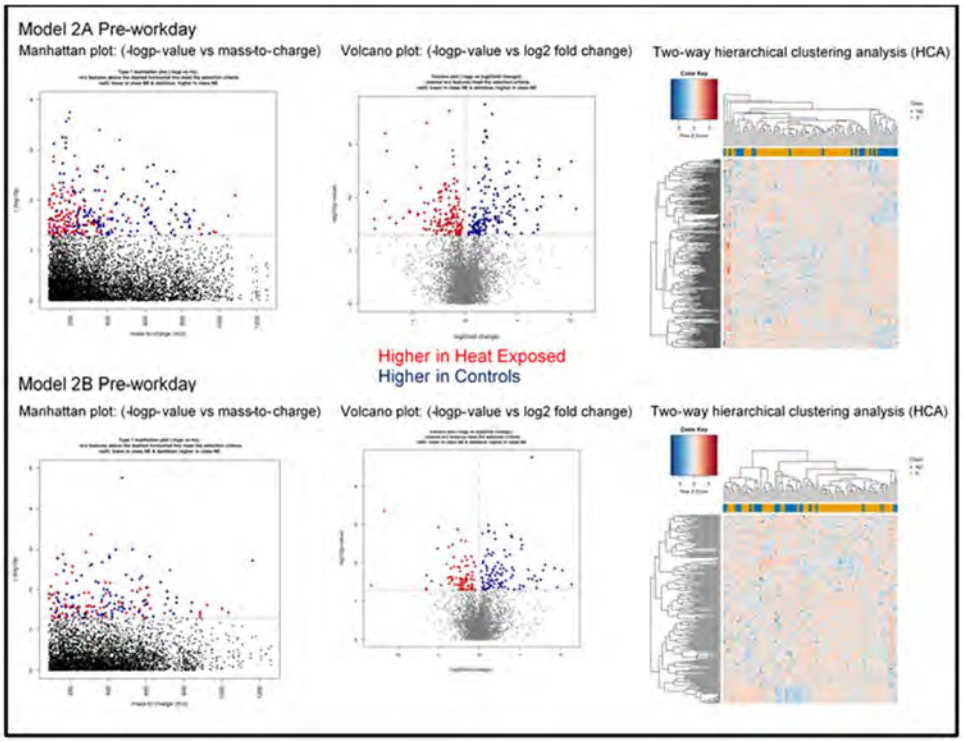

FIGURE 4. Visualization Summary Diagrams for Heat Exposed vs Controls, Post-Workday Models 2A and 2B

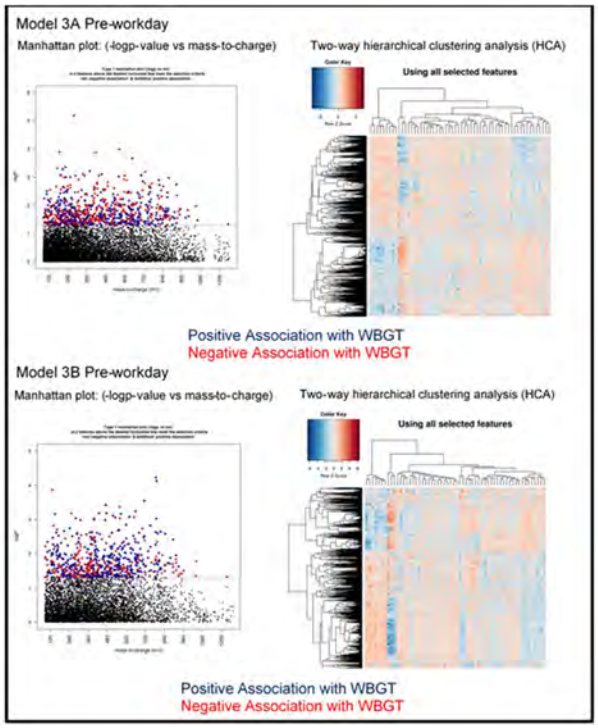

FIGURE 5. Visualization Summary Diagrams for Heat Exposed Participants Only, Positive Association with WBGT vs, Negative Association with WBGT, Pre-Workday Models 3A and 3B

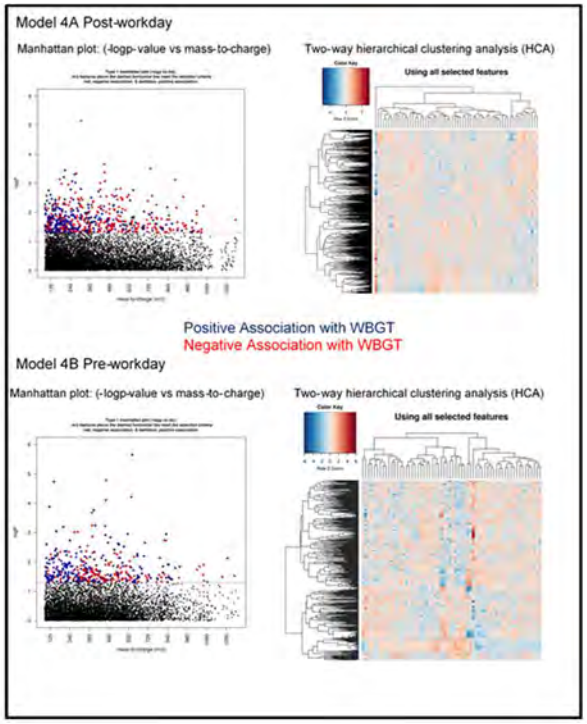

FIGURE 6. Visualization Summary Diagrams for Heat Exposed Participants Only, Positive Association with WBGT vs, Negative Association with WBGT, Post-Workday Models 4A and 4B

TABLE 7. Pathway Analysis for Models 1A, 1B, 2A, and 2B for Heat Exposed vs Controls

Metabolic Pathways Identified that Differed between Heat Exposed vs Controls[1]	Overlap size	p-value
Model 1A (Pre-workday)		
Tryptophan metabolism	4/33	0.00458
Aspartate and asparagine metabolism	4/46	0.0212
Tyrosine metabolism	5/67	0.0373
Model 1B (Pre-workday)		
Urea cycle/amino group metabolism	3/32	0.0649
Tryptophan metabolism	3/33	0.0727
Model 2A (Post-workday)		
Phytanic acid peroxisomal oxidation	4/7	0.0023
Arginine and Proline Metabolism	6/34	0.00541
Squalene and cholesterol biosynthesis	6/35	0.00589
Aspartate and asparagine metabolism	8/54	0.00603
De novo fatty acid biosynthesis	4/18	0.0064
Drug metabolism - other enzymes	4/21	0.00953
Ascorbate (Vitamin C) and Aldarate Metabolism	4/21	0.00953
Urea cycle/amino group metabolism	5/39	0.0251
Purine metabolism	6/53	0.03398
Model 2B (Post-workday)		
De novo fatty acid biosynthesis	4/19	0.00719
Aspartate and asparagine metabolism	8/54	0.00799
Glycerophospholipid metabolism	6/40	0.01242
Leukotriene metabolism	5/32	0.01436
Arginine and Proline Metabolism	5/34	0.01918

[1] Pathway Analysis using features selected at $p<0.05$

TABLE 8. Pathway Analysis for Models 3A, 3B, 4A, and 4B for Heat Exposed Participants Only, Positive Association with Wet-Bulb Globe Temperature (WBGT) vs Positive Association with WBGT

Metabolic Pathways Identified that had a positive association with WBGT vs a negative association with WBGT[1]	Overlap size	p-value
Model 3A (Pre-workday)		
Butanoate metabolism	5/19	0.09134
Carnitine shuttle	6/27	0.13084
Urea cycle/amino group metabolism	7/36	0.18209
Aspartate and asparagine metabolism	8/51	0.35004
Glycerophospholipid metabolism	5/28	0.30149
Model 3B (Pre-workday)		
TCA cycle	9/19	0.00071
Propanoate metabolism	8/16	0.00072
Galactose metabolism	12/34	0.00137
Pyruvate metabolism	7/18	0.0022
Glycerophospholipid	8/22	0.0024
Glycolysis and Gluconeogenesis	13/41	0.00242
N-Glycan biosynthesis	5/12	0.00344
Phytanic acid peroxisomal oxidation	4/9	0.00474
Fructose and mannose metabolism	7/23	0.00989
Caffeine metabolism	4/11	0.01175
Xenobiotics metabolism	17/66	0.01315
Valine, leucine and isoleucine degradation	7/24	0.01336
Vitamin B9 (folate) metabolism	5/16	0.01579
Glycine, serine, alanine and threonine metabolism	13/51	0.01908
Arginine and Proline Metabolism	9/36	0.03191
Model 4A (Post-workday)		
Lysine metabolism	6/17	0.00085
Histidine metabolism	5/17	0.0017
Urea cycle/amino group metabolism	8/36	0.00188
Purine metabolism	8/39	0.00274
Carnitine shuttle	6/27	0.00321
Aspartate and asparagine metabolism	9/52	0.00624
Glycerophospholipid metabolism	5/28	0.01354
Glycosphingolipid metabolism	4/21	0.01509
Methionine and cysteine metabolism	5/29	0.01625
Pyrimidine metabolism	5/34	0.03747
Model 4B (Post-workday)		
Butanoate metabolism	12/22	0.0009
Valine, leucine and isoleucine degradation	12/25	0.001
Ascorbate (Vitamin C) and Aldarate Metabolism	11/23	0.00107
Heparan sulfate degradation	5/6	0.00107
Chondroitin sulfate degradation	6/6	0.00107
Glycerophospholipid metabolism	16/41	0.00121
Glycine, serine, alanine and threonine metabolism	17/50	0.00206
TCA cycle	7/16	0.00236
Propanoate metabolism	5/6	0.00261
Aspartate and asparagine metabolism	19/62	0.00389
Glyosphingolipid metabolism	10/29	0.00458
Omega-3 fatty acid metabolism	4/8	0.00612
Selenoamino acid metabolism	7/20	0.00861
Lysine metabolism	8/25	0.01216
Methionine and cysteine metabolism	14/50	0.01578
Histidine metabolism	7/22	0.01641
Arginine and Proline metabolism	10/35	0.02091
Beta-Alanine metabolism	5/15	0.02434
Urea cycle/amino group metabolism	12/44	0.02535
Caffeine metabolism	4/11	0.02578
Linoleate metabolism	6/20	0.03265

[1] *Pathway Analysis using features selected at p<0.05*

Conclusions

The Emory investigative team was able to identify metabolic pathways that contained multiple metabolites that significantly differed between the heat exposed group and the controls [Table 7] as well as metabolites that were positively associated with WBGT and those that were negatively associated with WBGT [Table 8]. Large numbers of significant features were detected consistently more in pre-workday samples as compared to post-workday samples.

Metabolic pathways that were recurring through multiple models included aspartate and asparagine metabolism, TCA cycle, urea cycle/amino group metabolism, valine, lecucine and isoleucine degradation, ascorbate (Vitamin C) and aldarate metabolism, and purine metabolism. Examples of confirmed metabolites of some of the metabolic pathways identified were L-Carnitine, 4-Hydroxybenozate, pyridoxal, adenine, Pyridoxal, and 4-Acetamido-butanoate. Analysis of additional metabolites and their significance is ongoing.

This study is one of the first studies to provide evidence of acute kidney injury in occupational populations in Florida, and replicates the findings of the Girasoles Study completed in 2014 that found a similar prevalence of AKI in Florida agricultural workers. Occupational heat exposure has been linked to AKI as one of a few potential precipitating factors; however, the mechanism for the development of AKI in heat-exposed workers is not well understood. Therefore, the current study continues the examination of the emerging health threat of heat-related illness, with a specific focus on early biomarkers of AKI in pre- and post-workday urine samples, and set the foundation for the examination of the interrelationships between heat exposure and other potential risk factors. The current study sought to utilize plasma metabolomics analysis to determine if there were metabolic pathways associated with working in the heat, and then examine the relationship of these metabolic pathways related to those involved in acute kidney injury.

The biomarker results from this study might provide some degree of evidence that agricultural workers (heat-exposed) may not be recovering fully from the previous workday due to elevated urinary biomarkers of acute kidney injury (AKI) in morning, pre-workday urine samples as compared to non-heat exposed controls, but this possibility is diminished due to participants in the heat exposed being significantly more dehydrated at the pre-workday timepoint as compared to controls. There was no significant difference in biomarkers of AKI in the post-workday samples between the groups. In the unadjusted analysis of urinary biomarkers, several urinary biomarkers were significantly elevated in the pre-workday urine samples of the heat exposed group as compared to controls: beta2microglobulin (B2M), cystatin C, epidermal growth factor (EGF), kidney injury molecule-1 (KIM-1), osteopontin, and uric acid. In the creatine-adjusted biomarker analysis, osteopontin was the only significantly elevated biomarker of AKI at the pre-workday timepoint. Osteopontin is a biomarker that has been found in other studies to be elevated in acute and chronic kidney disease. Further investigation is needed in a larger and longitudinal cohort with concurrent serum biomarkers to elucidate these preliminary findings.

