Dehydration Status and Heat Related Symptoms in Florida Farmworkers

Linda McCauley, PhD, RN

Dean and Professor Nell Hodgson Woodruff School of Nursing

Emory University

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The “Year of Climate Change & Health”

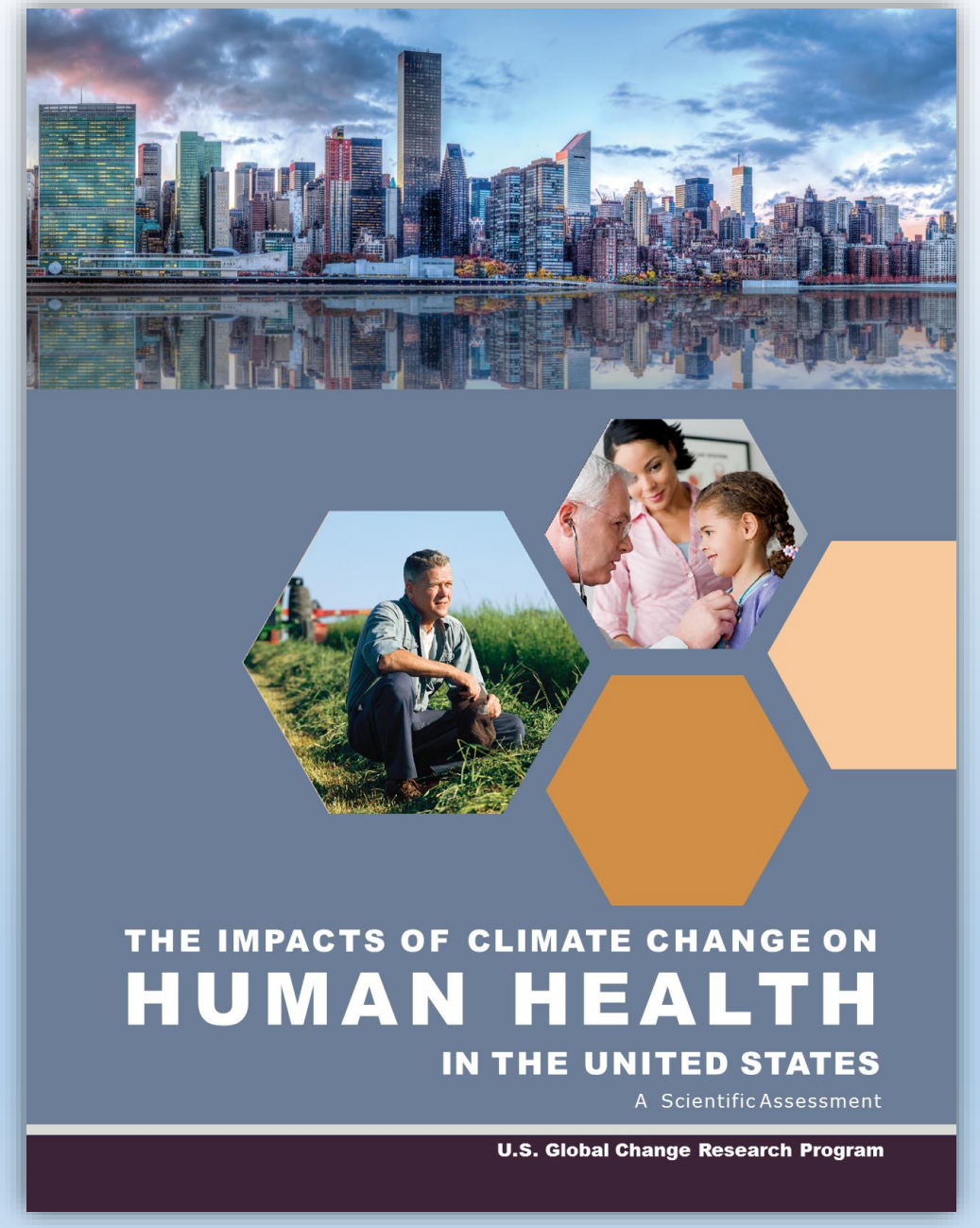
AMERICAN PUBLIC HEALTH ASSOCIATION

For science. For action. For health.

Climate Change

#ClimateChangesHealth

"We're committed to making sure the nation knows about the effects of climate change on health. If anyone doesn't think this is a severe problem, they are fooling themselves." --APHA Executive Director Georges Benjamin, in the Washington Post



