A Case-Crossover Study of Heat Exposure and Injury Risk in Outdoor Agricultural Workers

June Spector

Departments of Environmental and Occupational Health Sciences (DEOHS) & Medicine

University of Washington (UW)

Seattle, Washington

SHARP

Safety & Health Assessment & Research for Prevention

1-888-66-SHARP

With:

WA Dept of L&I, SHARP Program:

David Bonauto, Darrin Adams

PNASH

UW DEOHS:

Richard Fenske, Lianne Sheppard, Tania Busch-Isaksen, Miriam Calkins

Funding Source: CDC/NIOSH 5K01OH010672-02

Disclosures: None

What’s the problem?

⇧<u>Heat-related illness</u> fatality rate, 20x higher in crop production and support than all industries

1992-2006; US CDC/MMWR 2008

What’s the problem?

⇧<u>Heat-related illness</u> fatality rate, 20x higher in crop production and support than all industries

1992-2006; US CDC/MMWR 2008

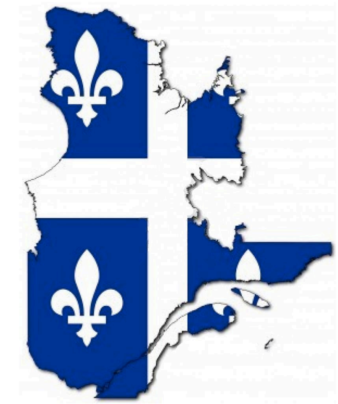
⇧<u>Injury</u> rate, WA State Fund workers’ comp claims for fruit/tree nut farming falls from elevation: 91/100,000 FTE

2002-2010; Anderson et al 2013

What do we know?

Morabito 2006

Xiang 2014



Adam Poupart 2015

↑ mean daytime apparent temp, max daily temp

↑ occupational injuries

Potential mechanisms

Exercise-related ↓hydration, ↑core body temp

↓Vigilance, concentration, balance

? Falls

Ganio 2011; Armstrong 2012; Zemkova 2014

Relevance in Washington State

May-Sept
2000-2012
mean (range)
max daily temp:
82 (46-107)°F

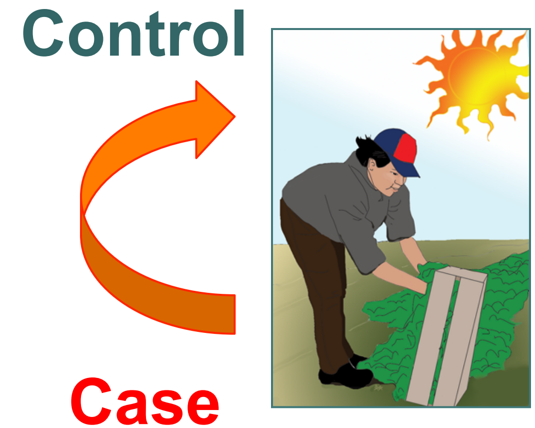
http://wak.infobaselearning.com/media/10635/Washingtonstate-agri-e.gif

Gaps we aimed to address

- Outdoor agricultural work
  - Tree fruit harvest
- Potential exposure misclassification
  - Modeled exposure data