The research team did not find a significant difference between the heat exposed group and controls in the level of physical activity at work based on heart rate. In addition, we did not find a relationship between levels of physical activity at work and specific urinary biomarkers of AKI. Intake of sugary beverages was significantly higher in the agricultural worker group as compared to the non-heat exposed controls. This finding has important health implications because in addition to other potential drivers of AKI and chronic kidney disease (CKD) experience by outdoor workers, the intake of sugary beverages, including those consumed during recovery form heavy physical activity, serves as an additional risk factor for this

population. In the metabolomic pathway analysis of pre-workday plasma samples, metabolites that were part of fructose and mannose metabolism showed differential expression in relation to wet-bulb globe temperatures from the previous workday. Further analysis will examine this finding more in depth.

Metabolic pathways that were recurring through multiple models included aspartate and asparagine metabolism, TCA cycle, urea cycle/amino group metabolism, valine, lecucine and isoleucine degradation, ascorbate (vitamin c) and aldarate metabolism, and purine metabolism. Examples of confirmed metabolites of some of the metabolic pathways identified were L-Carnitine, 4-Hydroxybenozate, Pyridoxal, Adenine, Carylic acid, Pyridoxal, and 4-Acetamidobutanoate. Analysis of additional metabolites and their significance is ongoing.

In the next stage of analysis, we will utilize targeted metabolomic analysis to examine specific metabolite associations with heat exposure (heat exposed participants) and WBGT. Then, we will cross-reference the key metabolites to those that have been identified in the literature as having potential involvement in metabolic pathways associated with acute kidney injury.

From this foundational data, we can begin to examine the interrelationships between chronic exposure to environmental heat, physical activity, and acute kidney injury over time, while identifying specific perturbations in endogenous metabolism. In the current study we designed and employed a protocol that utilized non-targeted metabolomics to identify pathways that differed in heat-exposed agricultural workers vs. non-heat exposed working groups as well as under varying outdoor temperatures for heat-exposed agricultural workers.

While continuing to pursue an understanding of the interrelationships between heat exposure and acute kidney injury though continued funding from NIOSH/CDC (CDC/NIOSH R01 OH011782), the study team is also building community-based approaches for decreasing heat-related illness through testing heat-adaptive strategies in agricultural worker communities around Florida while providing health education and health screenings based on study findings from the current program of research that are relevant for heat-exposed, agricultural worker populations.

Limitations. Our cross-sectional study that utilized pre- and post-workday measures for examining agricultural workers and controls in Florida is limited in scope and may not be generalizable to other agricultural worker populations in other regions. A longitudinal design that follows participants over time will be needed to better elucidate the incidence of acute kidney injury and changes in kidney function over time. Adjusting for creatinine in the urinary biomarker analysis, while recommended for spot urine samples, may add bias for this study sample. It is possible that some participants in this population may have elevated creatinine in their urine for pathological reasons, rather than as a normal and constant value by which to gauge urinary dilution and concentration. For individuals with pathologically elevated creatinine, the biomarker data may be falsely diminished. Our future longitudinal study includes plasma biomarkers, rather than urinary biomarkers like the current study, as well as more detailed measurements of hydration. As a more stable biological matrix, plasma biomarkers may show more resolution regarding biomarkers of AKI in this population. Data collection occurred in both May and August. Participants in the control group were eligible for participation if they worked indoors and in air-conditioned environments; however, control participants enrolled in August may have experienced higher heat exposure when not working as compared to May participants. We were unable to capture workplace microclimate ambient temperature and humidity readings due to equipment failure.

Outreach and Dissemination

The investigative team met with an environmental horticulture specialist, Miami-Dade County Extension Agent Vanessa Campoverde, to facilitate collaboration with growers and allow for additional recruitment access. Working closely with local extension agents and growers was a priority to bring attention to heat-related illness and to develop avenues for future dissemination of research findings. Ms. Campoverde learned about project recruiting needs and conducted a site visit of data collection in a nursery learn about the research process and assist with recruitment of other interested growers. Dr. Mac attended a training on H2A worker hiring and completed recruitment outreach. In August 2018, the project conducted a heat illness prevention training for crew leaders, growers and farmers build relationships with growers and farmers.

In October 2018, Linda McCauley presented and served as a panelist at the State of the Science Meeting for Heat in St. Petersburg, FL. Linda McCauley and Valerie Mac served as authors on the white paper generated from this meeting entitled, "State of the Science White Paper: Interdisciplinary Perspectives on Heat Related Illness Prevention". Photography generated from the "Facing the Sun" documentary provided key visuals that supported the findings and messages in this report.

In November 2018, Antonio Tovar and Roxana Chicas traveled to the Mexican Consulate to meet with representatives there and discuss heat-related health risks for agricultural workers in Florida and share findings from the current research program.

In April/May/June/July 2019, Jeannie Economos has participated in month calls with the National Heat Stress Network to share findings related to the occupational health risks of heat generated from our team's program of research.

In May/June/July/August 2019, Antonio Tovar traveled to talk to stakeholders (policy makers, clinicians, growers, the interagency for agricultural workers, campus and community partnerships) regarding the study findings of the current research from related to heat and acute kidney injury.

In May 2019, Roxana Chicas and Nezahualcoytl Xiuhtecutli traveled to the community of Pierson, Florida to disseminate findings from our current research program related to heat illness and kidney injury. Information about risks related to working in the heat and the team's current research efforts to decrease heat risk and understand the factors related to the acute kidney injury we are seeing in the Florida agricultural worker population was provided to prospective research participants. To support efforts to reduce heat illness and heat-related conditions like kidney disease, the team completed a pilot study (n=38) testing the feasibility and efficacy of heat-adaptive interventions for heat related illness prevention. Heat-adapted interventions that were tested for feasibility of use and effectiveness included a cooling vest with cooling inserts, a cooling bandana, or a combination of both. All participants received health -related information about how heat can affect their health as well as precautionary guidance for how to stay safe in the heat thorough hydration, breaks, and use of shade. Participants also received screening results for blood pressure, blood glucose, body mass index, urine dipstick readings, and kidney-related lab values like serum BUN and creatinine. Participants were instructed to share their screening results with their primary care provider. Participants were also notified if their results were out of normal lab value range and were provided information about how to access a local health care provider.

In May 2019, Antonio Tovar traveled to Albuquerque, NM to the Food Chain Workers Summit to present a workshop on training agricultural workers about heat illness prevention and the current heat illness prevention trainings offered by the Farmworker Association of Florida and the University of Florida, with the support of the SCCAHS, and based upon findings from the study team's current program of research relate to heat illness and acute kidney injury.

In July 2019, Jeannie Economos met with other community-based groups who support agricultural worker communities at the Food Chain Workers Alliance Annual Meeting in Albuquerque, New Mexico to discuss the ongoing heat and acute kidney injury research and outreach in Florida. Stakeholders included workers and NGO leaders who have affiliations to indigenous communities

In September, 2019, Valerie Mac and Jeannie Economos attended the SCCAHS State of the Science Meeting for Mental Health in Agricultural Communities in or der to interface with other SCCAHS members and stakeholders to discuss agricultural worker health, current study findings, and build collaborations. Valerie Mac discussed study findings with SCCAHS research core member, Tom Bernard, from the University of South Florida, who is a heat expert. Tom Bernard will be providing input and additional expertise for the heat biomonitoring-related papers that are in preparation by the study team

Due to the scientifically complex nature of the metabolomics-related findings, the dissemination effort for aims 3 and 4 will focus on a scientific audience. We plan to offer a webinar presentation to disseminate and discuss study findings once the planned metabolite and biomarker analyses are complete. We will also promote the bank of blood samples and the metabolomics database that will be available for other researchers for exploratory data analysis at that time. After this, a community-oriented dissemination will be designed with input from other heat experts, community stakeholders, and occupational health scientists at the SCCAHS. A manuscript is currently in preparation to share the findings of aims 1-4 for a scientific audience.

Publications

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Chicas, R, Mix, J, Dickman, N, Flocks, J, Hertzberg, V, and McCauley, L. Chronic Kidney Disease Among Workers: A Review of the Literature. Workplace Health Saf. 2019 Sep 10.1177/2165079919843308

Webinars and Panels

McCauley, L. (February 12, 2019). Heat Stress and Biomarkers of Renal Disease [Video webinar].

Retrieved from http://www.sccahs.org/index.php/2019/01/23/upcoming-webinar-heat-stress-andbiomarkers-of-renal-disease-feb-12th-10am-11am/.

Conferences

McCauley, L., (October 2018). The Girasoles (Sunflower) Study: Exploring the Physiologic Heat Stress Response. SCCAHS Heat-Related Illness State of the Science Meeting. St. Petersburg, FL.

Mac, V., (November 2018). Risk Factors Associated with Reaching Recommended Physiological Limits for Core Body Temperature in Agricultural Workers. American Public Health Association, San Diego, CA.
This poster displayed results from the Girasoles Study and discussed the level of heat illness risked faced by ag workers in Florida. This poster also discussed potential interventions for HI in Florida Ag workers and described the biomonitoring protocol that is also being employed in the current Renal Biomarkers or Heat Stress study.

Hertzberg, V.S., (November 2018). Regional Variation in End-Stage Renal Disease: Could Heat Exposure be a Risk Factor among Young Hispanic Males? American Public Health Association, San Diego, CA.
This poster describes an analysis of publicly available data from the CDC Wonder database. This study aimed to examine end stage renal disease (ESRD) mortality in young white males in the US, to determine time trends over 1999-2016, to compare mortality rates by ethnicity, and to examine if rates are elevated in southern states more likely to experience longer periods of hot temperatures.

Xiuhtecutli, N. & Mac, V. (February 2019). Heat-Related Illness Insights in Agricultural Workers through Collaborative Community-Based Research. Florida Rural Health Educational Summit. Jacksonville, FL. Neza Xiuhtecutli and Valerie Mac provided a presentation and attended the Florida Rural Health Summit in Jacksonville, FL

In March 2019, Linda McCauley and Valerie Mac attended the SCCAHS Community Stakeholder Advisory Board meeting in Apopka, FL where Linda McCauley participated in a scientific panel discussion about heat-related illness.

Mac, V. (2019, April). The Girasoles Study: Nurse-Led Heat Illness Research from Design to Dissemination. Concurrent session oral presentation at the American Association of Occupational Health Nurses Annual Meeting, Jacksonville, FL.

Chicas, R. (2019). Targeted heat-adaptive interventions for Florida agricultural workers. Podium Presentation at the Southeast Regional Research Symposium, Tampa, FL, April 4-5, 2019.
Roxana Chicas attended the Southeast Regional Research Symposium which focused on environmental and occupational health research. She presented about heat-adaptive interventions and dissemination and awareness efforts around acute kidney injury in Florida agricultural workers.

Chicas, R., Mac, V., Tovar, A., Hertzberg, V. & McCauley, L. (July, 2019). Targeted heat-adaptive interventions for Florida agricultural workers. Poster Presentation at the 2019 National Association of Hispanic Nurses Annual Conference, Reno, NV, July 18, 2019.
Roxana Chicas attended the NAHN conference to present her pilot study and provide information about her work and dissemination efforts for heat-related illness and heat-adaptive interventions for preventing heat illness.

Hertzberg V, Mac V, & McCauley L. (August, 2019). Gut Microbiome Profiles for Agricultural Workers Exposed to Exertional Heat, Dehydration, and Agricultural Pesticides. Poster Presentation.
PNASH Annual Meeting, University of Washington, Seattle, WA. Linda McCauley and Valerie Mac attended the PNASH Annual Meeting to represent the SCCAHS and to foster collaborative relationships with the other Ag Center. Valerie Mac McCauley serves as a member of the PNASH Advisory board.

Products

During the past 2 performance periods, the project has developed and tested an updated research protocol that includes more sensitive biomarkers of renal injury. A description of this protocol will be included in the manuscript that is generated from the results of aims 1-3 of this study.

The Emory investigative team has assembled a serum bank of samples from heat exposed and non-heat exposed participants from our data collection during Summer 2018 in Homestead, FL. These samples are available for the purpose of future exposome analyses for pesticides and nephrotoxic chemicals.

A metabolomics database has been assembled, which is currently in preparation for use to be available for exploratory analysis by other researchers. It will be available after the completion of our manuscript that reports our initial findings. This database will allow for the study of metabolic pathway perturbations associated with exposure to pesticide and nephrotoxic chemicals.

The documentary, *Facing the Sun*, was released on March 1st, 2019 and documents the problem of heat illness, the research addressing it, and the goal of working with employers to make workplaces safer. In the video, you will hear from SCCAHS researchers and affiliates in regards to the research project, in addition to SCCAHS partners (https://vimeo.com/325989337). This film was presented at the November 2019 Global Health Film Festival hosted by the American Public Health Association. This film is featured on the SCCAHS webpage in conjunction with the State of the Science White Paper for Heat Illness (http://www.sccahs.org/index.php/2019/02/05/girasole-documentary-facing-the-sun/).