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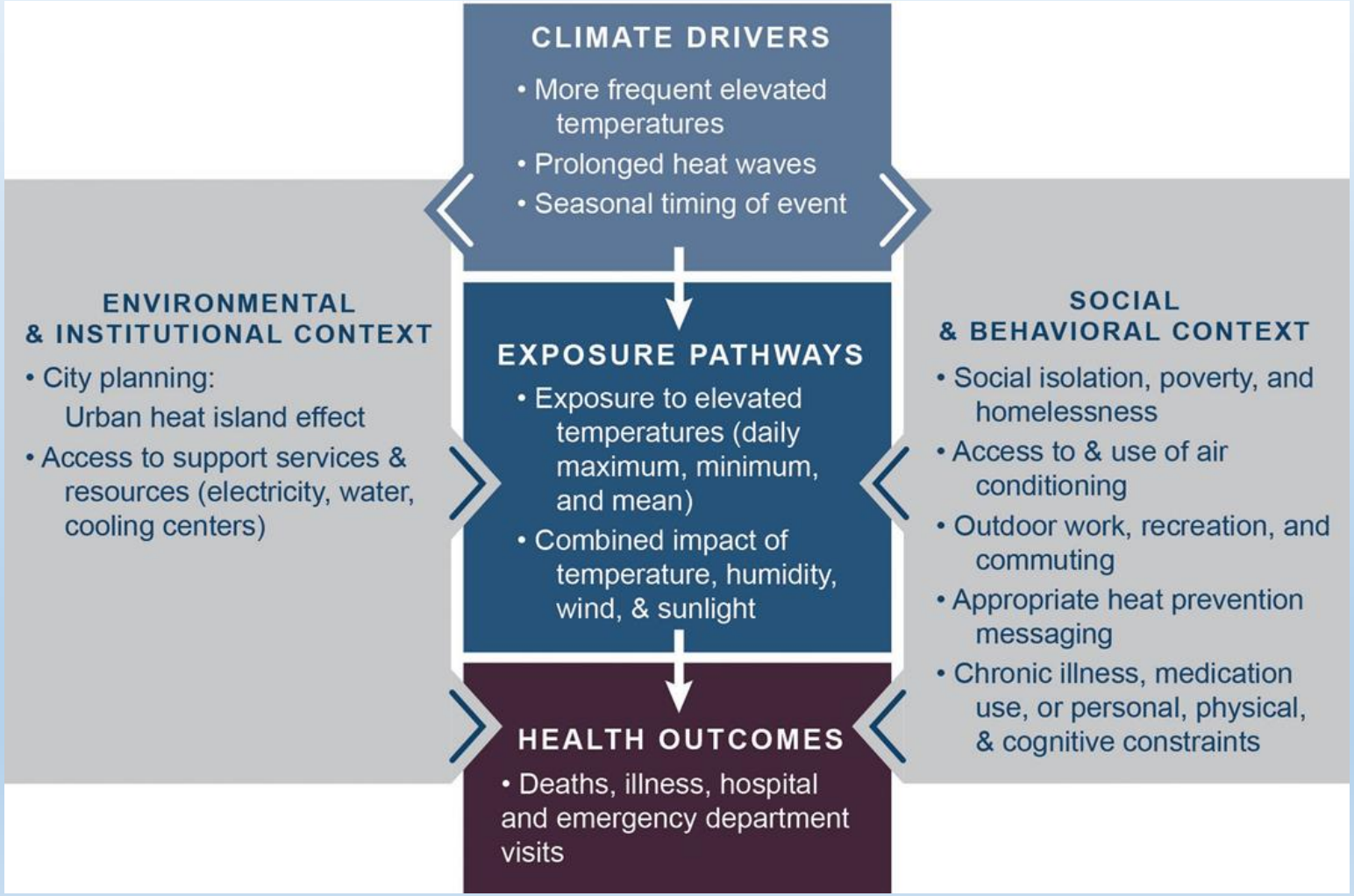
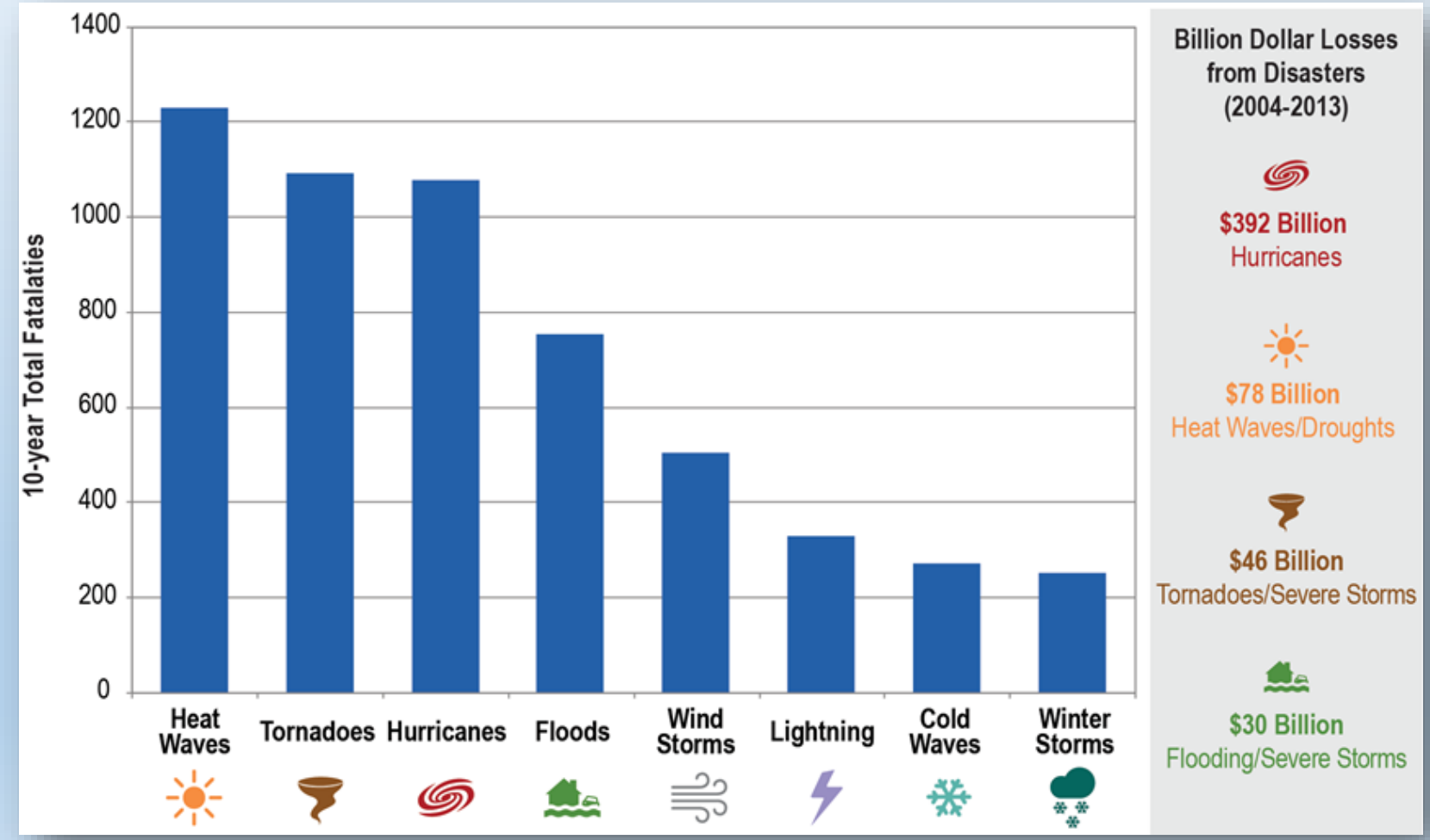
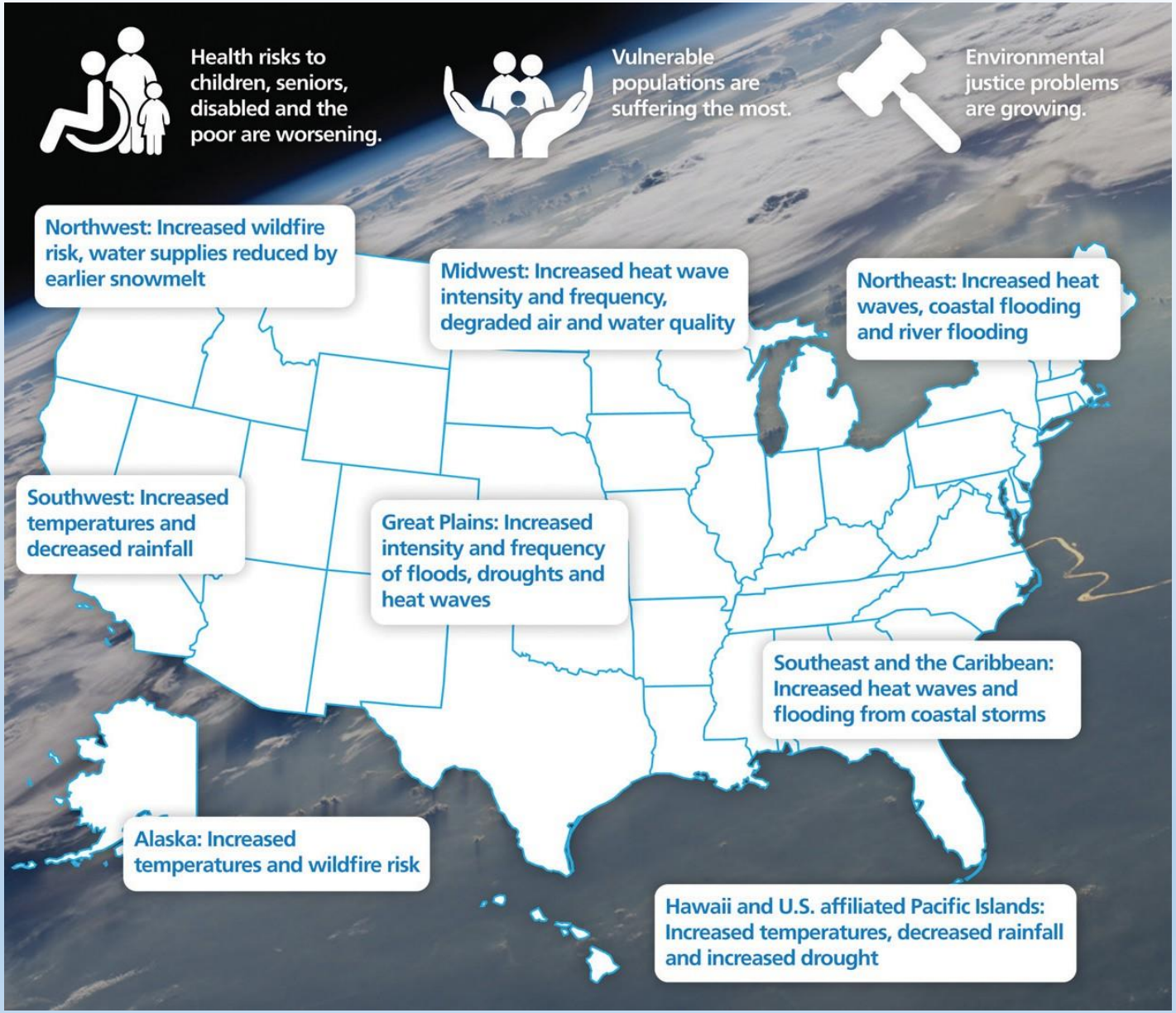
Climate Change and Health-Extreme Heat



Estimated Deaths & Billion Dollar Losses from Extreme Events in the United States 2004–2013





Third National Climate Assessment: Climate Change Impacts in the United States.

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Vulnerable Populations

- Factors that Contribute to Exposure
  - Occupation
  - Time spent in risk-prone locations
  - Responses to extreme events
  - Socioeconomic status
  - Infrastructure conditions and access
  - Compromised mobility, cognitive function and other mental or behavioral factors

Academic/Community Partnership

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Farmworker Association of Florida
La Asociación Campesina de Florida
Asosiyasyon Travayè Latè nan Florid

Pregnancy Health Among Florida Farmworkers

Aims

- Examine current perceptions of work hazards
- Assess extent of heat, ergonomic stress, and chemical exposures
- Develop health promotion education materials
- Disseminate results

CDC NIOSH R21 OH009830-01

Heat Related Illness Death

Pregnant Farmworker Dies After Being Denied Shade, Water; Family Calls for Action

Thursday, June 05, 2008
Associated Press

Print | ShareThis

AP

June 2: Josefina Flores, right, carries a photograph of Maria Isabel Vasques Jimenez, an undocumented farm worker who collapsed and died in a vineyard last month because her

LODI, California — The death of a pregnant teenager pruning grape vines in scorching heat has outraged California's farmworking community and sparked calls for safety reforms as laborers prepare for the long summer harvest.

Authorities in California — the only state with a heat-illness standard — suspect Maria Isabel Vasquez Jimenez, a 17-year-old undocumented Mexican immigrant, collapsed last month because her farm labor contractor denied employees proper access to shade and water.

On Wednesday, 500 farmworkers and their advocates capped a poignant, four-day march to the statehouse demanding safer

conditions on thousands of vineyards and orchards.

Heat Stress: hot humid work environments

The Girasoles (Sunflower) Study 2014-2018

Centers for Disease Control and Prevention | National Institute for Occupational Safety and Health R01OH010657