What we did

- Study design: Case-crossover

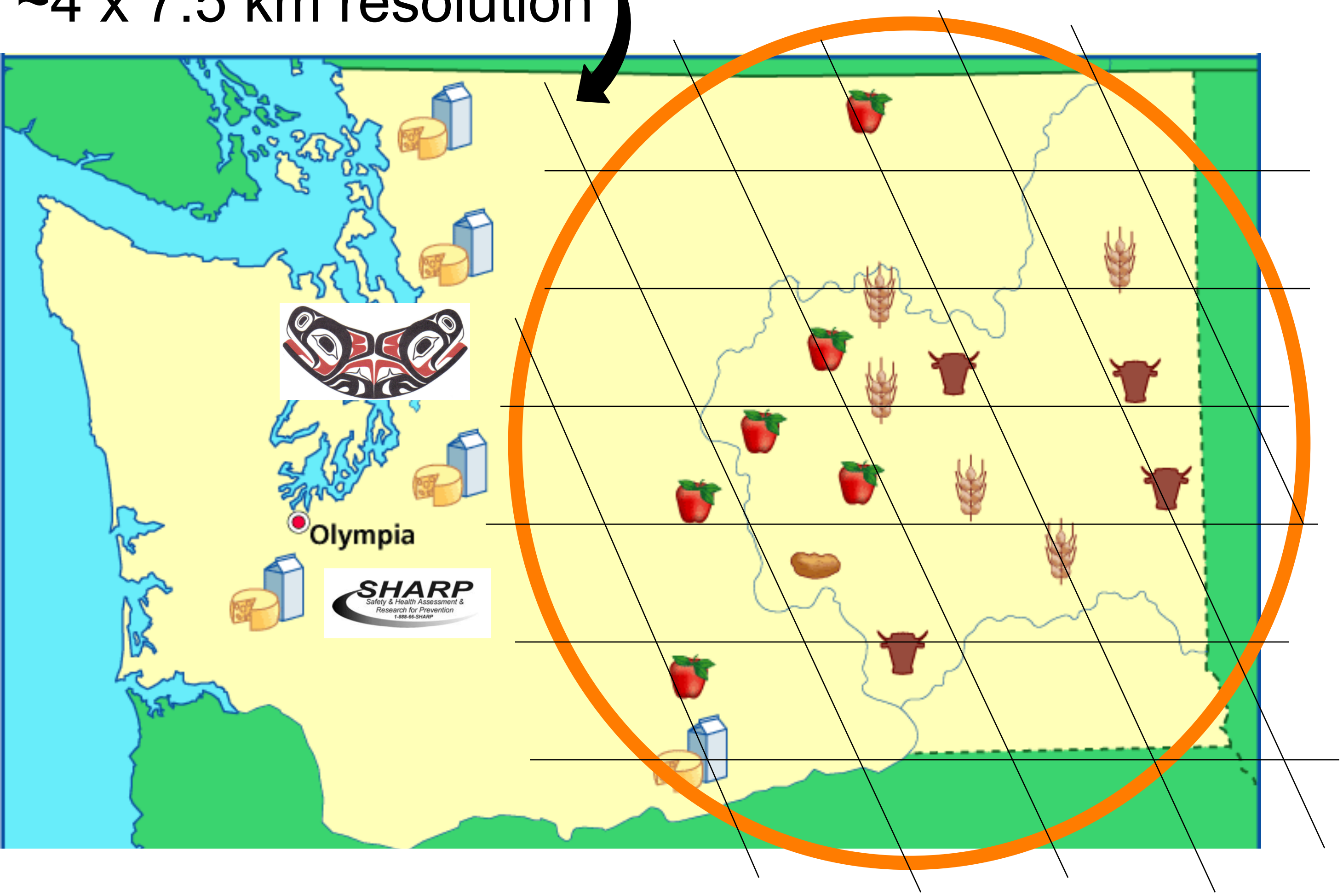


- Study population: WA State Fund adult outdoor agriculture workers' comp new traumatic injuries, 2000-2012