Sustainability

The study team received continued funding (CDC/NIOSH R01 OH011782; PIs: McCauley/Hertzberg/Sands, 08/01/19 – 7/31/23) to expand the current study to a longitudinal cohort of 90 workers to examine the persistence of cute kidney injury using biomonitoring and metabolomics. This study is entitled, "Occupational Heat Exposure and Renal Dysfunction" with the overall goal of determining the inter-relationships between environmental heat exposures, biomarkers of renal function, persistence of acute kidney injury, and indicators of renal function degradation a cohort of 90 agricultural workers for two years.

The study team has also submitted an additional grant proposal to NIMHD based on the data generated from the team's continued research program and heat-related community-based dissemination efforts with the goal of implementing and testing a multi-level intervention for heat illness in agricultural workers in Florida.

P I S C A

Entrenamiento de Pesticidas e Insolación que es Culturalmente Apropriada

Pesticide & Heat Stress Education for Latino Farmworkers That is Culturally Appropriate

PD/PI: Joseph Grzywacz
Co-PD/PI: Antonio Tovar-Aguilar

Overview

Farmworkers, the majority of whom are Latino immigrants from Mexico, experience elevated rates of occupational injury and illness. Chronic low-dose exposure to pesticides and extreme heat and humidity are major sources of poor occupational health outcomes. Recent revisions to the EPA's Worker Protection Standard (WPS-r) and growing concern over heat-related illness (HRI) necessitate the creation of safety education curricula that to minimize pesticide exposure and the deleterious effects of exposure to heat and humidity. Use of community health workers or *promotoras de Salud* (*promotoras*) is common in farmworker occupational health, but few WPS or HRI curricula have been developed for dissemination by *promotoras*, and there is scant evidence that *promotoras* are equally effective as "professional educators" who often have college degrees or highly specialized training in the cognate material. The growing concern over heat illness and recent revisions to the U.S. Environmental Protection Agency (EPA) Worker Protection Standard focused on pesticide exposure training led to PISCA's work on a new safety education tool.

PISCA's overall goal is to reduce the burden of poor occupational health outcomes among Latino farmworkers resulting from pesticide exposure and heat illness. To achieve this goal the proposed project has built a community-advocate-university partnership to accomplish three primary aims –

1. Create reproducible, culturally- and contextually-appropriate appropriate curricula for Latino farmworkers targeting pesticide exposure (suitable for meeting employer requirements under the revised WPS) and heat-related illness (HRI).

2. Determine the effectiveness of the developed pesticide and HRI curricula implemented by professional educators in promoting advocated safety behaviors.

3. Identify the comparative effectiveness of promotora-based implementation of developed pesticide and HRI curricula relative to the use of professional educators.

Key Accomplishments in 2018-2019

PISCA Curricula

The three-pronged approach of the PISCA project has allowed for distinct phases to guide progress and innovation. Phases 1 and 2 were completed by the close of Year 3 and supported a preliminary test of the effectiveness of the PISCA Revised Worker Protection Standards (WPS-r) pesticide safety curriculum in changing knowledge and attitudes central to the WPS-r about pesticides. In Year 2, SCCAHS reported preliminary findings from Phase 1 and a manuscript was released during Year 3 titled, *Attending to pesticide exposure and heat illness among farmworkers*, in the Journal of Occupational and Environmental Medicine. (Figure 1)

ORIGINAL ARTICLE

Attending to Pesticide Exposure and Heat Illness Among Farmworkers

Results From an Attention Placebo-Controlled Evaluation Design

FIGURE 1. 2019 JOEM Manuscript, Phase I Results

Phase 1 Findings

The specific objective of the Phase I study was to determine the effectiveness of the PISCA curricula for improving knowledge and attitudes pertaining to pesticide exposure and heat illness. The evaluation makes two striking improvements to the literature to date. First, unlike any of the evaluations to date, PISCA uses a comparative design to compare pre- to post- test changes in farmworkers knowledge and attitudes. Second, the project simultaneously addresses two occupational health threats (ie, pesticide exposure and heat illness). In summary, heat illness knowledge and behavioral intention changed in a manner specific to the curriculum received (Figures 2,3,4) Change in knowledge and behavioral intention about heat illness were significantly elevated for those receiving the heat illness curriculum relative to those who received the WPS curriculum.

FIGURE 2. Estimated marginal means of pesticide safety behavioral intentions by study condition.

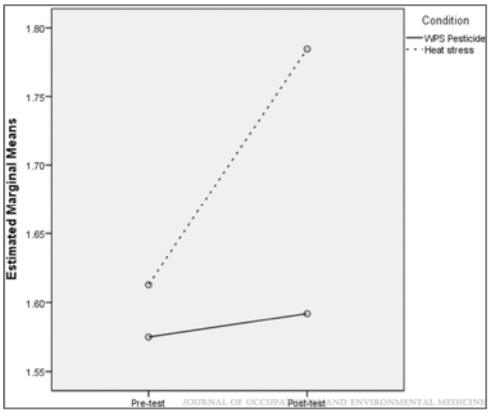


FIGURE 3. Estimated marginal means of heat illness knowledge by study condition.

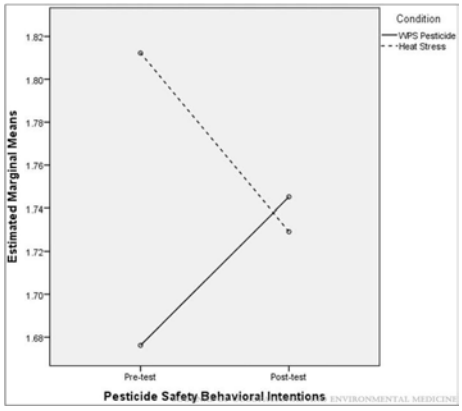


FIGURE 4. Estimated marginal means of heat illness behavioral intentions by study condition.

Phases II – III Progress

The Environmental Protection Agency (EPA), Office of Pesticide Programs approved the PISCA WPS Facilitator Guide and presentation for pesticide safety training for workers, titled "Agricultural Worker Pesticide Safety Training: Facilitator Guide" and "Worker Training: Worker Protection Standard Agricultural Worker Pesticide Safety Training" in July 2019. The training presentations and facilitator guide now include the EPA certification statement –

EPA has approved this material to fully train workers on pesticide safety in accordance with the 2015 WPS (40 CFR 170). The approval number is "EPA WPS Worker PST 00036."

Phase II data collection remained ahead of schedule. All farmworker participants were recruited (N=356) and pre-test and post-test data were obtained. Data collection closed in August 2019 and 3-month follow up retained 63% of recruited farmworkers across the 3-month observational period (N=221). Phase II data is presently being validated and analyzed. Preliminary models suggest PISCA WPS curriculum performs better in changing long-term behavior than the distributed EPA WPS video.

Trainings were presented at the October 2019 East Coast Migrant Stream Forum in San Juan, Puerto Rico. The overall goal of the session was to train step by step, following the ECMSF Training Toolkit, the delivery of the updated worker protection standard training to avoid, recognize, and treat pesticide exposure.

Phase III launched in Year 3 at the end of Quarter 4 and the investigative team is modifying the design to enable a comparison in effectiveness of "novice" relative to "experienced" *promotoras*, and both compared to "professional trainers." The hiring of novice *promotoras* will be finalized in Year 4 and the team anticipates data collection in December 2019.

Culturally Appropriate Curricula: Reaching Haitian Farmworkers

Translation of the PISCA curricula (both WPS and HRI) into Haitian Creole was completed. This was an unplanned element; however, the project's expansion into southern Florida resulted in exposure to a large number of Haitian farmworkers whose WPS training needs were not being met. The team has already completed all curricular materials (powerpoint slide deck, facilitator guides) in both English and Spanish. By the end of Project Year 3 all curricular materials (powerpoint and facilitator guides) will be available in Haitian Creole.

Outreach and Dissemination

PISCA Outreach with Echols County Familia Adelante, 2018

The PISCA investigative team continues to work closely with their Southeast communities to disseminate findings and build their network of key stakeholders. Nearly 1,000 Hispanic/Latino participants were reached during Year 3 outreach events. Year 3 outreach opportunities captured include the following:

- State of the Science Meeting: Stress and Resilience among Agricultural Workers in Vulnerable Rural Communities, St. Petersburg, Florida

- East Coast Migrant Forum, San Juan, Puerto Rico
- SCCAHS CSAB Annual Meeting, Apopka, Florida
- Migrant Farmworkers Clinic, Quarterly Meetings, Lake Park, Georgia
- Familia Adelante Training, Valdosta, Georgia
- Echols County Fall Festival, Statenville, Georgia
- Jennings Fall Festival, Jennings, Florida
- Echols County Career Day, Echols County High School, Statenville, Georgia
- Valdosta Latino Networking Monthly Meeting, Valdosta, Georgia
- Fiesta Latina, Lake Park, Georgia
- Peach State Hispanic Heritage Month, Moultrie, Georgia
- Lowndes County College Day, Valdosta, Georgia

Publications and Presentations

Grzywacz, J., Gonzales-Backen, M., Liebman, A., Marin, A., Trejo, M., Gudino, C.O., Economos, J. and Tovar-Aguilar, J.A. (2019). Attending to Pesticide Exposure & Heat Illness among Farmworkers: Results from an Attention Placebo-Controlled Evaluation Design. *Journal of Occupational and Environmental Medicine*. *61*(9): 735-742.

Denis-Luque, M., Luque J., Saint-Louis, C., Tovar, A. and Grzywacz, J.G. (November 2019). *Research to Practice (R2P) in occupational safety among South Florida Haitian workers.* Roundtable presentation at the meeting of the American Public Health Association. Philadelphia, PA. East Coast Migrant Stream Forum. San Juan, PR.

Tovar, A. and Trejo, M. (October 2019). *PISCA: Entrenamiento en Pesticidas e Insolación que es Culturalmente Apropiado – Community Health Workers (CHW) Training on the Delivery of the updated Workers Protection Standard (WPS)*.

Grzywacz, J.G., Luque, J., Becker, A. (2018). *Pesticide exposure and its health effects among Latino and other farmworkers.* In R. Burke & A. Richardsen (eds.), Increasing occupational health and safety in workplaces: Research and practice. Edward Elgar Publishing.

Grzywacz, J. G., & Allen, J. W. (2017). Adapting the Ideas of Translational Science for Translational Family Science. *Family relations*, 66(4): 568-583. PMID: 29422702

Grzywacz, J.G., Gonzales-Backen, M.A., Aguilar Tovar, A., Marin, A., Trejo, M., Ordaz Gudino, C., Garcia Rendon, M., & Liebman, A.K. (November 2018*). Improving pesticide and heat stress knowledge among Latino farmworkers: Phase I of PISCA*. American Public Health Association Annual Meeting. San Diego, CA.

Tovar-Aguilar, A., (April 10, 2018). A Web of Immigration and Labor Regulation and How it Binds Farmworkers. *American Association of Geographers Annual Meeting*. New Orleans, LA.

Tovar-Aguilar, A., (April 4, 2018). Translating Scientific Research on Heat Related Illness into Extension Education for Florida Farmworkers. *Society for Applied Anthropology Annual Meeting.* Philadelphia, PA.

Using Social Marketing to Prevent HRI and Improve Productivity among Farmworkers

PD/PI: Paul Monaghan
Co-I: Maria Morera
Co-I: Fritz Roka
Co-I: Antonio Tovar

Overview

Ongoing heat-related illnesses (HRI) and fatalities among Florida farmworkers underscore the need to identify economic incentives to occupational heat safety implementation in agriculture. Although culturally- and linguistically-responsive safety promotion interventions have proven effective in delivering important agricultural safety information to diverse farmworker populations, workplace barriers, such as piece-rate pay and limited access to rest breaks, continue to discourage HRI preventive practices. Three key problems limiting greater investment in heat safety are: i) insufficient documentation of the comparative effectiveness of competing models of farmworker safety promotion, ii) a paucity of observational data linking safety behaviors to health outcomes, and iii) a lack of translation between health outcomes and industry benefits.

The overall goal of this research project is to elucidate factors linked to organizational demand for farmworker safety. The project is guided by the following three aims:

1. Utilize social marketing research to educate and motivate field supervisors and piece rate harvesters to follow HRI recommendations, including through culturally appropriate social media platforms to reinforce behavior adoption in the field.
2. Determine the effectiveness of the social marketing approach in comparison to existing HRI educational programming currently used in Extension and employer-based models of safety promotion.
3. Establish the relationship between hydration interventions, changes in safety culture and productivity levels by measuring output per worker in order to incentivize investment in farmworker safety.