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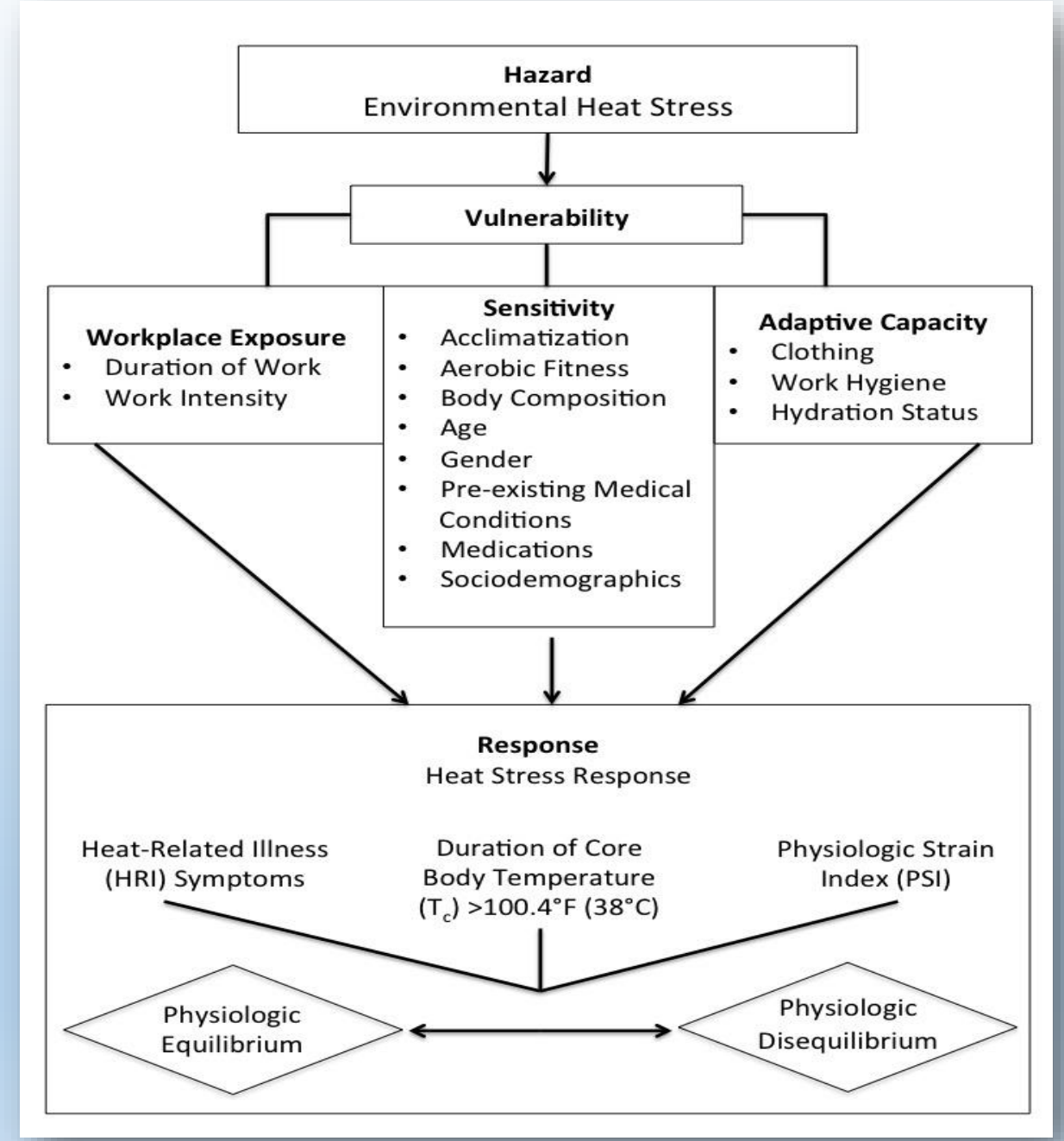
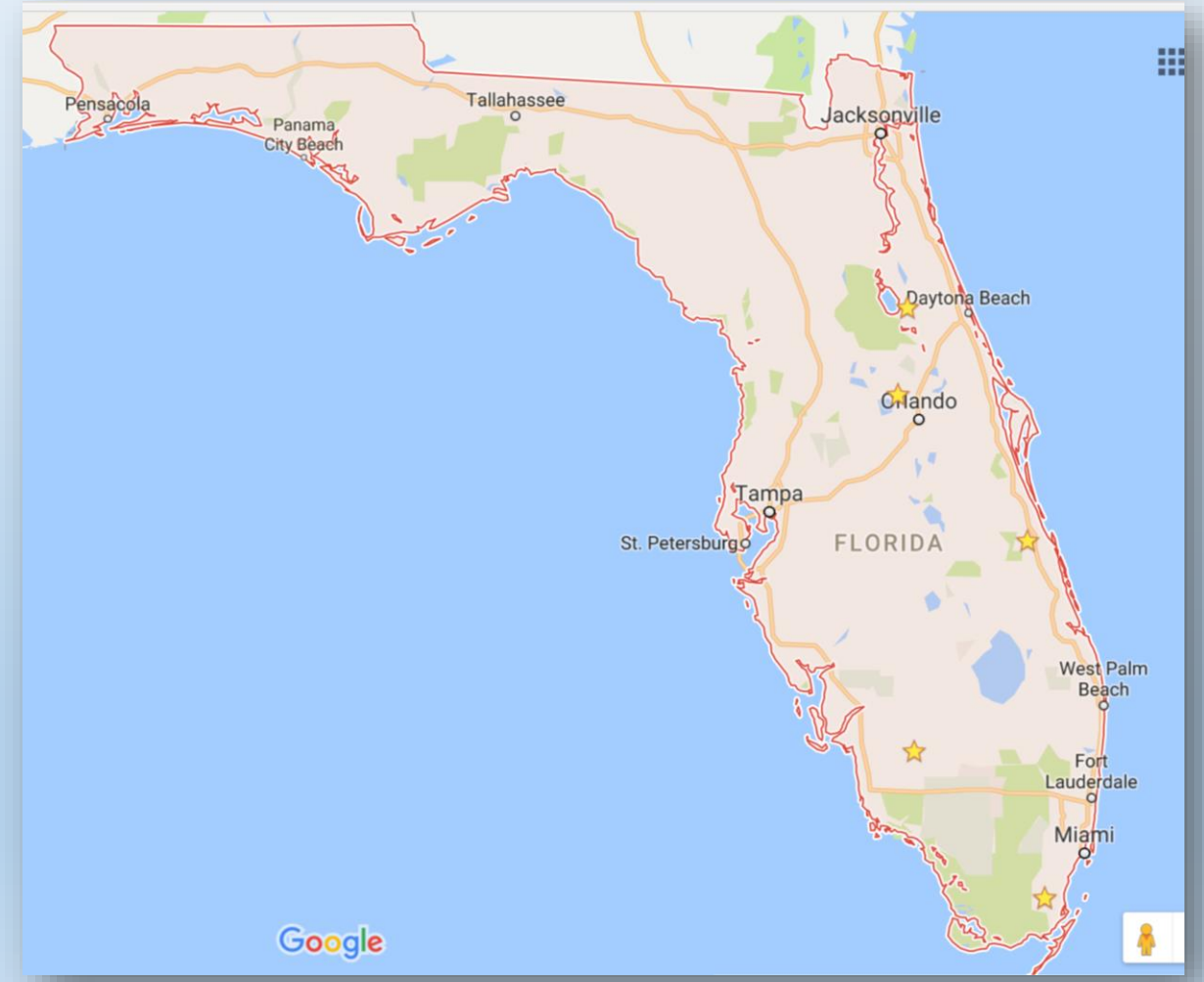
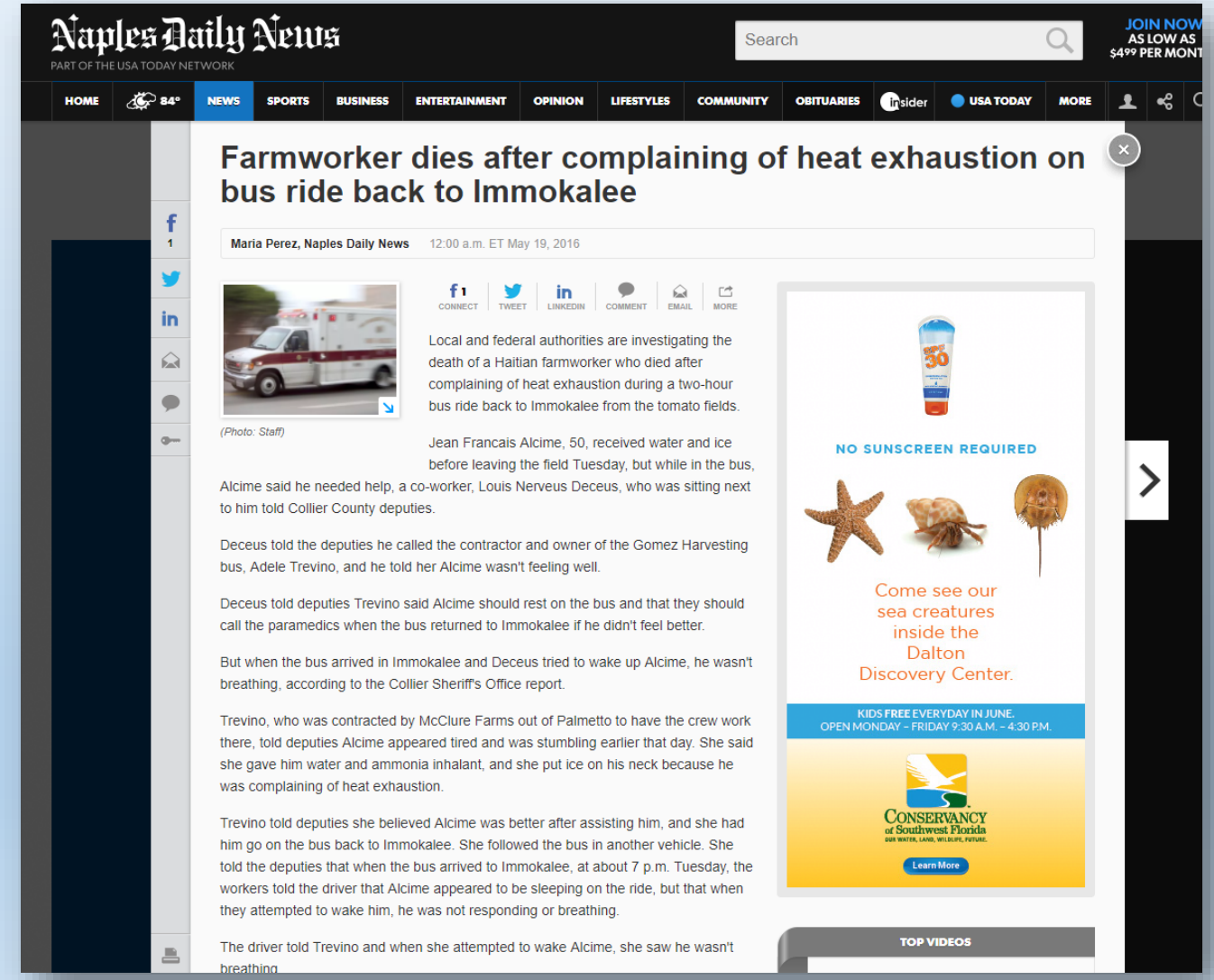