Washington State Department of
Labor & Industries

Where & how we did it

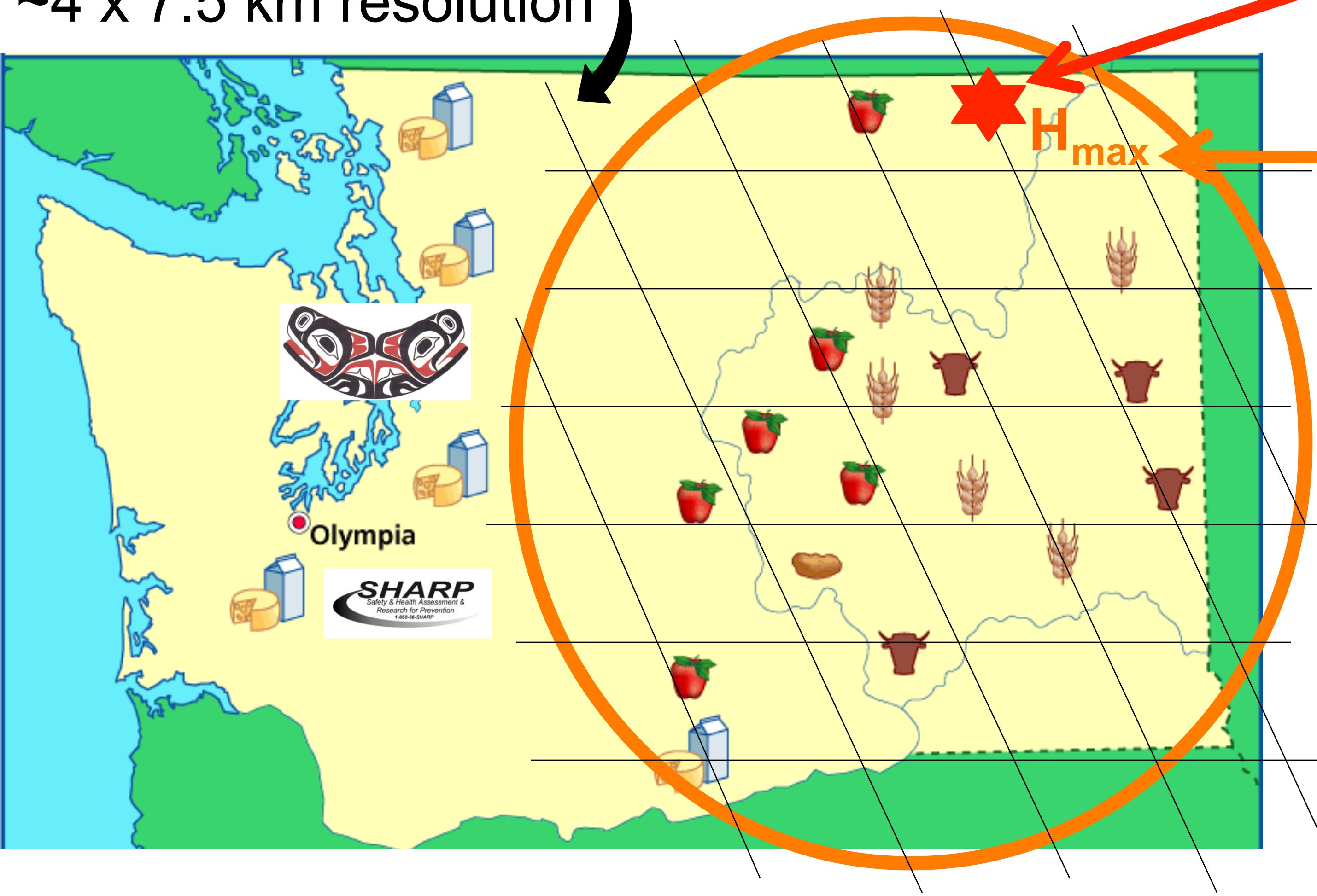
Modeled/gridded UW Climate Impacts Group meteorological data:
~4 x 7.5 km resolution



Maurer 2002; https://github.com/geocommons/geocoder/;
http://wak.infobaselearning.com/media/10635/Washingtonstate-agri-e.gif

Where & how we did it

Modeled/gridded UW Climate Impacts Group meteorological data:
~4 x 7.5 km resolution