Key Accomplishments in 2018-1019

Development and validation of research instruments and procedures
Research instruments designed to investigate perceptions of HRI risk, familiarity with preventive practices, hydration routines, HRI symptoms experienced at work, frequency of rest breaks, work activities, occupational safety climate, and exposure to training and safety promotion materials were developed during the fall of 2018. The instruments included two focus group guides, a pre-intervention survey, and a post-workday survey. Procedures for the collection and analysis of urine samples, designed to measure the hydration status of workers, were also developed at this time.

The survey instruments and procedures were pilot-tested in southwest Florida during a five-day period in May, 2019. Twenty-nine farmworkers in a single tomato harvesting crew were recruited, consented, and introduced to the project. Baseline data were collected during the first two days. Pre- and post-workday urine samples as well as post-workday survey data were collected

during the remaining three days. Surveys were administered collectively at the farmworkers' housing complex with the use of TurningPoint audience response technology (Figure 1).

Preliminary results

Project participants were all male from Mexico. The majority were H2A workers between the ages of 26 and 35. Most had worked in the U.S. for one to five seasons.

Baseline survey responses indicated that approximately one third of project participants were "not at all concerned" about becoming ill from the heat while working. The remaining were "slightly" to "moderately concerned." Yet more than three quarters of participants had experienced at least one HRI symptom in the previous week. The symptom most commonly experienced was "sudden muscle cramp." No one sought treatment for their symptom(s).

Baseline survey responses also indicated that most participants hydrated "whenever they were thirsty" and "at lunch." Only 10% consumed beverages "every hour." Seventy-six percent avoided any rest breaks aside from having lunch, going to the restroom, and changing fields.

Post-workday survey responses regarding work activities and HRI symptoms revealed that the highest frequency of HRI symptoms and levels of heat, work intensity, and productivity were reported on Day 1, the longest but not hottest, of the three workdays under study (Figures 2-5). Results of urinalysis indicated all 29 project participants were hypohydrated by the end of that workday (Table 1). A greater percentage of project participants implemented cooling practices and took rest breaks on Day 1. Results of bivariate correlation analysis suggest safety behaviors had more to do with the immediate experience of symptoms than with training and knowledge (i.e., reactive vs. preventive).

TABLE 1. Baseline, pre- and post-workday mean urine specific gravity (±SD)

	Baseline	Range	Pre-workday	Range	Post-workday	Range
	1.025 (0.006)	1.010 - 1.030				
Day 1			1.027 (0.005)	1.010 - 1.030	1.030 (0.000)	1.030 - 1.030
Day 2			1.026 (0.007)	1.005 - 1.030	1.025 (0.007)	1.010 - 1.030
Day 3			1.024 (0.007)	1.005 - 1.030	1.025 (0.007)	1.010 - 1.030

Occupational Health and Safety Surveillance of Gulf Seafood Workers

Project PI: Andy Kane, Principle Investigator, UF Environmental and Global Health
Melvin Myers, Consultant, Emory University
Robert Durborow, Consultant, Kentucky State University

Overview

Commercial fishing remains one the most dangerous work sectors in the world. Occupational fatalities and injuries in the fishing sector occur at rates much higher than national averages for all occupational fatalities and injuries. In the southeastern US, Florida has one of the highest fatality rates for seafood workers, ranked third nationally only to Alaska and Massachusetts. Non-fatal occupational injuries and illnesses are common across southeastern and Gulf fishery sectors. Non-fatal injuries include blunt traumatic injuries, limb and digit amputations, fractures, trunk and lower back strains; sprains; skin cancers; infections due to cuts, bites, punctures and entanglement; dehydration and heat stress. Risk factors and frequency of occurrence for injuries, illnesses and other work sector-specific hazards, however, are largely undocumented.

Operational variability observed in oyster farming operations in Florida and Alabama. Use of different equipment under different conditions required different skills and has different risks. Alongside cage harvesting from a boat in Florida (A) poses greater risk of musculoskeletal injury compared with cage placement in anchored frames in tidal creeks in Alabama (B). Traditional clam farming in Cedar Key grades harvestable clams on shore (C) that costing more time and fuel, but allows for handling more product; the trade-off is repetitive motion injuries and hearing loss. Some operations have installed graders and tumblers on their boats (D) to eliminate some challenges. Long-line culture (E) and use of air lifts on a "shell-evator" (F) represent innovation from which to learn and share solutions throughout the industry.

This five-year, community-based research project engages seafood harvesting communities within the Southeastern Coastal Center's region, to conduct occupational health and safety surveillance to better understand the OHS needs of the industry and, ultimately, support the health and well-being of the workers, and their professionalism including workplace safety. In-person interviews, and workplace observations on harvest boats are being used to discern hazards and risk factors associated with inshore occupational injury and health outcomes for regional shrimp, fish, and crab, oyster and clam harvesters. Data will be shared with fishers, community partners and extension engineers to support a culture of safety within these heritage Gulf fisheries, and generate valued insights into potential behavioral and mechanical interventions to keep the Southeastern US fishery workforce safe and on the water.

Efforts in years 01 and 02 have successfully brought this surveillance project into multiple Gulf communities, established project-specific working relationships with community partners and liaisons, developed, piloted the survey instrument, and began recruitment of participants to contribute to the study.

Key Accomplishments in 2018-2019

Community Engagement

Dr. Kane and the project team engaged with new and existing community partners and liaisons to establish and maintain working relationships based on project objectives, and to tailor the study approach to best support and bring the objectives of the project to the community. The project team met with community partners to establish lines of communication, discern outreach meeting space, facilitate participant recruitment, and tailor advertising and outreach content in Cedar Key, Steinhatchee, Pensacola, Apalachicola and Eastpoint, FL, Decatur AL, and Long Beach, Biloxi and Pass Christian, MS.

Input from our community partners indicated that two communities could not contribute to this study as initially planned. In Steinhatchee, the number of commercial fishers has dropped from >50 to 3 (two of which remain residents but fish elsewhere) between 2014 and 2019. In Alabama, *Organized Seafood Association of Alabama* was unable to gain traction with its membership to contribute to the study due to concerns of tighter regulation and increased cost to the industry at a time when landings are down. The principal was sympathetic, since a shrimper had recently died due to winch entanglement, but the allegiance to their membership remained the priority. Also, the *Alabama Multi-Cultural Fisher and Seafood Worker-Owned Coop* that provided initial support for the project, no longer had the capacity to facilitate project goals. Challenging in these communities, coinciding with declining Gulf fisheries and the dollar value of Gulf seafood, have shifted project emphasis to expand into Mississippi and include new partners and fishing communities.

To this end, the project team has fruitfully engaged with *Mississippi Commercial Fisheries United* in Biloxi, representing shrimpers, crabbers and oyster harvesters, and *Oyster South* in Decatur, GA, representing the coastal oyster farming industry Gulf-wide. Coastal shellfish aquaculture appears to be an important and burgeoning Gulf fishery sector, and we are pleased to be supporting that workforce as part of this study, particularly in light of the notable declines, and in some cases, collapse, of Gulf oyster fisheries.

Assessments

Initial analyses of survey data inspired an instrument revision for clarity and to provide an iPad-based data collection interface to eliminate transcription error and facilitate data analyses. The revised REDCap instrument was approved by University of Florida's Institutional Research Board (IRB), and the team has implemented the survey with 56 new participants representing shrimpers, fishers, crabbers, and oyster and clam harvesters across Florida, Alabama and Mississippi, bringing the total number of participants contributing surveys to 71 (not counting participants who piloted the instrument nor workplace observations).

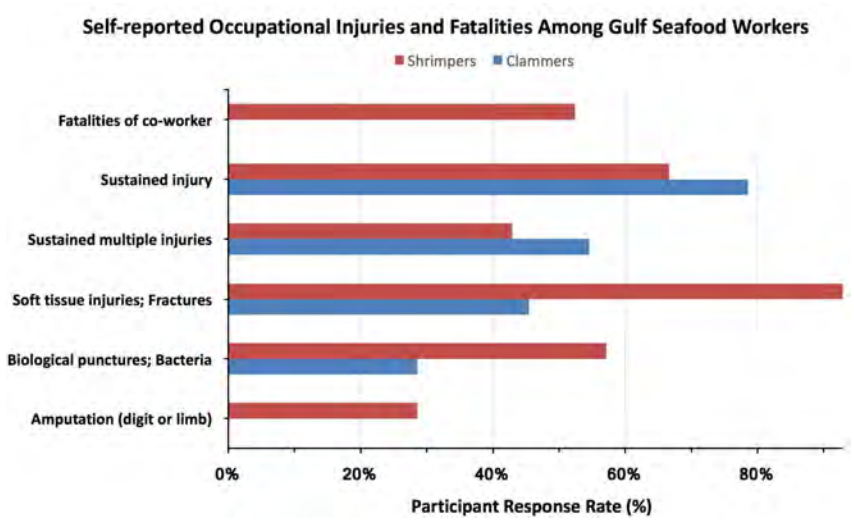


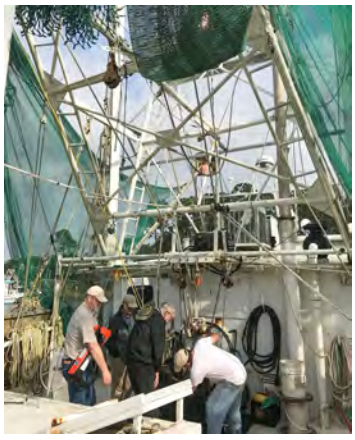
FIGURE 1. Fatality and injury data from shrimpers and oysterers in Bay St. Louis and Biloxi, MS (n=21), and clam producers in Cedar Key, FL (n=15). The majority of these fishers sustained at least moderate severity work-related injuries, that translated to lost time off the water and the need for medical attention.

Seafood workers who contributed data to the project were mostly male (89%), Caucasian, 21-73 years old (median age=49yo), and worked as commercial fishers between 6 and 40 years (median # years worked was 21 years). The vast majority of finfish, crab, oyster and clam fishers harvested product inshore from vessels with an average overall length of 28 feet; shrimp boats averaged 48 feet overall. Approximately half of the participants were multigenerational fishers. The majority of participants were over 50 years old, reflecting an aging workforce without vital recruitment from the next generation.

Initial observations from the data indicate that OHS risks vary between fishery sectors. For example, the risk of fatality on a shrimp boat is dramatically different than working on harvest vessels in any other sector in ths study, mostly associated with dangerous equipment (winches), clocking long hours, fishing at night on an unstable platform, and challenges retaining valued, sober crew members. Traumatic stingray punctures associated with harvesting from *in the water* is not uncommon in clam harvesting operations and, coupled with chronic lower back pain, ranks among the top concerns for safety and longevity in that workforce sector.

Workplace Observations

Workplace observations help to account for differences in vessel size and design, dynamics in rigging, and variation in how fishing gear is deployed. Onboard workplace observations complement data from surveys to identify risk factors and possible interventions that may be specific to certain fisheries or gear types. A shrimp harvesting safety training exercise was organized and implemented for the SCCAHS Seafood Worker Project Team through our community partner in MS, with further input and participation from Chelsea Woodward, NIOSH Western States Division. This training was most helpful in order to learn regional vocabulary, and discern common issues in boat design and gear deployment, and how crew behavior contributes as risk factors. Workplace observations were conducted on shrimp and oyster harvesting boats in Biloxi and Pass Christian, MS, oyster boats in Apalachicola (tong fishery) and in Panacea (oyster farming), and clam harvesting boats in Cedar Key. Image and video data from these observations are being collated and analyzed at the time of this report. Many of the safety issues in the shrimp fleet are associated with winch



Shrimp vessel safety training aboard the F/V Fair Maiden with (L to R): Chelsea Woodward, Andy Kane, Mel Myers and Capt. Frank Parker.

location, gear condition, and positioning of level wind and hydraulic controls. Winches that are installed forward of the wheelhouse permit direct line of sight by the captain, although less deck space for culling and working the nets. Some boats place the winch overhead, on top of the wheelhouse, practically eliminating the larger danger zones associated with winch operation. Additional surveys and workplace observations will be implemented in YR04 and the beginning of YR05.

Project Outreach and Dissemination

- Attended and contributed to the Mississippi Commercial Fisheries United annual meeting, 11/30/18, with 57 stakeholders in attendance. Dr. Kane shared a 20-min overview of project goals and benefits and, opportunities to enroll in project/study.

- Project team exhibited at the 3rd annual meeting of Oyster South, Orange Beach, AL, February 22-24, 2019. Meeting registrants (n=175) represented oyster farmers across all Gulf states. Engagement at this meeting, coupled with support from our community partners, provided the requisite entré into this sector to facilitate recruitment of oyster farmers in the project.

- Attended SCCAHS Community Stakeholder Advisory Board Meeting, March 14th, 2018, UF/IFAS Mid-Florida Research and Education Center, FL. Engaged with regional stakeholders and advisors relative to YR03 Center progress and study aims.