Five Girasoles Study Recruitment Locations

- Apopka
- Pierson
- Immokalee
- Fellsmere
- Homestead



Heat Related Illness Death



Comprehensive Heat Stress Monitoring

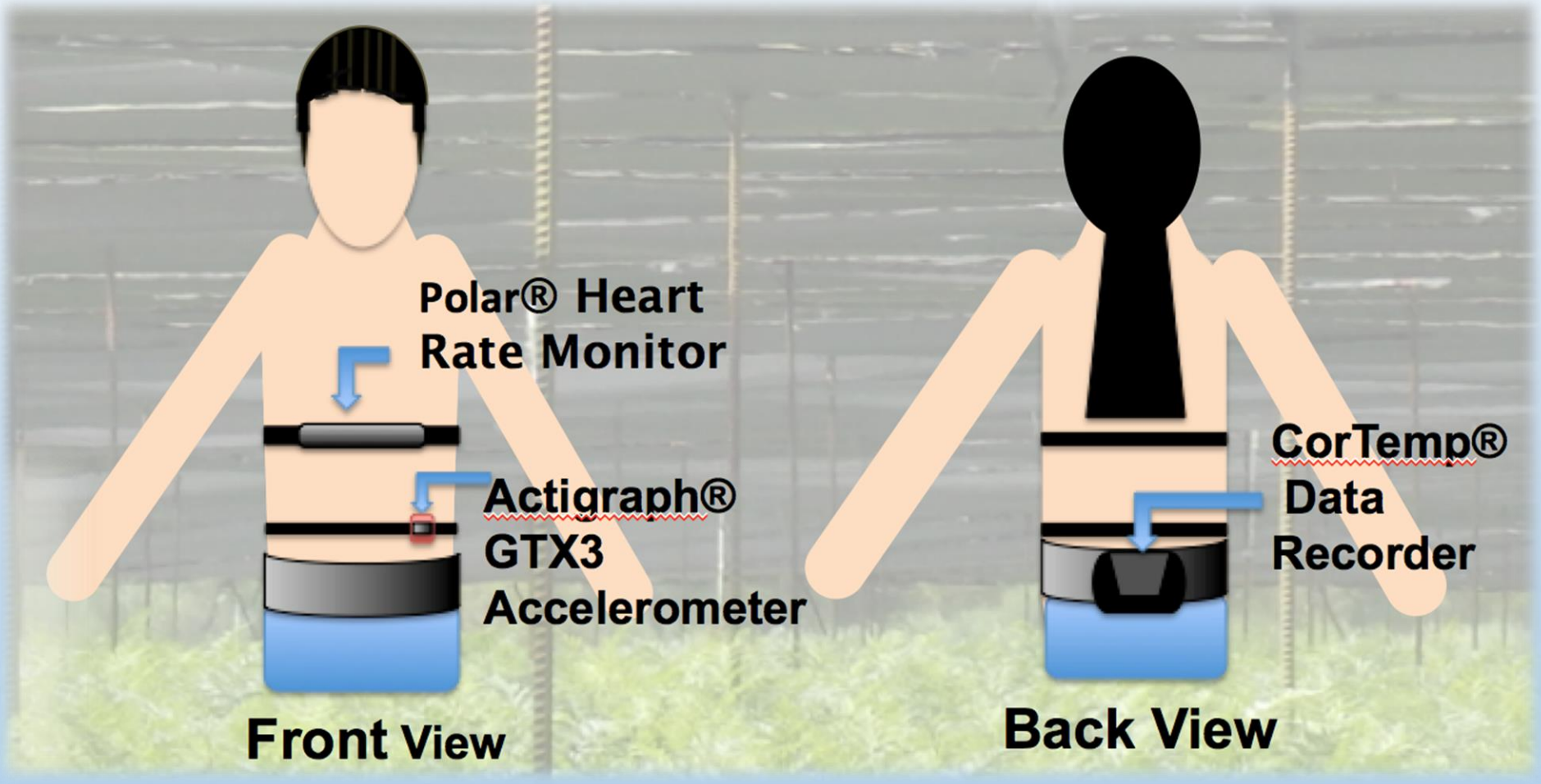
Actigraph monitor records physical activity and amount of movement

Cortemp monitor records the internal temperatures from the pill

Heart rate monitor measures heart beats during work

Home monitor records the overnight temperatures from the home

iButton records the temperature and humidity at your workplace


Polar® Heart
Rate Monitor
Actigraph®
GTX3
Accelerometer
Front View
CorTemp®
Data
Recorder
Back View

Demographics of Florida Farmworkers (n= 192); 2015-2016

Characteristic	n (%) or mean ± sd
Age	38.0 ± 8.2
Gender	
Male	76 (40%)
Female	116 (60%)
Nationality	
Mexico	124 (65%)
Guatemala	34 (16%)
Haiti	26 (13%)
United States	3 (2%)
Other	8 (4%)
Years of education	6.5 ± 3.5
BMI	
Male	27.9 ± 4.2
Female	29.2 ± 4.5

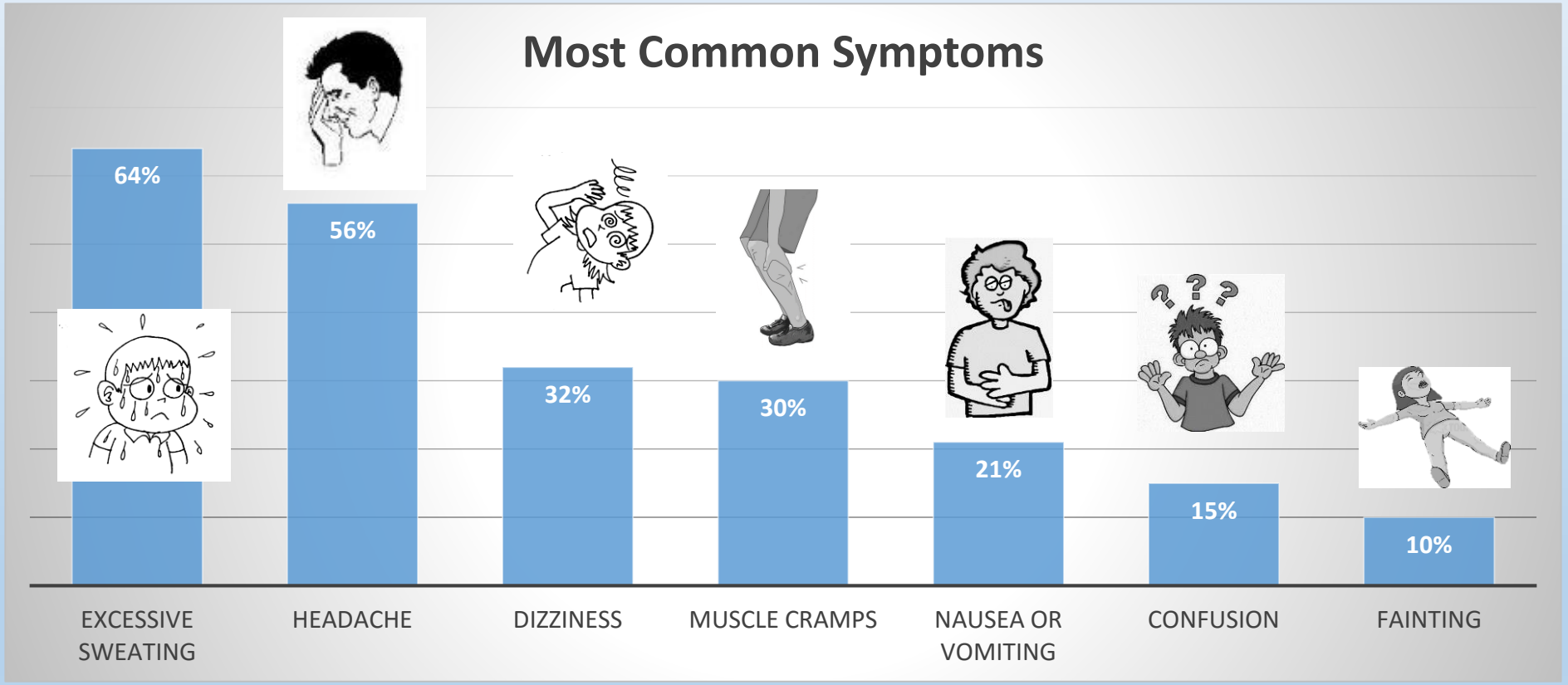
Work Characteristics of Florida Farmworkers (n= 192); 2015-2016

Work Characteristics	n (%) or mean ± sd
Years worked in agriculture	12.0 ± 7.8
Hours worked per day	7.5 ± 1.5
Primary work type	
Nursery	59 (31%)
Fernery	67 (35%)
Crop	66 (34%)
Drink more of beverage at work during hot and humid weather	
Water	188 (98%)
Sports drinks	132 (69%)
Soda	96 (50%)
Juice	74 (39%)
Energy drinks	31 (16%)
Coffee	18 (9%)
Alcohol	4 (2%)

Environmental Characteristics on Data Collection Days Across Three Florida Communities 2015-2016

Environmental Characteristics	n (%) or mean ± sd
Ambient temperature (°F)	84.4 ± 3.3
Relative Humidity (%)	73.9 ± 9.6
Mean Heat Index	91.8 ± 5.9