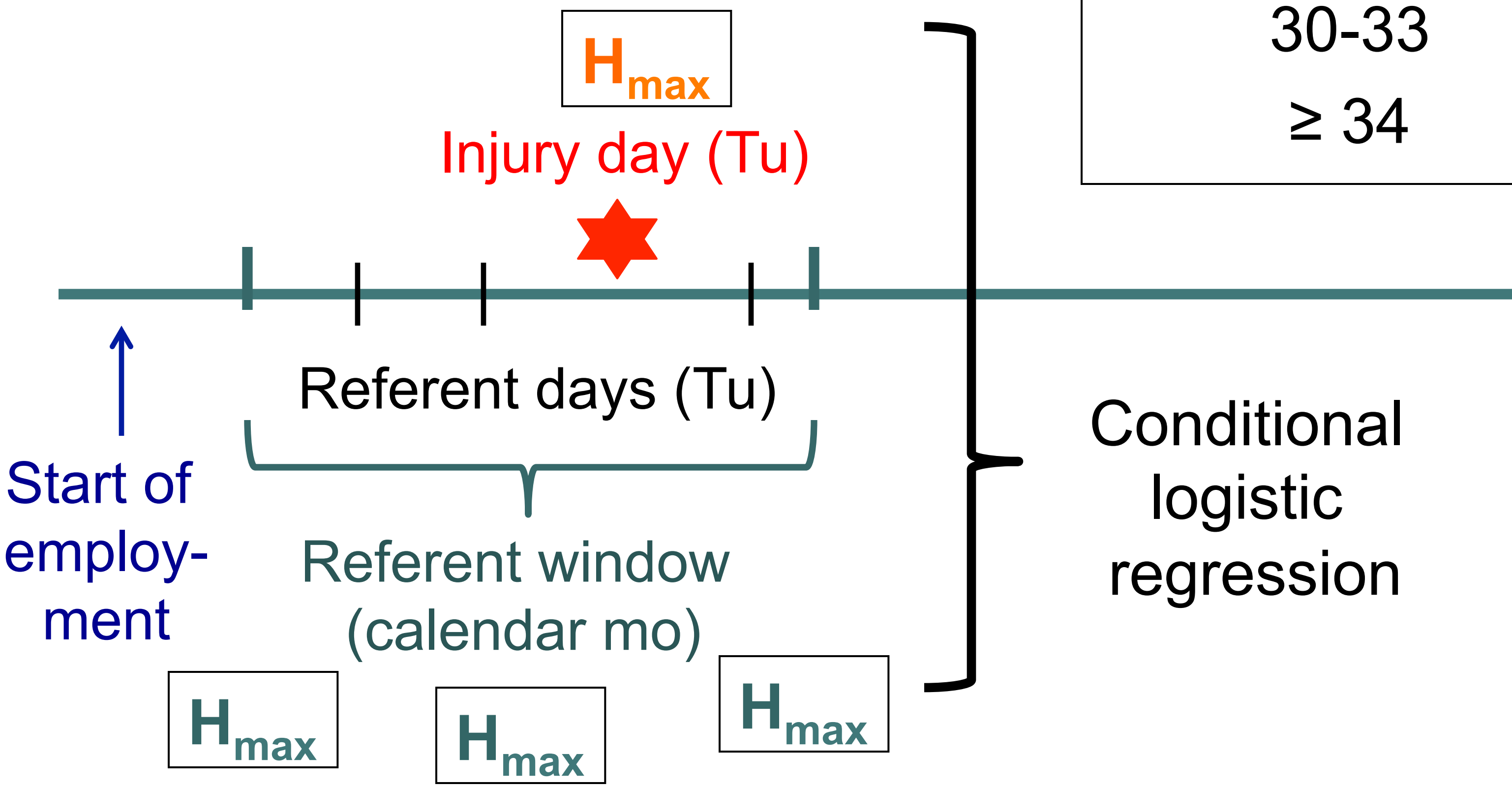
Injury lat/long assigned

Joined to nearest daily max Humidex (~ air temperature, dew point) using Euclidean nearest neighbor approach

Maurer 2002; https://github.com/geocommons/geocoder/; http://wak.infobaselearning.com/media/10635/Washingtonstate-agri-e.gif

What we compared

A priori, max daily Humidex (H_{max})
< 25
25-29
30-33
≥ 34



Janes 2005; Occ Health Clinics for Ontario Workers 2012

What we found

Selected injury claim characteristics (N=12,213)

Characteristic		n(%) or median (IQR)
Age (years):	18-34	6,929 (57%)
	35-44	2,762 (23%)
	45-54	1,638 (13%)
Male gender		9,468 (78%)
Length of employment (days)		61 (7, 760)