- "Occupational Health and Safety Surveillance of Gulf Seafood Workers." Dr. Kane's webinar was streamed live from SCCAHS series with Q&A on 10/31/19.

- Developed recruitment materials and outreach brochures to support participant enrollment and project engagement in participating communities.

- Attended and contributed to the Occupational Network (SouthON) meeting in Tampa, FL. These meetings provided important opportunities for national and international networking relative to SCCAHS project efforts and seafood worker health and safety.

- Project team contributed four presentations at 5th International Fishing Industry Safety & Health (IFISH) Conference, St. John's, Canada, and one at the 8th International Symposium on Aquatic Animal Health (ISAAH), Charlottetown, PEI, Canada

Publications and Presentations

Myers ML, Kane AS and Durborow RM. 2018. Gulf of Mexico Seafood Harvesters: Part 1. Occupational Injury and Fatigue Risk Factors. Safety doi:10.3390/safety4030031.

Myers ML, Durborow RM, Kane AS. 2018. Gulf of Mexico Seafood Harvesters, Part 2: Occupational Health-Related Risk Factors. Safety doi: 10.3390/safety4030027.

Myers ML, Durborow RM and Kane AS. 2018. Gulf of Mexico Seafood Harvesters: Part 3. Potential Occupational Risk Reduction Measures. Safety doi:10.3390/safety4030033.

Pilot/Feasibility Program

J. Glenn Morris, Jr.
Farah A. Arosemena

Overview

The Pilot/Feasibility Program is a key component of the Southeastern Coastal Center for Agricultural Health and Safety (SCCAHS). This program provides seed funds to stimulate original projects relevant to health and safety in the agricultural, forestry, and fishery (AFF) industries. The Pilot Program awards high quality research that promotes collaboration between the Center and the Southeast partner communities, as well as builds a nexus for mentorship and development of new/early-stage investigators as they aspire to establish independent research. Projects may include basic/etiologic research, translational research, intervention studies, and/or surveillance.

The goal is to provide seed support to projects that ask innovative and important questions, and which lay the groundwork for subsequent research grant submissions or interventions. Successful implementation of the Pilot/Feasibility Program will ultimately expand research in health surveillance, air quality, respiratory health, pesticide exposure, mental health and health disparities of migrant and seasonal farmworkers and/or fishers. Some of the projects selected will be "high risk, high reward" novel ideas and approaches, with limited preliminary data, but with the potential for having a major impact. Cumulatively, across years 1 through 3, the *Southeastern Coastal Center for Agricultural Health and Safety* awarded 9 pilot research projects to improve the safety and health of agricultural workers.

Pilot Grant Awards

SCCAHS recently announced its fourth round of pilot project requests for funding. The following pilot awards have been funded to date –

Pilot study of the acute psychological and health impacts of Hurricane Irma in UFAS extension workers Lynn Grattan, Pilot Project PI, University of Maryland

Uncovering patterns of mental, physical, and occupational health issues among migrant farmworkers with different socio-cultural networks: A pilot study among Haitian and Mexican farm workers in Immokalee, FL Gülcan Önel, Pilot Project PI, University of Florida

Chronic low back pain in seafood workers: a pilot intervention study to identify modifiable work and movement solutions Kim Dunleavy, Pilot Project PI, University of Florida

Pilot study of mobile app monitoring to prevent heat-related symptoms among Hispanic farmworkers Juan Luque, Pilot Project PI, Florida A&M University

Understanding the scope of the opioid epidemic for agricultural industries Heidi Radunovich, Pilot Project PI, University of Florida

A novel approach (sweat patches) to monitoring pesticide exposure in farmworkers Gregg Stanwood, Pilot Project PI, Florida State University

Agro-ecological practices in the face of climate change: Resilience, sustainability, and preparedness in Puerto Rico Antonio Tovar-Aguilar, Pilot Project PI, University of Florida

Field evaluation of N95 filtering facepiece respirators against airborne dust and microorganisms during cotton harvest Atin Adhikari, Pilot Project PI, Georgia Southern University

A pilot study to assess personal PM2.5 exposure and respiratory virus Infections among farmworkers in the Southeast Eric Coker, Pilot Project PI, University of Florida

Highlights

Publications and Presentations

Luque, J, Becker, A, Bossak, B, Grzywacz, J, Tovar-Aguilar, A: Guo, Y. (2019) Knowledge and Practices to Avoid Heat-Related Illness among Hispanic Farmworkers along the Florida-Georgia Line. *Journal of Agromedicine*. DOI: 10.1080/1059924X.2019.1670312 PMID: 31544652

Luque, J, Becker, A, Bossak, B, Grzywacz, J, Tovar, A, Guo, Y. "Knowledge and Practices for Adapting to Working in the Heat among Latino Farmworkers in the Florida-Georgia Border Region," roundtable paper presented at the APHA Conference (November 2019), Philadelphia, PA.

Adhikari, A, Dotherow, JE. Respiratory deposition modeling for PM10, PM2.5, and PM1 exposure in cotton farms for standard and heavy workers. Third Aerosol Dosimetry Conference, Inhaled Aerosol Dosimetry: Models, Applications and Impact (October 2019), Irvine, CA.

Stacciarini, J.M., **Onel, Gulcan**, & **Tovar, A.** A Rural State of Mind: Addressing Mental, Physical, and Economic Health of Farm Communities in Florida. *East Coast Migrant Stream Forum.* (October 2019), San Juan, Puerto Rico.

Awards

Heidi Radunovich. Co-Investigator. (2019). Agrisafe Network, Inc. (PI: Natalie Roy) *Southern region farm and ranch stress assistance network.* Develop a clearinghouse of farmer assistance programs in the region inclusive of programs providing professional agricultural behavioral health counseling and referral.

Heidi Radunovich. (2018). Florida Nursery, Growers and Landscape Association (FNGLA). Endowed Research Fund. Research Enhancement Award. During August 2017, FNGLA leadership identified opioid misuse as a problem within their industries and contacted the Southeastern Coastal Center for Agricultural Health and Safety (SCCAHS) to gain assistance with addressing the issue of opioid misuse. SCCAHS created a resource section dedicated to opioids in order to help support FNGLA. However, it is unclear the extent to which opioids are a problem for FNGLA, what the economic impact might be, how individuals and families are affected, and what resources or programs might be useful for these industries. This project seeks to document the impact that opioid abuse has had on Florida's nursery, grower and landscaper industries, as well as their families, and determine how best to help them. In order to do this, information will be obtained from relevant stakeholders, and stakeholders will be informed of findings. This project will involve both assessment and information dissemination, which will be outlined below.

Gülcan Önel and **Antonio Tovar**. (2018). Robert Wood Johnson Foundation. Interdisciplinary Research Leaders Award. The broad goal of the Interdisciplinary Research Leaders (IRL) program is to produce diverse interdisciplinary leaders who conduct and apply high-quality, community-engaged, action-oriented, equity-focused health research in order to drive improvements in the health of communities.

Emerging Issues Program

Joan Flocks, MA, JD

Overview

The Emerging Issues Program (EIP) assists SCCAHS in addressing new, emerging and re-emerging problems within their region. EIP works within the center to maintain connections with all projects, cores, advisory boards and other stakeholders to identify, prioritize, and address issues that appear during the life of the center. The tasks of the EIP include: identifying new AgFF worker safety and health issues in the region; prioritizing these issues; addressing prioritized emerging issues through small investments; and referring other emerging issues to appropriate resources.

Key Accomplishments in 2018-2019

Process to Identify, Prioritize and Address Arising Concerns

The unique design of EIP allows SCCAHS to streamline the identification of new occupational health and safety issues, map their geographic/demographic span, assess the significance of the problem(s), and respond accordingly. EIP work coincides with the Pilot/Feasibility Program to target relevant, real-time need for research and encourage new investigators to apply for pilot funding to address emerging issues; contributes to the Outreach Core by promoting SCCAHS at meetings and conferences and participating in the development of materials; and, when necessary, rapidly funds programs to improve the health and well-being of disproportionately affected agricultural, fishery, and forestry communities.

Outreach

Throughout Year 3 EIP's Director, Joan Flocks, attended local meetings, regional symposia and national conferences as a frontline method to identify new agricultural and fishery worker safety and health problems. Additionally, EIP participated in meetings and collaborated with external organizations and SCCAHS stakeholders such as: the nationwide NIOSH Ag Center Directors; the Agricultural Safety and Health Council of America; the East Coast Migrant Stream Forum; Florida Department of Agriculture and Consumer Services (FDACS); the Farmworker Association of Florida; the Rural Women's Health Project; the University of Florida's Institute of Food and Agricultural Sciences (UF IFAS) Extension; the University of Florida Health Street; and the Southwest Center for Agricultural Health, Injury Prevention and Education to promote SCCAHS' goals and develop its regional and national networks.

Emerging Issues Forecast

Forestry

Consulted with Dr. William Hubbard, Assistant Director/Program Leader Maryland Sea Grant and the University of Maryland College of Agriculture and Natural Resources. Discussion served as an informational session for emerging issues in forestry within the SCCAHS region. Building an informational network with regional forest service programs, industry associations and forestry commissions is needed.

Sugar Cane Burning
EIP convened meeting with the Sierra Club's Patrick Ferguson and Cris Costello of the *Stop Sugar Field Burning Now* campaign, connecting SCCAHS Senior Advisor Tara Sabo-Atwood, Research Core PI Paul Monaghan and Pilot PI Eric Coker. The purpose of the meeting was to understand data/research needs to explore the impact of sugar cane burning on agricultural community health in South Central Florida. EIP committed to funding an Environmental & Global Health Research Assistant to complete a systematic review of studies on sugar cane burning and respiratory health. An expected product is a Year 4 publication on the state of the problem globally and domestically and how interventions can be applied regionally.

H2-A Temporary Agricultural Worker Visas
EIP continues efforts to measure the impact of increased H-2A workers in Florida. EIP supported Research Assistant, Anne Saville, to complete a policy brief on Florida H-2A workers and their health and safety implications for SCCAHS.

Heat-related Illness
EIP supported the Farmworker Association of Florida Train-the-Trainer Program on pesticide and heat-related illness safety for three trainers in August 2019. 22 participants enrolled in worker trainings at Florida sites in Apopka and Pierson. EIP will sustain the training program and extend into the Florida sites of Fellsmere and Immokalee in Year 4. Joan Flocks will also continue to work with Research Core PIs to move the HRI research agenda into R2P and new proposal submissions.

Revised Worker Protection Standard Respirator Requirements
There is a need to support efforts by the Florida Department of Agriculture and Consumer Services (FDACS) and the University of Florida Institute of Food and Agricultural Sciences (IFAS) Extension Agents to provide training within the Florida agricultural industry on revised Worker Protection Standard respirator requirements. In January 2019, EIP and members of the previously formed Respirator Working Group invited Carolyn Sheridan from the Agricultural Health and Safety Alliance to visit UF and give a Zoom training on the new requirements.

Farmworker Health in the Caribbean
EIP encouraged pilot research applications for new/early stage investigators actively exploring farmworker health and safety in the Caribbean. Migrant Clinicians Network responded to the Year 4 call for proposals to fund a project in Puerto Rico and was awarded to begin in November 2019.

Additional Ongoing Issues Identified and Researched by EIP
Several emerging issues were identified, researched, and presented to the SCCAHS Internal Operating Committee. These included: building an informational network with regional forest service programs, industry associations and forestry commissions; the impact of using antibiotics for disease management in Florida citrus groves; the occurrence and management of pterygium and pinguecula in Caribbean and Florida fishers and agricultural workers; preliminary identification of health and safety issues in the emerging hemp industry.

Cumulative Publications and Presentations

Publications

Mix J, Elon L, Mac V, **Flocks J**, Economos J, Tovar-Aguilar A, Hertzberg V, McCauley LA. "Physical Activity and Work Activities in Florida Agricultural Workers." *American Journal of Industrial Medicine*. 62: 1059-1067.

Chicas R, Mix J, Mac V, **Flocks J**, Dickman NE, Hertzberg V, McCauley L. "Chronic Kidney Disease Among Workers: A Review of the Literature." *Workplace Health and Safety* 67:481-490, 2019.

Flocks J, Tovar JA, Economos E, Mac V, Mutic A, Peterman K, McCauley L. "Lessons Learned from Data Collection as Health Screening in Underserved Farmworker Communities." *Progress in Community Health Partnerships: Research, Education, and Action* 12:93-100, 2018.

Mix J, Elon L, Mac V, **Flocks J**, Economos E, Tovar-Aguilar AJ, Stover-Hertzberg V, McCauley LA. "Hydration Status, Kidney Function and Kidney Injury in Florida Agricultural Workers." *Journal of Occupational and Environmental Medicine* 60:e253-e260, 2018.