Heat-related Illness: Symptoms



Heat-related Illness: Monitored vs Recall

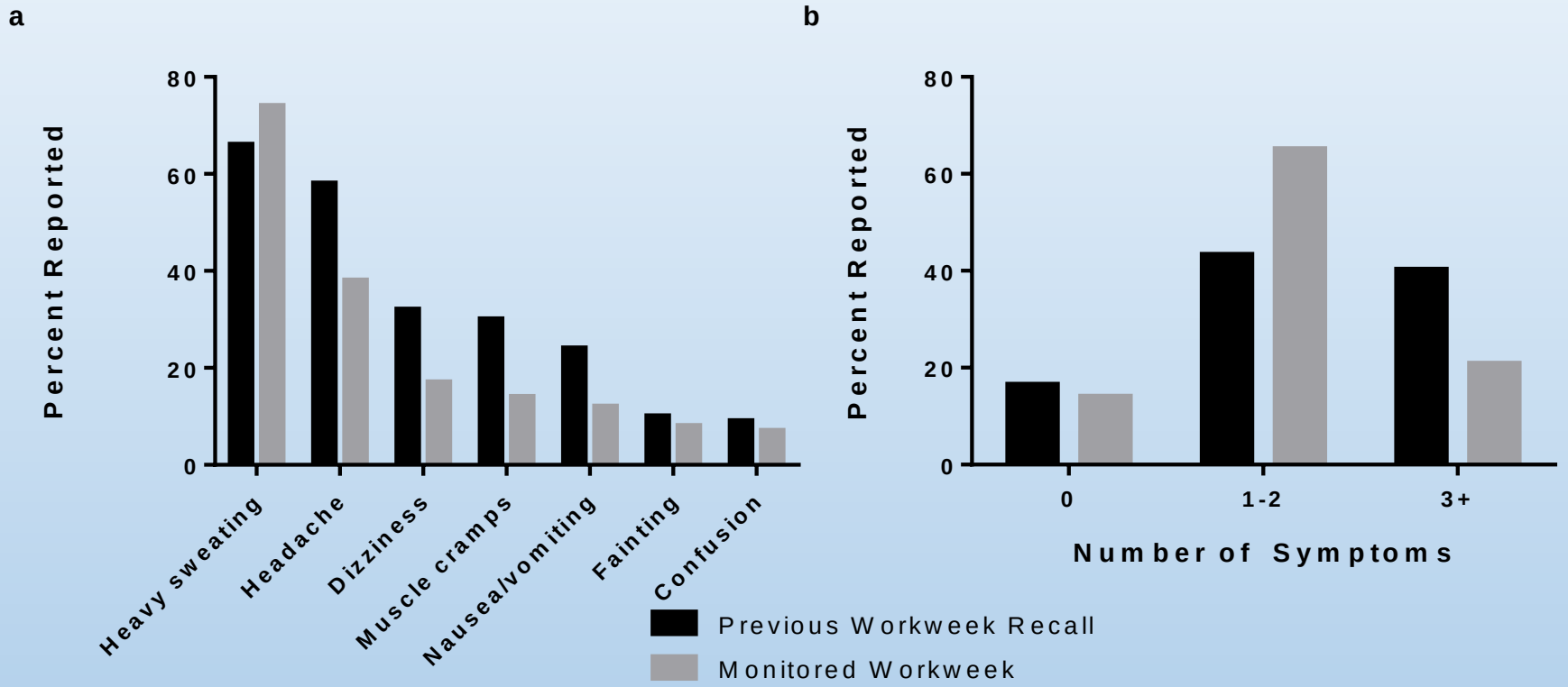
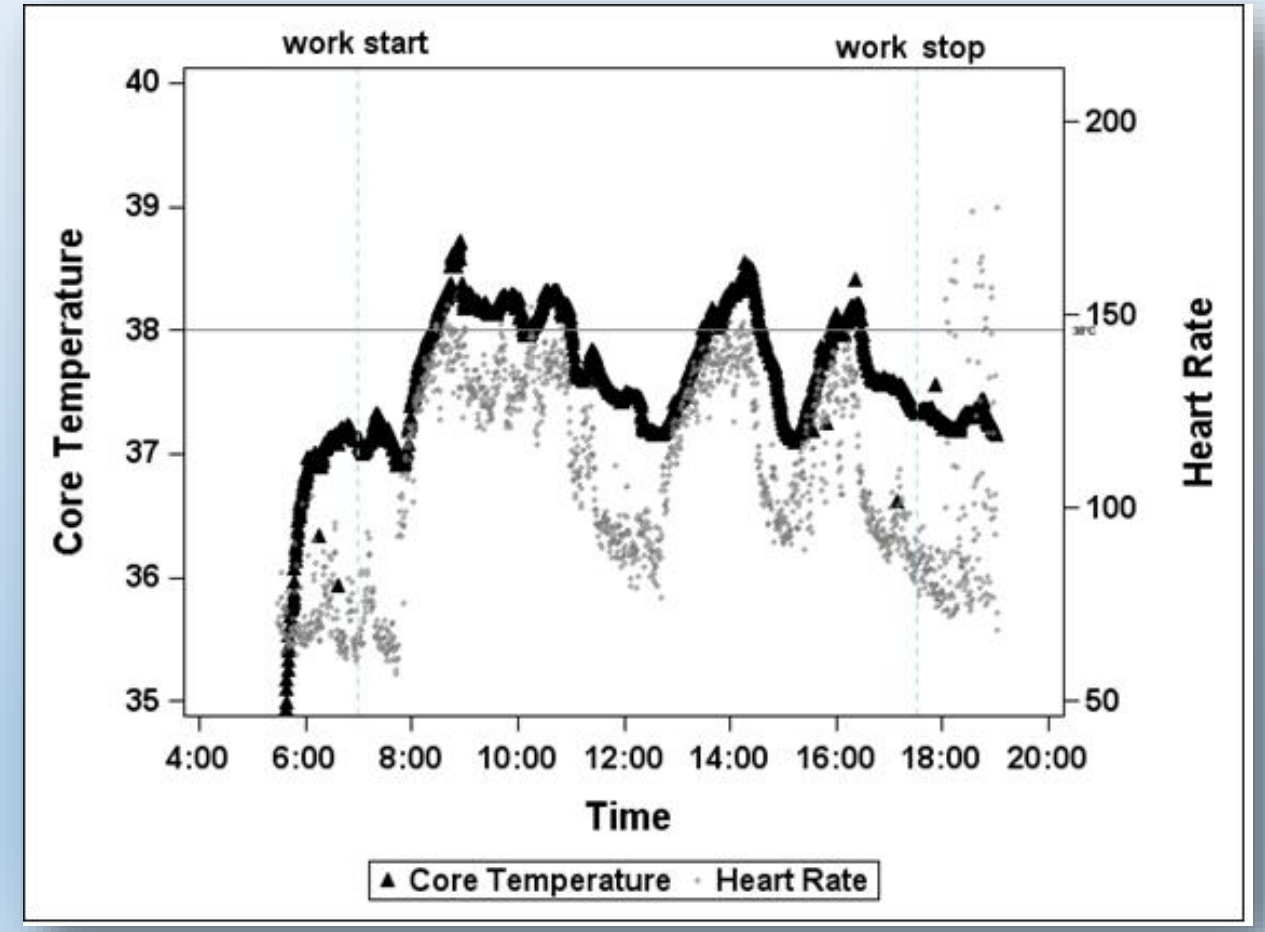
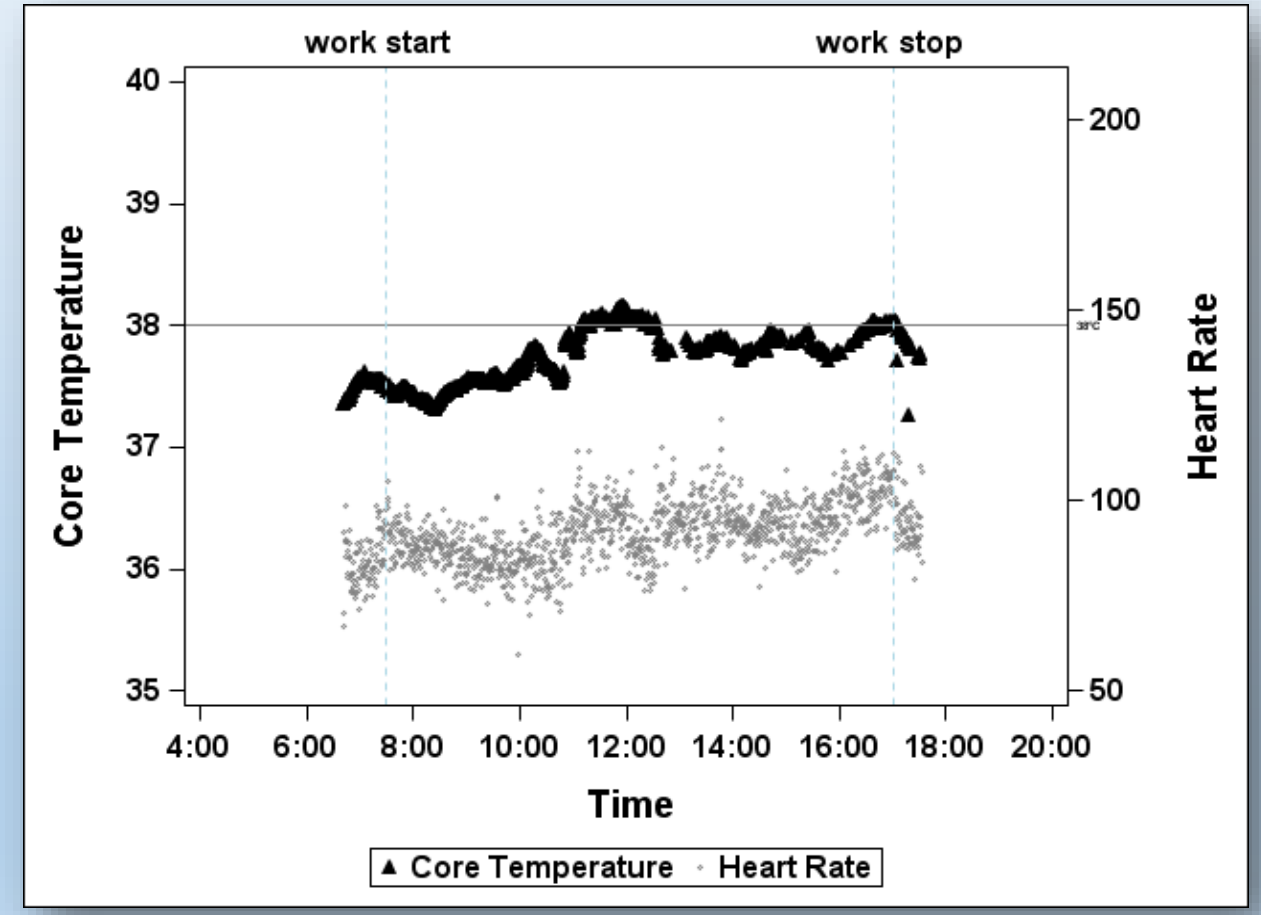


Figure 1. Frequencies of symptoms reported by farmworkers for previous workweek and during the monitored workweek. (a) By type of HRI symptom. (b) Distribution of 0, 1-2, or 3 or more symptoms

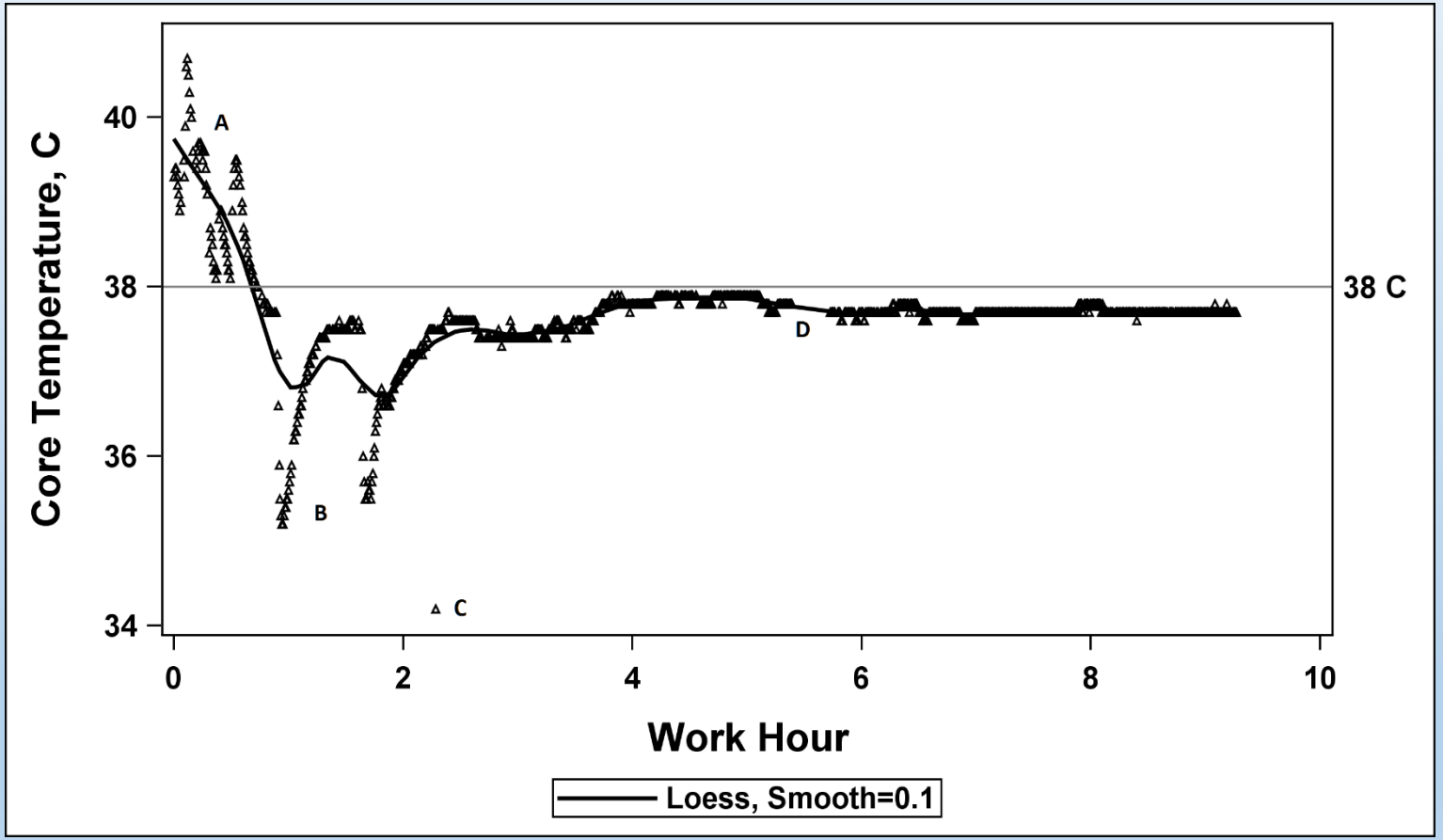
Body Temperature & Heart Rate- Summer



Body Temperature & Heart Rate- Winter



Core Body Temperature



△ = observation; ——— = estimated curve

PHASE 1:

This graph shows several issues that commonly arise in our data:

A- Bouncing ball effect

B- Rapid decline/recovery

C- Extreme values

D- Gaps

Hertzberg 2016

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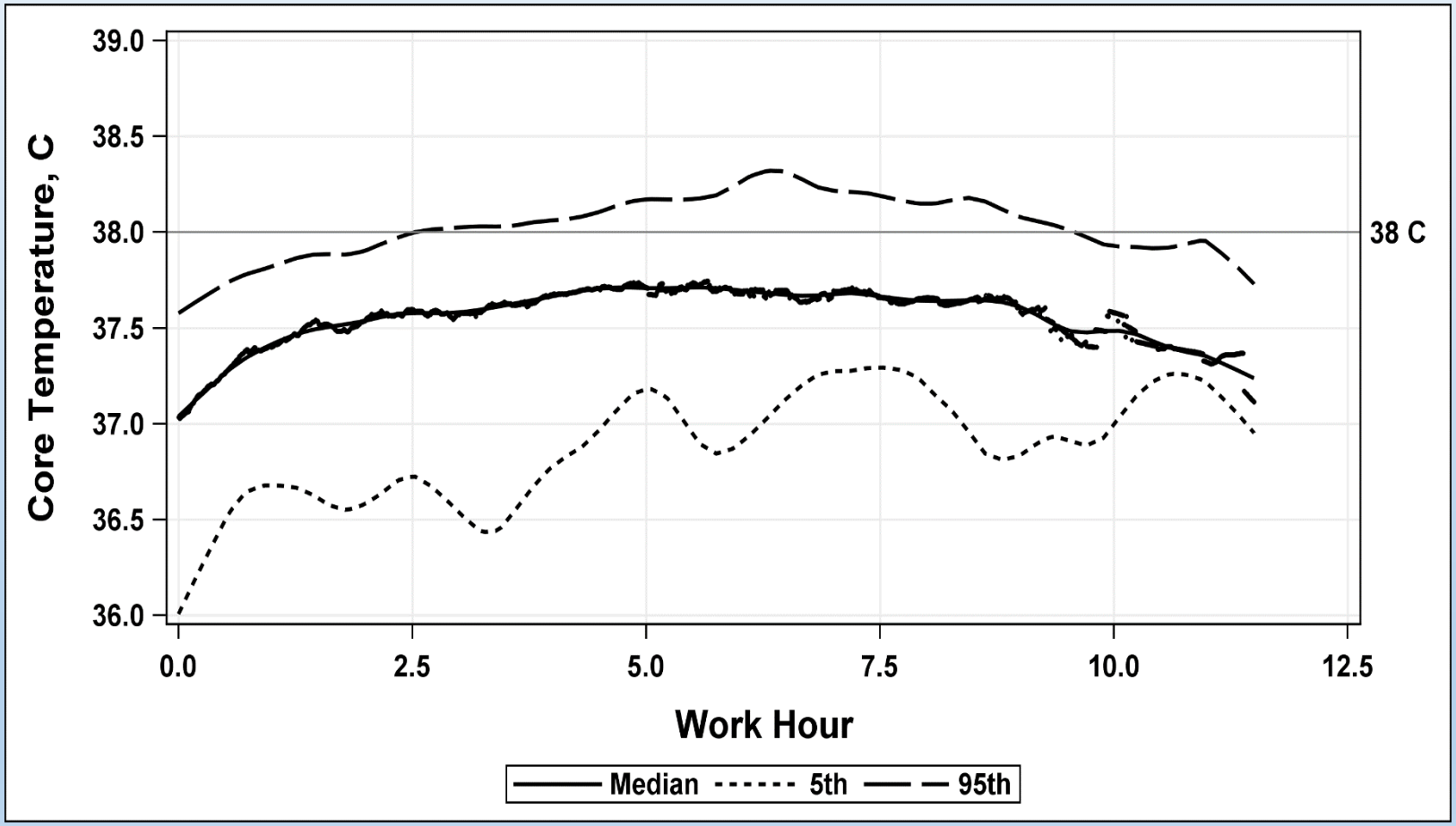
Core Body Temperature



PHASE 2:

Observations from multiple participants for each 30 second time point create a median core temperature estimate.

A smooth curve is generated by these point estimates.

Core Body Temperature

PHASE 3:

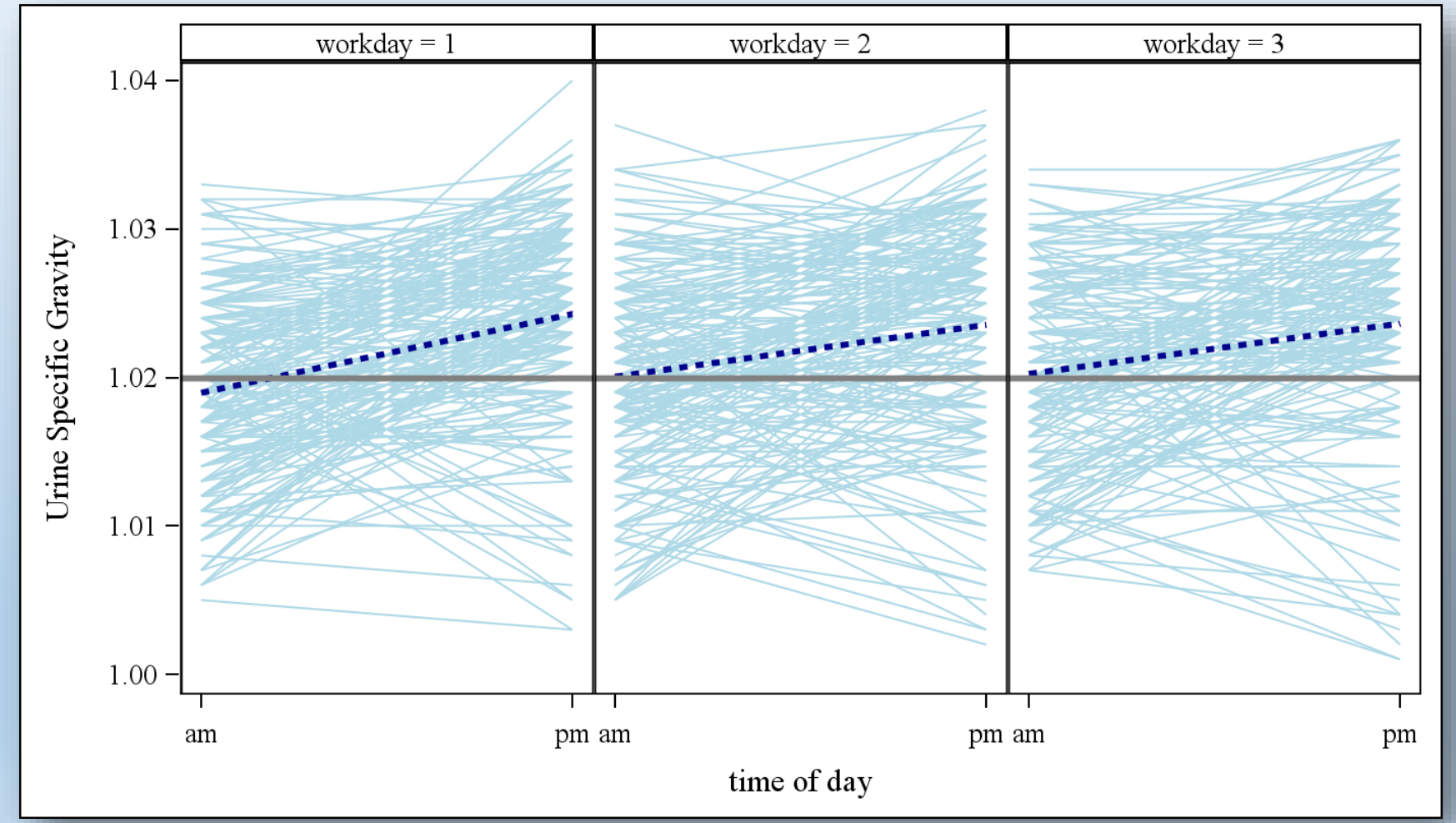
Comparison of median core temperatures for each 30 second time point during the workday.