Mutic A, Mix J, Elon L, Mutic N, Economos J, **Flocks J**, Tovar-Aguilar JA, McCauley L. "Classification of Heat-Related Illness Symptoms Among Florida Farmworkers." *Journal of Nursing Scholarship* 50:1-9, 2017.

Runkle J, **Flocks J**, Economos J, Dunlop A. "A Systematic Review of Mancozeb as a Reproductive and Developmental Hazard." *Environment International*, 99:29-42, 2017.

Mac V, Tovar-Aguilar J, **Flocks J**, Economos J, Hertzberg V, McCauley L. "Heat Exposure in Central Florida Fernery Workers: Results of a Feasibility Study." *Journal of Agromedicine* 22(12): 89-99, 2017.

Hertzberg V, Mac V, Elon L, Mutic N, Mutic A, Peterman K, Tovar-Aguilar JA, Economos E, **Flocks J**, McCauley L. "Novel Analytic Methods Needed for Real-Time Continuous Core Body Temperature Data." *Western Journal of Nursing Research*. 39(1): 95–111, 2017.

Presentations

Flocks, J. "Prevention of Heat Stress among Farmworkers" (roundtable discussion moderator) *Western Agriculture Safety & Health Conference*, Seattle, WA, August 7-9, 2019.

Flocks, J., Saville, A., & Economos, J. "Differing Reponses and Perspective to Environmental Justice, Lessons from Lake Apopka, FL" (panel) with A Saville and J Economos. *Association for Environmental Studies and Sciences Annual Conference*, Orlando, FL, June 27, 2019.

Flocks J. "Immigration Policy and Agricultural Labor in Florida" *University of Florida, Department of Agricultural Education and Communications Seminar Series,* Gainesville, FL, October 27, 2017.

Mutic A, Mix J, Elon L, Tovar J, **Flocks J**, Economos E, and McCauley L. "Classification of Heat Related Illness Symptoms among Florida Farmworkers." *American Public Health Association Annual Meeting,* Atlanta, GA, November 7, 2017.

Tovar J, Economos E, and **Flocks J**. "Community Based Research on Heat-Related Illness in Florida Farmworkers." *American Public Health Association Annual Meeting,* Atlanta, GA, November 7, 2017.

Flocks J. "Immigration, Farm Labor, and Food Justice" *University of Florida, Center for the Study of Race and Race Relations, Race Matters in the News Seminar Series,* Gainesville, FL, November 9, 2017.

Flocks J, Monaghan P, and Tovar-Aguilar A. "Southeastern Coastal Center for Agricultural Health and Safety (SCCAHS): Current Projects at the Newest NIOSH Center for Agricultural Disease and Injury Research, Education, and Prevention." *2018 North American Agricultural Safety Summit*, Scottsdale, AZ, February 21-23, 2018.

Tovar-Aguilar A and **Flocks J**. "A Web of Immigration and Labor Regulation and How it Binds Farmworkers." *American Association of Geographers Annual Meeting*, New Orleans, LA, April 10-14, 2018.

Flocks J, Grzywacz J, Tovar-Aguilar A, McCauley L, Mac V, Chicas R, Vulpe C, Roberts S, and Denslow N. "Current Occupational Heat and Pesticide Research in Southeastern Coastal States," (poster) *NIDDK-NIEHS Workshop on Chronic Kidney Diseases in Agricultural Communities*, Bethesda, MD, June 25-26, 2018.
http://www.sccahs.org/index.php/2018/07/11/joan-flocks-presents-on-behalf-of-sccahs-at-national-conference/

Flocks J. "The Environmental and Social Injustice of Farmworker Pesticide Exposure," (online guest lecture) for Vanessa Casanova's Environmental Justice class at the University of Texas Health Science Center at Tyler, July 11, 2018.

Bronstein J, Economos E, **Flocks J,** and Grzywacz J."Pesticides and Health: What We Need to Know" (panel) *19th National Our Community, Our Health Town Hall,* University of Florida Health Street, Gainesville, FL, August 29, 2018.
https://mediasite.video.ufl.edu/Mediasite/Play/e7e8e15cc65c462b93bfb0c1d22da2371d

Flocks J. "Immigration, Farm Labor, and Food Justice" *University of Florida, Center for the Study of Race and Race Relations, Race Matters in the News Seminar Series,* Gainesville, FL, November 9, 2017.

Mutic A, Mix J, Elon L, Tovar J, **Flocks J**, Economos E, and McCauley L. "Classification of Heat Related Illness Symptoms among Florida Farmworkers." *American Public Health Association Annual Meeting,* Atlanta, GA, November 7, 2017.

Tovar J, Economos E, and **Flocks J**. "Community Based Research on Heat-Related Illness in Florida Farmworkers." *American Public Health Association Annual Meeting,* Atlanta, GA, November 7, 2017.

Flocks J. "Immigration Policy and Agricultural Labor in Florida" *University of Florida, Department of Agricultural Education and Communications Seminar Series,* Gainesville, FL, October 27, 2017.

Section III – Outreach Core

Project PI: Tracy Irani
Ricky Telg; Lisa K. Lundy; Angela B. Lindsey; Martie Gillen; Claire Mitchell

The Outreach Team leads a comprehensive Core, providing knowledge transfer support for the Research Core and Pilot/Feasibility Program, integration with all proposed educational and extension activities, and effective and culturally competent communication, and information dissemination to stakeholders across the six-state region. The Outreach Core activities consist of disseminating relevant risk reduction interventions and research findings and promoting adoption of best practices in the agricultural and fishery workplaces.

Community Stakeholder Advisory Board

Overview

The Southeastern Coastal Center for Agricultural Health and Safety (SCCAHS) is committed to stakeholder involvement. The Outreach Core prioritizes community-based participatory research, and has included representatives from Extension, industry, public agencies, regulatory agencies, academia, advocacy organizations, and medicine on our Center's Community Stakeholder Advisory Board. A high-functioning CSAB allows our Center to better engage stakeholders in receiving input on research findings, educational and communications materials and message testing to make our work accessible to the community at large.

Key Accomplishments in 2018-2019

The 26 CSAB members represent five specific sectors – industry (agriculture, forestry, fisheries); Extension; farmworkers' organizations; regulatory and training organizations; and public agencies. The semi-annual meetings of the Community Stakeholder Advisory Board (CSAB) serves as a means to update participants on the progress and results of ongoing research and also to develop outreach strategies, test messages and programs, and synthesize evaluation results. The Year 3 meeting was held at the UF/IFAS Mid-Florida Research and Education Center in Apopka, FL on March 14, 2019.

In-Service Trainings

Overview

A day and a half training provided the Florida State Agricultural Response Team (SART) team members and partners, first and direct Responders, Florida Department of Agriculture & Consumer Services (FDACS) employees, University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) Extension faculty and staff and other community members active in disasters the skills needed to address mental health needs and issues following disasters.

Key Accomplishments in 2018-2019

Trainings were held across several Florida counties (Bay, Charlotte, Pinellas, Marion, Suwannee, Broward, and Osceola) and included Mental Health First Aid.

- A one day 8-hour training developed by the National Council for Behavioral Health. The Mental Health First Aid curriculum provided attendees with an understanding of mental health, and how to support those with mental health challenges.
- A half-day training included research findings overview and the sharing of Best Management Practices.

Communications

Overview

The Outreach Core prioritizes a connection with center leadership to develop messages for farm families, laborers, supervisors, and company owners (all the stakeholders) to communicate important points about workplace safety. These messages are developed with different frames to ascertain which frame will be most effective. SCCAHS seminars/webinars in agricultural safety and health/occupational health have proven reach to all stakeholders and academic partners. The seminar/webinar series adds to the library of outreach materials and is intended to draw on SCCAHS investigators as well as external speakers. Seminars are webcast and archived on the SCCAHS website to facilitate inclusion of investigators at collaborating institutions.

Key Accomplishments in 2018-2019

The SCCAHS Outreach Core developed the following resources to help agricultural managers, Extension Agents and clinicians better understand heat stress, how to identify symptoms of heat stress and how to prevent heat stress from impacting outdoor workers:

- Up-to-date webinar schedule and archived webinar repository
- Social Media Messages
- 2018 State of the Science White Paper

The Outreach Core and Planning/Evaluation Core worked synergistically to host quarterly webinars in heat stress education, health impacts of disaster, social marketing, the opioid epidemic, agricultural liability, Gulf seafood workers, and corporate accountability for worker protection. During Year 3, nine webinars were released. The 2019 schedule (Figure 1) highlights many of SCCAHS presenters. Additional webinars were made available to the public September – November 2018, as well as in August and September 2019.

The most recent Year 3 Quarter 4 webinars included,

- Luque, J. and Irani, T. (September 2019). *Heat-related Illness (HRI) in Agriculture: A two-part webinar providing research findings on a mobile app to monitor HRI and a compilation of educational research-based resources to help prevent HRI.* [Webinar]
- Lundy, L. (August 2019). *Delivering agricultural health and safety research to stakeholders: Best practices and theoretical foundations.* [Webinar]

Webinars offered in Year 3 Quarter 1 included,

- Perez, J.A. (November 2018). *The Need for a Safety Focus in Agriculture.* [Webinar] https://vimeo.com/299519310

- Kane, A. (October 2018). *Occupational Health and Safety Surveillance of Gulf Seafood Workers.* [Webinar] https://vimeo.com/296933322

- Gillen, M. (September 2018). *Assessing Agriculture Liability.* [Webinar] https://vimeo.com/290512722

FIGURE 1. Outreach Core Webinar Schedule January - June 2019.

Communication strategies related to media were strategized differently for Year 3. The objective was to develop fewer posts on social media to work towards determining an effective social media plan to promote the research being conducted by affiliates of SCCAHS, provide resources on agricultural health and safety topics, and highlight researchers with the center. Reducing the impact of injury on agricultural and fishery workers through public awareness was a priority and this need resulted in the following products.

- Corresponding Electronic Data Information Source publications syncing with the published webinars. (Figure 2)
- The SCCAHS Impact of Heat Stress educational package. (Figure 3)

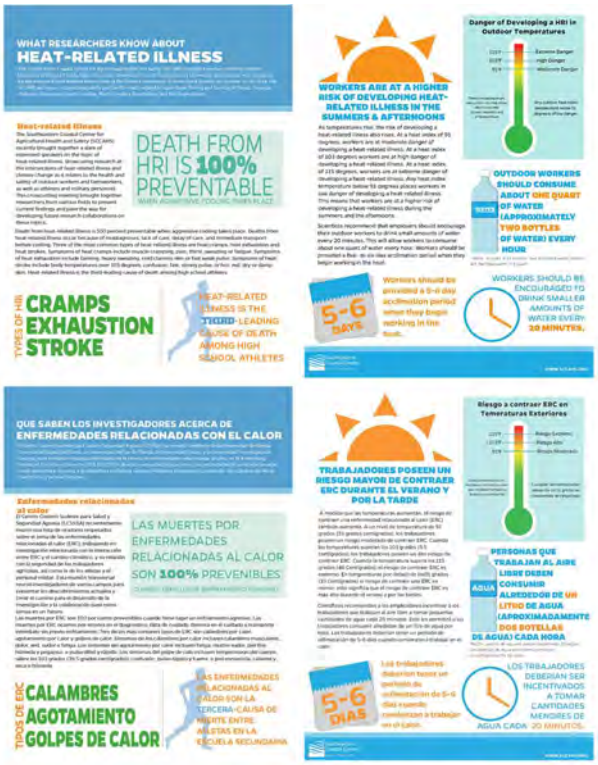


FIGURE 2. Bilingual outreach education materials on heat-related illness.

FIGURE 3. Impact of heat stress educational package, Fall 2018.

State of the Science Meeting

Overview

In Year 3 SCCAHS hosted the inaugural State of the Science Meeting in Quarter 1 and the 2nd *State of the Science* in Quarter 4. The meetings were convened to educate the Southeast regional academic community and frontline professionals on clinical and public health science driving new thinking in areas of heat-related illness and stress and resilience among agricultural, fishery, and forestry workers.

State of the Science Poster Session, September 26, 2019, St. Petersburg, Florida.

Given our southern location, the work of SCCAHS has included a major focus on heat-related illness. Additionally, addressing mental health remains a public health concern. Those who work in agriculture face many stressors, including financial uncertainty, family and relationships issues, social isolation, disaster, accidental injury, and acute and chronic diseases, that can affect their mental health. While some mental health issues, such as the high rate of farmer suicides, have been discussed widely, other mental health stressors that affect agriculture workers in vulnerable rural communities have not been discussed as broadly. Multidisciplinary research, strategies, and policies are needed 1) to identify the mental health issues that farmworkers, farm operators, farm owners and others in these communities face; 2) address the social, environmental and built-environment associations with mental health in rural communities; and 3) understand the inequities in farmworker/fishery/ forestry community mental health (depressive or substance use disorder rates) and how we might close these gaps to encourage individual, family, and community-level resilience. A recap of the Southeastern Coastal Center for Agricultural Health and Safety 2018 and 2019 State of the Science Meetings can be found at the below websites:

October 25/26, 2018, https://vimeo.com/299306184

September 26/27, 2019, https://vimeo.com/365794411

Key Accomplishments in 2018-2019

There has been an increased focus on moving beyond generating evidence to translating evidence into practice and policy actions to ensure that scientific discoveries actually reach the populations for whom they are intended and are implemented with fidelity. The State of the Science meetings were developed in response to this increased focus, and the dissemination approach is accomplishing its work by deepening multidisciplinary relationships, building capacity for public health professionals to collaborate effectively with other–related disciplines, and developing a research agenda on farmworker/fisher/forestry health translation, dissemination, and implementation through interdisciplinary collaboration.