Work hours 5-7 have the most occurrences when the difference between Fernery and Nursery core temperatures are significant.

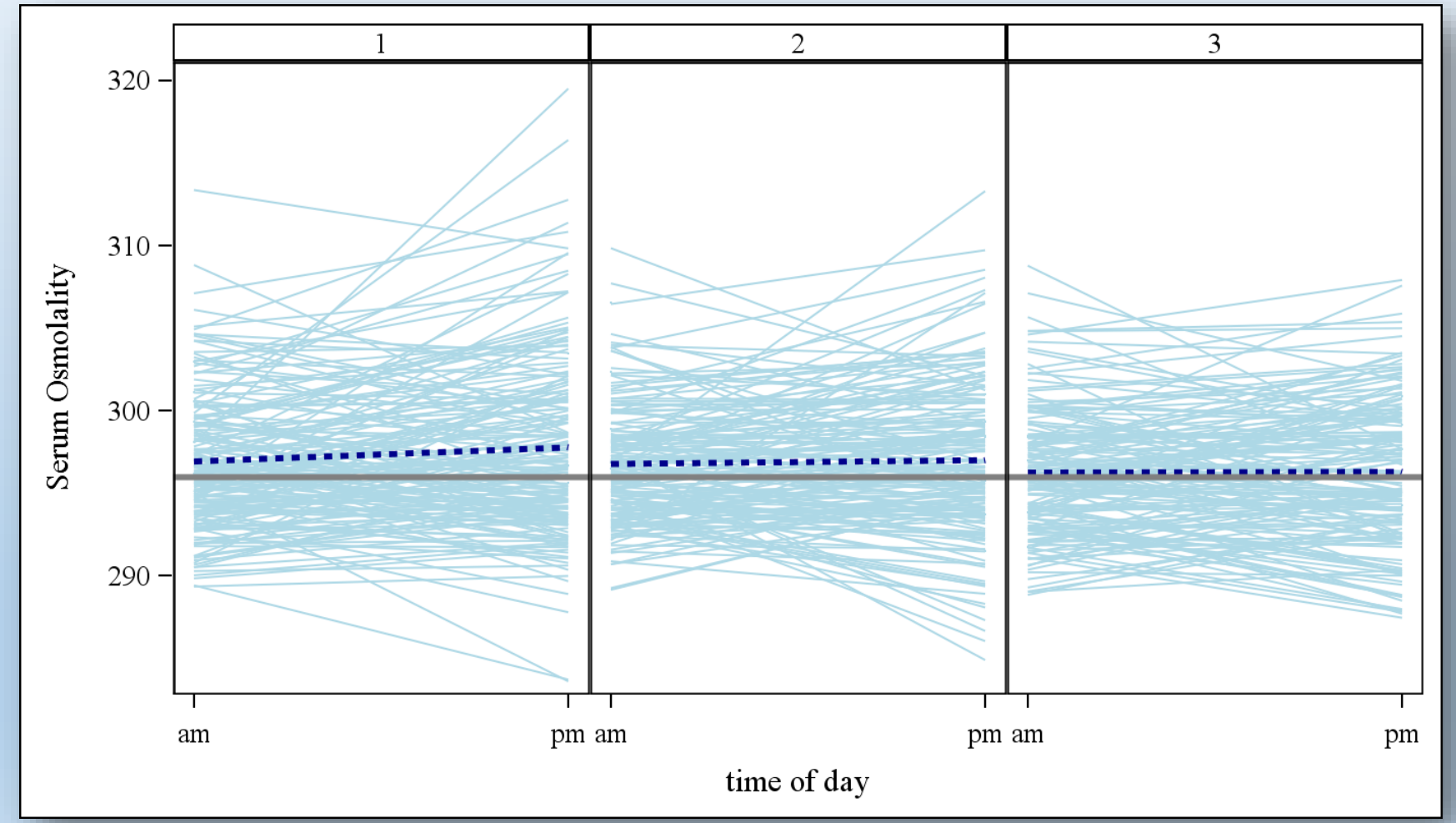
Dehydration Measures

- Urine Specific Gravity
  - Measure of solute concentration in urine
    - Comparison of water and urine density
    - Measure of kidney function and hydration status
    - USG ≥ 1.020 hypohydrated
    - 1.030 > clinically dehydrated
- Serum Osmolality
  - Measure of chemicals dissolved in serum
    - Na^+, Cl^-, Bicarbonate, Proteins, Sugars
    - Increases with dehydration
    - 275 to 295 mOsm/kg
    - > 296 dehydrated

Dehydration levels by urine specific gravity



Dehydration levels by serum osmolality



Hydration Status among Florida farmworkers; 2015-2016

Biomarker	Before Work[1] (n = 190[2])	After Work[1] (n=192)	P value[3]
USG, mean	1.019 ± 0.005	1.024 ± 0.006	<.0001
USG ≥ 1.020	53%	77%	<.0001
USG > 1.030	5%	15%	<.0001
Serum Osmolality, mean	296.7 ± 3.3	297.1 ± 4.1	.02
Serum Osm > 296	54%	53%	.9

[1]n participants for day 1 was n=192, day 2 was n=188 and day 3 was n=175
[2]based on 555 observations before work and 525 observations after work
[3]adjusted for number of days worked

Kidney Function Markers among Florida farmworkers; 2015-2016

Biomarker	Before Work[1] (n = 190[2])	After Work[1] (n=192)	P value[3]
Serum Creatinine, mean	0.70 ± 0.21	0.81 ± 0.22	<.0001
eGFR, mean	114.6 ± 13.4	104.3 ± 16.5	<.0001
eGFR <90	5%	24%	<.0001
BUN, mean	14.6 ± 4.2	15.8 ± 4.5	<.0001
Serum Potassium, mean	4.4 ± 0.3	4.2 ± 0.4	.003
Serum Sodium, mean	140.9 ± 1.4	141.1 ± 1.7	<.0001

[1]n participants for day 1 was n=192, day 2 was n=188 and day 3 was n=175
[2]based on 555 observations before work and 525 observations after work
[3]adjusted for number of days worked

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Girasoles Community Engagement

- Dissemination of results to community
- Outreach to provide care for participants
- Training promotoras
- Community Advisory Board
- Health screenings
- Clinician handouts
- Focus groups

Participants Health Education

- Body composition information (BMI, body fat)
- Blood pressure reading
- Approximate highest internal temperature
- On-site blood analysis reports

Information Addresses

- Heat prevention practices
- Warning signs
- Recommended ranges for BMI and blood sugar

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Mi SALUD

La grasa corporal _____ La presión arterial _____

Alta temperatura _____ Indice de masa corporal ____

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Indice de masa corporal

<18.5	Bajo de peso
18.5-24.9	Normal
25-29.9	Sobrepeso
30+	Obesidad

La diabetes es una enfermedad en la que el exceso de azúcar en el cuerpo conduce a problemas de salud.