Considerable effort was dedicated to planning/implementation. Areas of responsibilities included: 1) venue contract management; 2) website and program development; 3) marketing materials; 4) budget support; 5) poster abstract submissions and review; 6) keynote speakers; 7) local organization; 9)audio visual services; and 10) published proceedings framework for Year 3.

Heat Related Illness State of the Science Meeting, October 25-26, 2018

Keynote Speakers

Thomas Bernard: Professor, Environmental and Occupational Health, Sunshine Education and Research Center (ERC), University of South Florida, *Occupational heat stress exposure, assessment: Limits on sustainable exposures*

Candi Ashley: Professor, Exercise Science, University of South Florida, *Acclimatization, decay, and re-acclimatization*

Rebecca Lopez: Program Director, Athletic Training Professional Program, University of South Florida, *Management & return to work/activity following exertional heat illness*

Joe Grzywacz: Professor and Chair, Family & Child Sciences, College of Human Sciences, Florida State University, *Attending to Heat Illness & Pesticide Exposure among Farmworkers: Results from an Attention Placebo-Controlled Design*

Linda McCauley: Dean, School of Nursing, Emory University, *The Girasoles (Sunflower) Study: Exploring the physiologic heat stress response*

Eric Coris: Medical Director, Primary Care Sports Medicine, University of South Florida, *Heat illness prevention in athletes*

Vasubandhu Misra: Professor, Earth, Ocean and Atmospheric Sciences, Florida State University, *Heat related illness in a changing climate and demography of Florida*

Mike Sawka: Professor, Biological Sciences, Georgia Tech University, *Exertional heat illness: physiology, pathology, and modifying factors*

Stress and Resilience among Agricultural Workers in Vulnerable Rural Communities State of the Science Meeting, September 26-27, 2019

Keynote Speakers

Christine Chasek: Associate Professor, Department of Counseling and Psychology, University of Nebraska Kearney, *Investigating opioid and alcohol risk and misuse among rural agricultural workers*

Anna Scheyett: Dean of the School of Social Work, University of Georgia, *Characteristics and contextual stressors in farmers and agricultural worker suicides in Georgia, 2008-2017*

Robert Leeman: Associate Professor, Department of Health Education and Behavior in the College of Health and Human Performance, University of Florida, *Stressors, Resilience factors and applicability of new interventions for substance misuse*

Jeanne-Marie Stacciarini: Director of Diversity and Inclusion, College of Nursing, University of Florida, *CBPR: Rurality, social networks and mental well-being in rural Latinos*

Ashley Wennerstrom: Associate Professor, Community and Population Medicine, School of Medicine, Louisiana State University and Julie Smithwick: Director of the Community Health Worker Institute, University of South Carolina, *Community health workers in mental health: A powerful resource for improving behavioral health and improving community resilience*

Lynn Grattan: Professor and Division Head, School of Medicine, Neuropsychology, University of Maryland, *Surviving the storm: Individual resilience in agricultural leaders after Hurricane Irma*

Stress and Resilience Among Agricultural Workers in Vulnerable Rural Communities State of the Science Meeting, September 26-27, 2019

Lightning Round Speakers

Angela Lindsey: Assistant Professor, Family, Youth and Community Sciences at the University of Florida, *Mental health first aid workshops to address mental health needs following Florida hurricanes*

Kim Dunleavy: Associate Clinical Professor, Physical Therapy at the University of Florida, *Characteristics of seafood workers who select teamwork, movement and equipment modification options to address chronic low back pain*

Heidi Radunovich: Associate Professor, Family, Youth and Community Sciences at the University of Florida, *Understanding the scope of the opioid epidemic for agricultural industries, and the roles of pain, depression and stress*

Farah Arosemena: Program Manager, Southeastern Coastal Center for Agricultural Health and Safety, *Embedding health surveillance into SCCAHS: Contributing to a Southeast regional research data repository*

Joseph Grzywacz: Professor and Chair, Family & Child Sciences, College of Human Sciences, Florida State University, *Methodological issues in mental health surveillance among seasonal and migrant Latino farmworkers*

Cumulative Publications and Presentations

Mitchell, R.C., Irani, T, Arosemena, F. A., Pierre, B., Bernard, T.E., Grzywacz, J.G., McCauley, L.A., Vi Thien Mac, V., Lopez, R.M., Ashley, C.D., Sawka, M.N., Misra, V., Pierre, B., & Morris, J.G. SCCAHS2019-02. Gainesville, FL: University of Florida/Southeastern Coastal Center for Agricultural Health and Safety.

Lundy, L. K., Rogers-Randolph, T. M., Lindsey, A. B., Hurdle, C., Ryan, H., Telg, R. W., & Irani, T. (2018). Analyzing Media Coverage of Agricultural Health and Safety Issues. Journal of Applied Communications, 102(4), 5.

Rogers, T., Lundy, L.K., Lindsey, A.B., Irani, T., Telg, R.W., McLeod, A., Stokes, P., Mitchell, R.C. Identifying Influencers in Agricultural Health and Safety Twitter Conversations. Southern Association of Agricultural Scientists Conference.

Tovar J.A., (September 10-12, 2018). Processes of Development and Implementation of Training Conducted by Community Health Workers. *Midwest Migrant Stream Forum.* New Orleans, LA.

Mitchell, R.C. (August 15-16, 2018). Southeastern Coastal Center for Agricultural Health and Safety. *Citrus Expo.* Ft. Meyers, FL. Available at: https://public.3.basecamp.com/p/5M5WdbGzHTWYoA3TTPw5zzsb

Monaghan, P., (July 10-13, 2018). The Role of Labor Supervisors in Florida Citrus and Vegetable Production and How that Shapes Safety Behaviors. *University of Nebraska Medical Center Agricultural Health and Safety Course*. Omaha, NE.

Monaghan, P., (April 3-7, 2018). Preliminary findings. *Society for Applied Anthropology Annual Meeting.* Philadelphia, PA.

Section IV – Evaluation Program

Overview

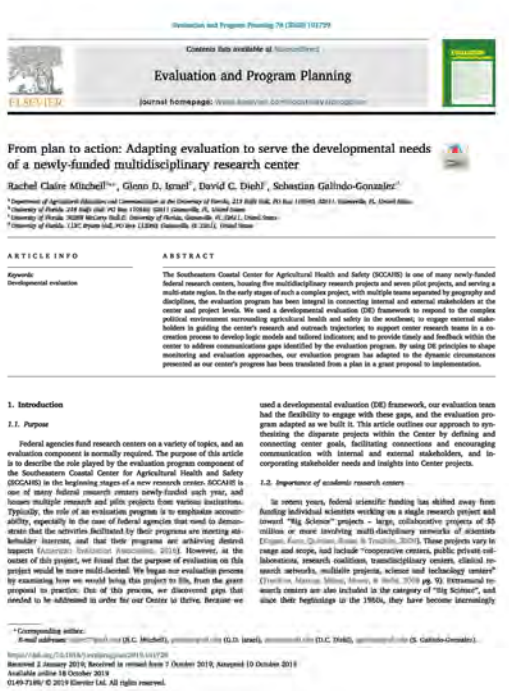
A formal monitoring and evaluation strategy is an interwoven component of SCCAHS. The Evaluation Program provides a framework for longitudinal, center-wide evaluations to assess the processes, outcomes, and impact of program and core activities; assists the leadership team in developing and implementing evaluation plans/logic models; and provides timely reporting as well as accountability information to the sponsoring agency.

The Evaluation Program aims to 1) Engage stakeholders to maintain a responsive and focused evaluation program; 2) Collect relevant monitoring and evaluation data from the center as a whole, the Outreach Core, and individual research projects; 3) Analyze and interpret data to establish the quality and effectiveness of the center as a whole, the Outreach Core, and the individual research projects; 4) Report and share evaluation findings and recommendations with key stakeholders; and 5) Maintain an open line of communication and engagement with other Ag Centers across the country.

Key Accomplishments in 2018-2019

Indicators and Data Reporting

The Evaluation Program developed indicators based on the grant submission narrative and subsequently developed logic models for each new research project that started during Year 3, program and Core. Indicators are organized into forms describing activities and products, and are assigned to SCCAHS team members annually to assess and improve center projects, infrastructure, and overall performance. Additionally, the Evaluation team attended quarterly PI-to-PI meetings in Year 3 to support oversight and provide feedback to PI's regarding their timelines and/or challenges in reaching milestones.



Evaluation and Program Planning

From plan to action: Adapting evaluation to serve the developmental needs of a newly-funded multidisciplinary research center

Rachel Claire Mitchell, Glenn D. Israel, David C. Diehl, Sebastian Gallindo-Gonzalez

ARTICLE INFO

ABSTRACT

1. Introduction

1.1. Purpose

1.2. Importance of academic research centers

FIGURE 1. SCCAHS Developmental Evaluation Framework, February, 2020 Manuscript

Utilizing this process-oriented evaluation complements standard traditional measures of research output (e.g., peer-reviewed publications, participant accrual, influence on practice and policy), especially in the early years of a multidisciplinary center. Information generated by process evaluation is useful for the SCCACS Internal Operating Committee, Community Stakeholder Advisory Board and the External Scientific Advisory Board to inform approaches that improve overall efficiency and quality of the research process and program implementation. (Figures 1 and 2)

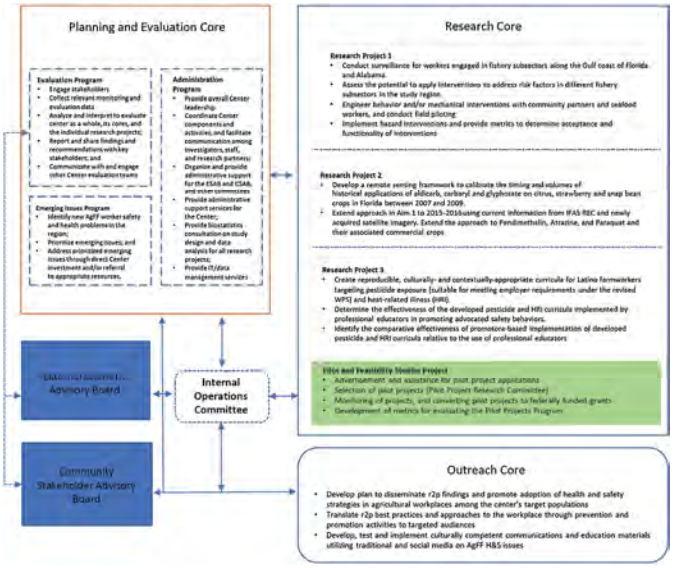


FIGURE 2. Organizational Plan

Data reporting systems were tailored to each program or Core, and were designed to not only help researchers track their own activities and products, but to determine fidelity to project timelines and goals. Once reporting data were collected, the EP summarized the activities and products, and sent them back to project and core leaders. They were then posted on the

SCCAHS project management website. The data reporting process facilitates open communication with programs and cores ensures improved efficacy and efficiency in reporting progress to stakeholders and funders.

Return on Investment

The evaluation team expanded its work on developing a return on investment (ROI) assessment plan. In Year 3, the team held meetings with several partners and consultants to hone in on details of how to proceed with evaluating the economic impact of SCCAHS' heat related illness (HRI) research. Among others, some of the experts consulted included: Dr. Jaclyn Kropp, Associate Professor, Food and Resource Economics Department, University of Florida; Dr.

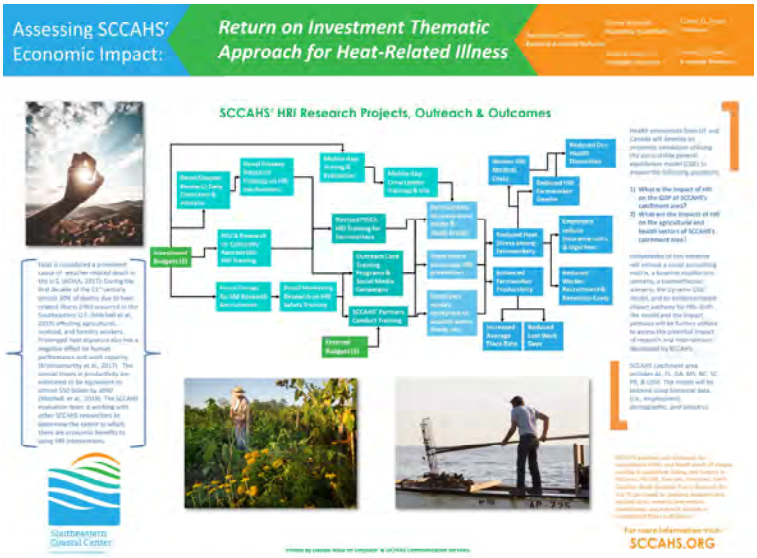


FIGURE 3. HRI Prevention: Collaboration with Health Economics

Melvin Myers, Co-Investigator on the SCCAHS Occupational Health and Safety Surveillance of Gulf Seafood Workers project; Dr. Marc Schenker, former Director of the Western Center for Agricultural Health and Safety and active PI on an HRI study within the Centers' Research Core; Dr. Fernando Wilson, Co-Investigator/Economist, Central States Center for Agricultural Safety and Health, Evaluation Program; and Dr. Vakaramoko Diaby, Assistant Professor in the Department of Pharmaceutical Outcomes and Policy, College of Pharmacy, University of Florida.As a result of these meetings, the Evaluation Program decided to allocate $19,825 to fund the mini proposal "Economic impact of heat-related illness on the Southeastern Coastal Center for Agricultural Health and Safety's catchment area," to be implemented between July 1st and October 31st of 2019. Dr. Diaby and his team of health economists will use a computable general equilibrium (CGE) model to estimate the net economic impact of heat-related illness on SCCAHS's catchment area over a 10-year time horizon (2019–2028). The CGE model will be tailored using

historical data, including employment, demographic, and industry data (including agriculture and health sectors) that are unique to the modeled regions. The deliverables of this project include: a social accounting matrix (SAM) representing the flow of transactions (income and expenditures) between entities, including consumers, firms, and government, for a particular calendar year; a control scenario informed by theoretical and empirical work available in the literature; an alternative or counterfactual scenario; and the net economic impact dynamic CGE model. Figure 1 shows a poster related to this work that was presented by the evaluation team at a couple of meetings during Year 3.

Strategic Planning Process

The 2017 Stakeholder Needs Assessment conducted by the Evaluation Program identified the need for SCCAHS to develop more, and more diverse, relationships with stakeholders in agriculture, fishing, and forestry sectors, within the center's catchment area. In response to that need, the Evaluation Program is leading a participatory strategic planning process to assess our center's internal and external environments, generate foresight, and create a strategic plan that is useful for the future development of the center. The main goals of this process are to…: create agreement and understanding of our center's future planned direction in expanding our coverage to our mandated geographical region and occupational sectors; prioritize, focus, and plan the use of our center's energy and resources; and generate foresight and approaches to develop strategic partnerships and collaborations with new and existing external stakeholders. This strategic planning process is being carried out by Haaris Saqib, a graduate student working under the supervision of Dr. Galindo and Dr. Irani. Figures 4 and 5 depict the process, and Figure 6 is an infographic outlining the whole concept that was presented by Haaris Saqib at the International Conference on Sustainable Development held in New York on September of 2019.

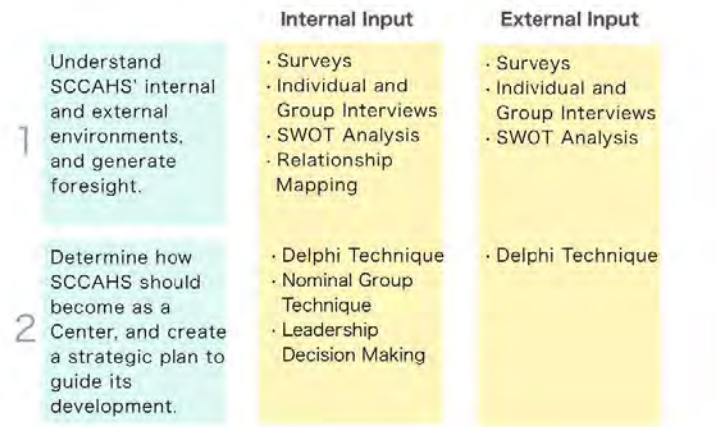


FIGURE 4. Process Overview

FIGURE 5. Strategic Planning

It is anticipated that the products from this activity will be invaluable for focusing our center's engagement and impact over the coming years, as well as strengthening the renewal application of 2021. The initial findings and products form this exercise will be used to focus and facilitate part of the discussion during the SCCAHS internal retreat scheduled for December of 2019.

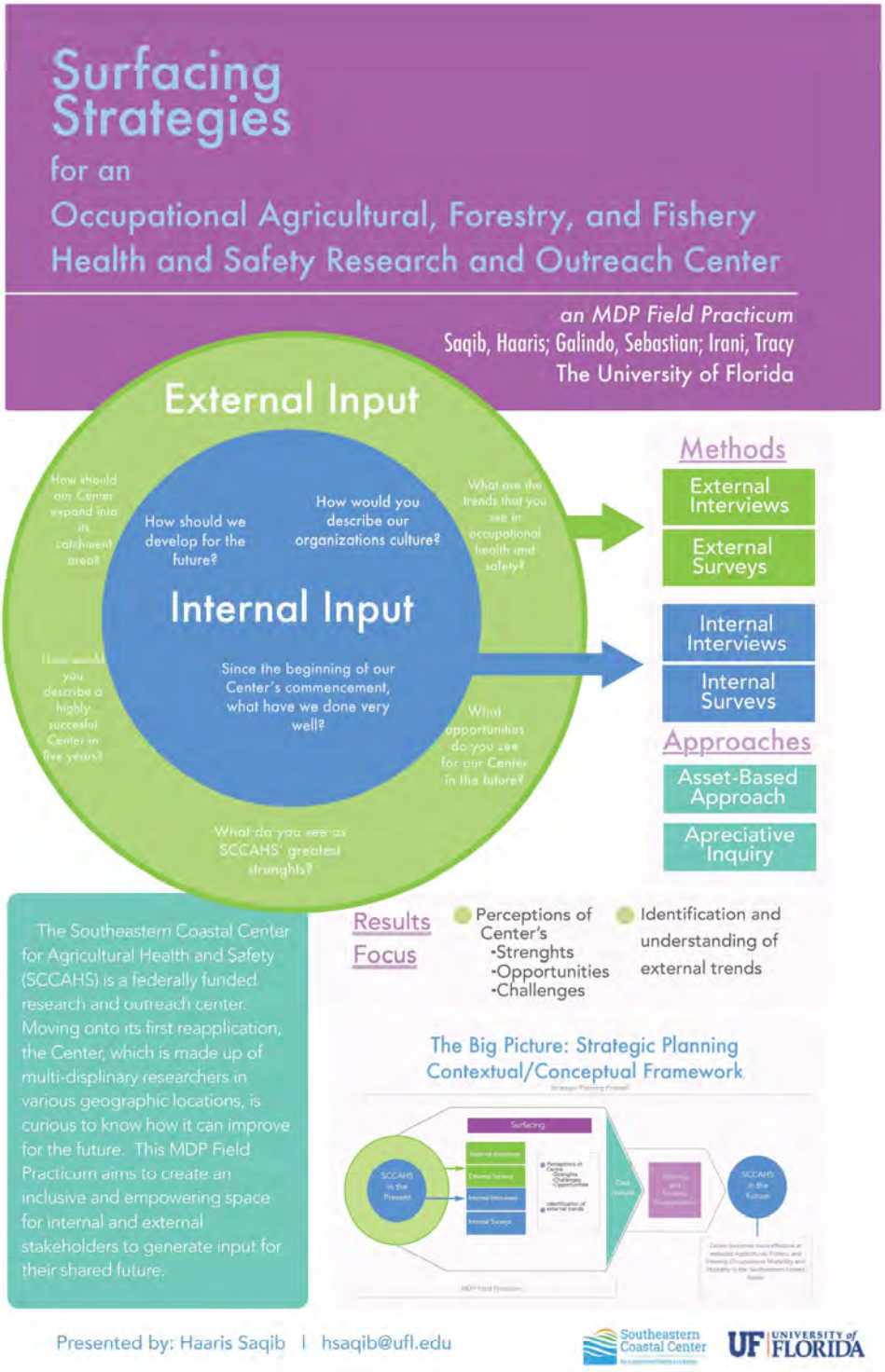


FIGURE 6. Full Concept

Impact Assessment

The Evaluation Program has worked during Year 3 on designing a strategy to enhance its effectiveness in measuring impact. Different interconnected activities, including the ROI study, were conducted during Year 3 supporting this goal. These activities also involved:

- Meeting with NIOSH's evaluation team. As part of a larger initiative aimed at enhancing UF/IFAS evaluation expertise, Drs. Galindo, Israel, and Diehl visited Washington D.C. in June 2019. This visit included a meeting at NIOSH's office on E Street. The meeting focused on discussing impact assessment, specifically centered around the publication "Contribution Analysis Approach to Evaluating Science Impact." NIOSH participants in the meeting included Emily Novicki and Amia Downes (co-authors in the publication), Steve Dearwent, Christina Spring, and Donjanea Williams. As a result of this meeting, the SCCAHS Evaluation Program and the evaluation team at NIOSH agreed to collaborate in the future developing and implementing approaches that better integrate program-centered and problem-centered tools and models to assess science impact using contribution analysis.

- Research on impact assessment. July Nelson, a doctoral student working under the guidance of Dr. Galindo, is focusing her research on developing a common evaluation framework for NIOSH's Centers for Agricultural Safety and Health. This framework will initially focus on two or three major thematic areas (e.g., heat-related illness, mental health, pesticide exposure, etc.) developing and implementing approaches that better integrate program-centered and problem-centered tools and models to assess science impact using contribution analysis. July presented a draft of her plan at the annual meeting of ISASH during June of 2019.

- Securing additional extra-mural funding. Assessing impact is a major and challenging task that requires significant resources, beyond what we currently have available. The evaluation program recently hosted the visited of Brad Husberg, Director, NIOSH Office of Agriculture Safety and Health; Co-Chair, National Occupational Research Agenda (NORA) Agriculture, Forestry and Fishing Sector Council. His visit included a day-long meeting with the Evaluation Program team to discuss the goals and priorities of NORA/NIOSH, receive feedback on evaluation initiatives being pursued, and explore the availability of funding from NIOSH for evaluation. It was recommended during this meeting that the evaluation program applies for either an R01, R21 or U01 to obtain the additional funding required for impact assessment; the U01 was identified as the most appropriate option. SCCAHS evaluation program will be ready to respond to the relevant call for proposals, as soon as those become available.

Publications and Presentations

Mitchell, C., Israel, G. D., Galindo, S. & Diehl, D. C. (February, 2020). From Plan to Action: Adapting Evaluation to Serve the Developmental Needs of a Newly-Funded Multidisciplinary Research Center. *Evaluation and Program Planning*. 78. ISSN 0149-7189

Halverson, C. & S. Galindo. (2019, April). Creating an Organizational Culture Responsive to Emerging Public Health Threats. Presented at the 2019 National Conference of the American Association of Occupational Health Nurses (AAOHN), Jacksonville, Florida.

Galindo, S., Mitchell, C., Saqib, H., Israel, G. D., & Diehl, D. C. (2019). Assessing SCCAHS' economic impact: Return on investment thematic approach for heat-related illness. Poster presented at the annual conference of the International Society for Agricultural Safety and Health, Des Moines, Iowa, June, 2019.

Nelson, J. D., Galindo, S., Israel, G. D., & Diehl, D. C. (2019). Developing a Common Evaluation Framework for the Centers for Agricultural Safety and Health. Oral presentation at the annual conference of the International Society for Agricultural Safety and Health, Des Moines, Iowa, June, 2019.Galindo-Gonzalez, S., Mitchell, R. C., Diehl, D., Israel, G. D., Williams, D.

Saqib H, Galindo S, & Irani T. Surfacing Strategies: Organizational Learning for the Strategic Development of an Agriculture, Forestry, and Fishing Occupational Health and Safety Research and Outreach Center. Poster presented at: International Conference on Sustainable Development; September 23-24, 2019; Columbia University, New York.

Galindo, S., Mitchell, C., Saqib, H., Israel, G. D., & Diehl, D. C. (2019). Assessing SCCAHS' economic impact: Return on investment thematic approach for heat-related illness. Poster presented at SCCAHS State of the Science Meeting, Saint Petersburg, Florida, September, 2019.

Galindo-Gonzalez, S., Mitchell, R. C., Diehl, D., Israel, G. D., Williams, D. F., Avalos, N., & McLoed, A. The agricultural safety and health innovation, information and knowledge system: Considerations for its evaluation. Poster presented at the annual conference of the International Society for Agricultural Safety and Health, Halifax, Nova Scotia, Canada, June, 2018.