Azúcar en la sangre recomendada <200

El estrés por calor señales de advertencia:

Sudor excesivo
Respiración rápida
Debilidad
Mareos
Fatiga
Náuseas
Vómitos
Calambres

Control y Prevención

Mantenga un peso (IMC) normal
Perder 7% del peso corporal (For BMI > 25)
Evitar los alimentos azucarados
Ejercitar 30 minutos 5 días a la semana
Consulte a su médico si experimenta síntomas de insolacion

Qué hacer

Trasladarse a una zona más fresca o con sombra
Sentarse
Beber agua o bebidas deportivas
Ventile y aplique agua fría al cuerpo

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SANTE MWEN

Grès nan kò _____ EMK ____

Tanperati Wo _____

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Endèks Mas Kò

<18.5	Mèg
18.5 - 24.9	Nòmal
25 - 29.9	Twò gwo
30+	obèz

Dyabèt se yon maladi kote twòp sik nan kò a mennen lot pwoblèm sante

Nivo sik nan san rekòmande

< 200

Avètisman siy estrès chalè

Swe anpil
Respire rapid
Feblès
Vètij
Fatig
Kè plen Vomisman

Kontwòl ak prevansyon

Rete nan nòmal EMK
Pèdi 7% nan pwa kò
Evite manje ki gen sik
Egzèse 30 minit senk jou nan yon semèn
Konsilte doktè ou si experimante sentòm

Kisa pou fe

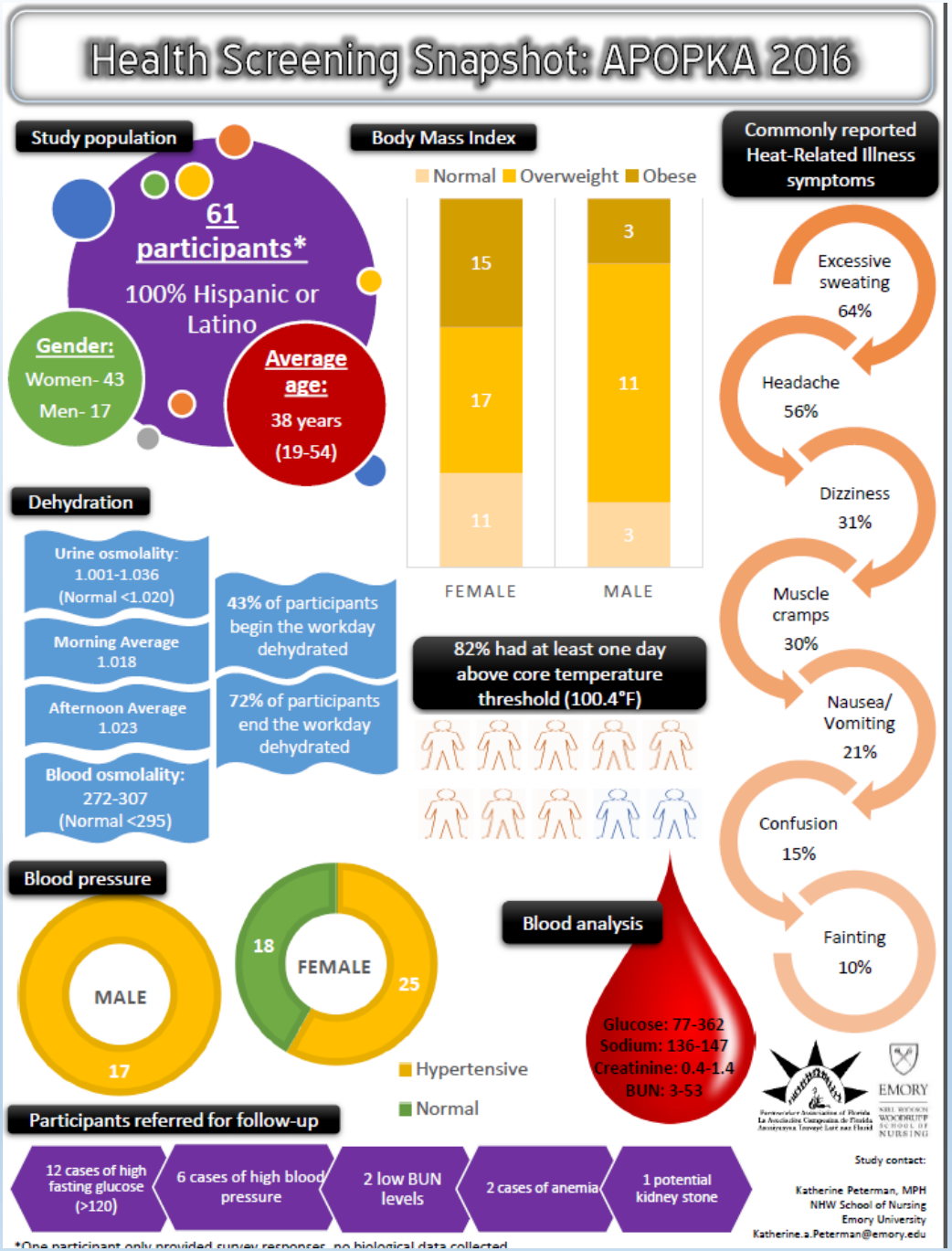
deplase nan pi fre, zòn fonse
chita
bwè dlo oswa espò bwè
fanatik ak aplike dlo fre nan kò

Farmworker Community Demographics

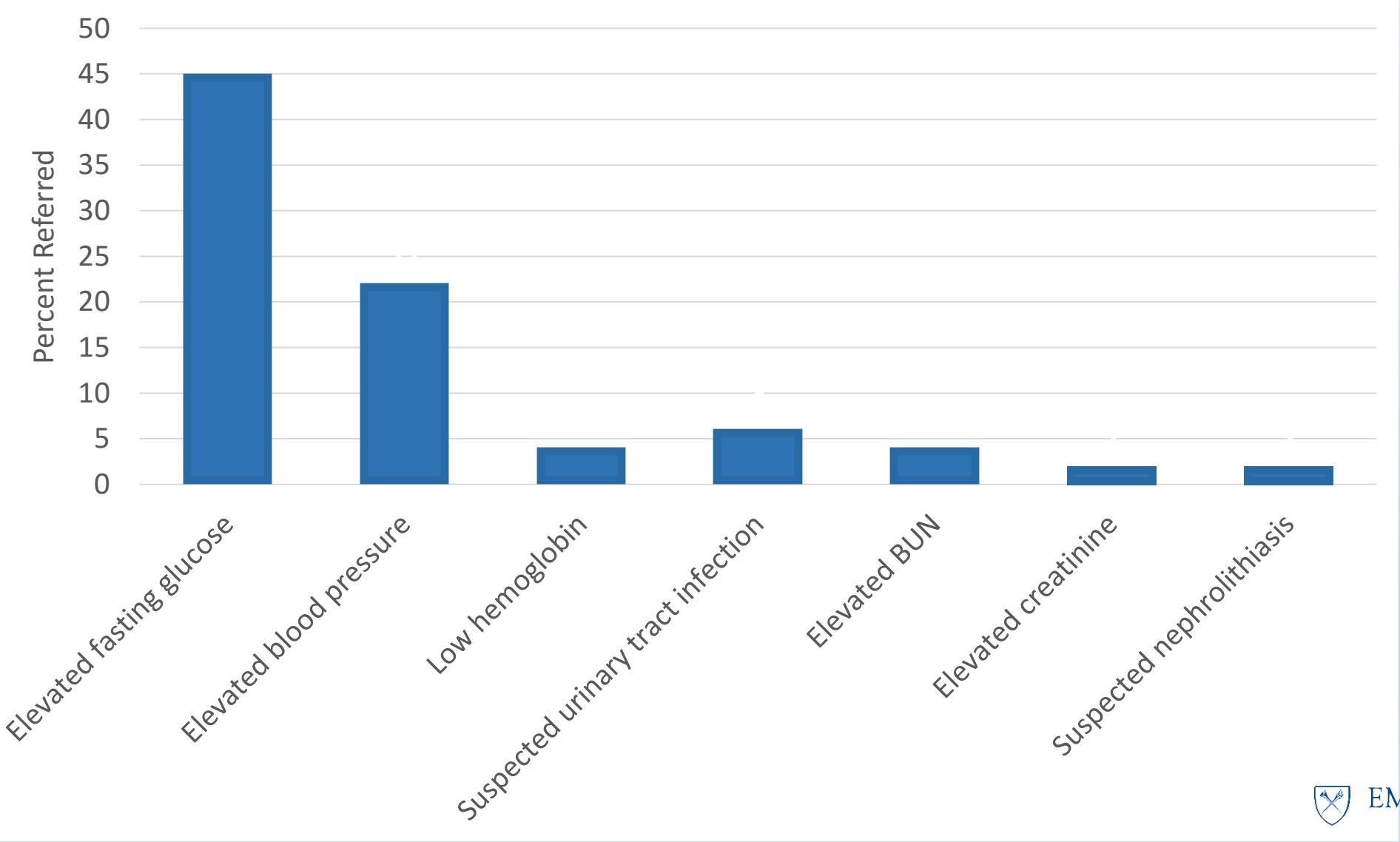
- Age
- Gender
- Race/Ethnicity

Farmworker Risk Factors

- BMI
- Blood pressure
- Serum analysis
- Max core temperature during workday
- Average dehydration levels
- Reported HRI symptoms



Participant Referrals In Apopka Summer 2016



Future Directions

- Interventions, interventions, interventions…
- Mesoamerican Nephropathy

Ramon Garcia-Trabanino 2015

Acknowledgements

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Appendix

Serum creatinine

- 31% of participants had at least one workday with serum creatinine above sex-specific limits OR an increase of >= 0.3 mg/dL on at least one workday

- Sex specific limits:
  - Males: >1.3 mg/dL
  - Females: >1.1 mg/dL

Acute Kidney Injury (AKI)

- Kidney Disease Improving Global Health Outcomes (KDIGO) criteria is based on serum creatinine change

AKI present	Increase of post-shift serum creatinine by at least 0.3 mg/dL OR ≥ 1.5 times the pre-shift creatinine
AKI stage 1	≥ 0.3 mg/dL increase in serum creatinine OR 1.5 to 1.9 times the pre-shift creatinine
AKI stage 2	2.0 to 2.9 times the pre-shift creatinine
AKI stage 3	≥ 3.0 times the pre-shift creatinine

AKI in Girasoles

Presence of AKI:

- 33% of participants had the criteria indicating AKI on at least one workday
  - 28% on one workday
  - 4% on two workdays
  - 1% on three workdays

Stages of AKI:

- 26% had **stage 1 AKI** on at least one workday; 3% on two; 0.5% on three
- 3% had **stage 2 AKI** on at least one workday
- 0.5% had **stage 3 AKI** on at least one workday

Normal ranges/cutoff value for hydration and kidney markers

MARKER	Normal Range/Cutoff valuye for Adults
Hydration markers	
Urine specific gravity (USG)	USG <1.015: euhydrated
Serum osmolality	275-295 mOsm/kg
Kidney function markers	
Serum creatinine	Males: <1.1 mg/dL Females: <1.3 mg/dL
Estimated glomerular filtration rate (eGFR)	>90 ml/min/1.73m^2
Blood urea nitrogen (BUN)	10-20 mg/dL
Serum potassium	3.5 – 5.2 mEq/L or 3.5 – 5.2 mmol/L
Serum sodium	136 – 145 mEq/L