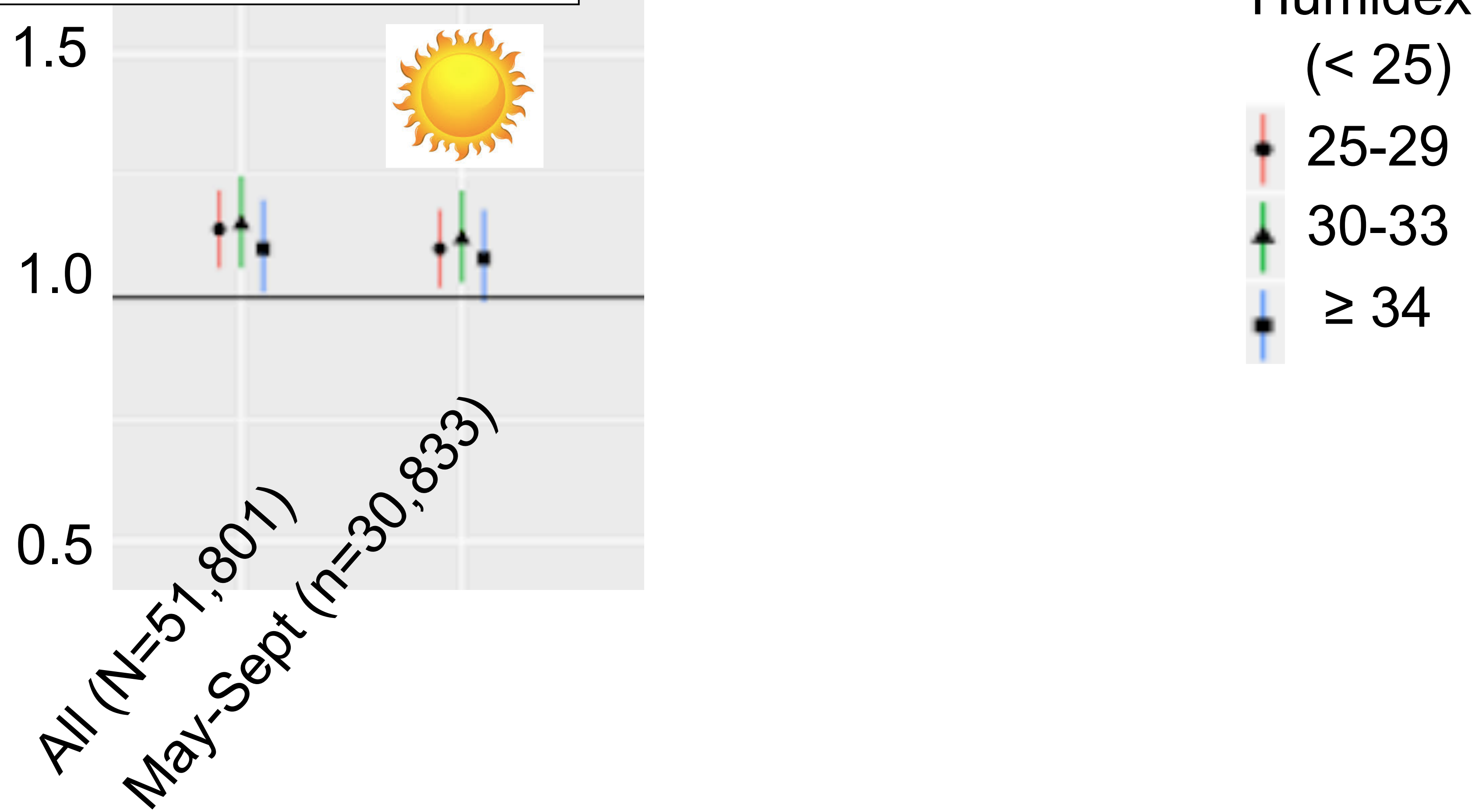
What we found

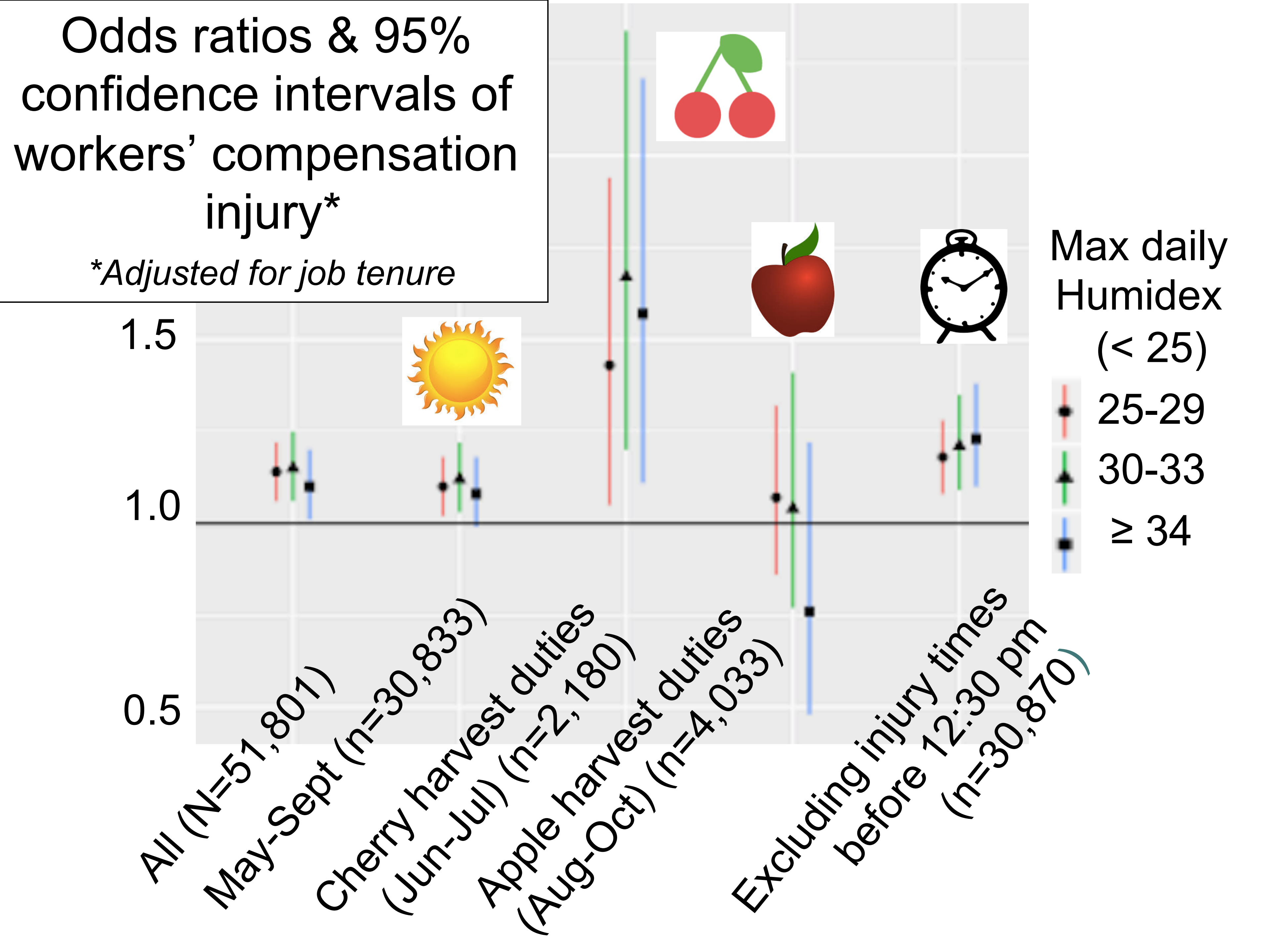
Selected injury claim characteristics (N=12,213)

Characteristic		n(%) or median (IQR)
Age (years):	18-34	6,929 (57%)
	35-44	2,762 (23%)
	45-54	1,638 (13%)
Male gender		9,468 (78%)
Length of employment (days)		61 (7, 760)
Body part:	Upper extremity	4,717 (39%)
	Lower extremity	2,709 (22%)
Event/exposure:	Falls	5,893 (48%)
	Bodily reaction/exertion	3,947 (32%)

Odds ratios & 95% confidence intervals of workers' compensation injury*

**Adjusted for job tenure*




Odds ratios & 95% confidence intervals of workers' compensation injury*
*Adjusted for job tenure
1.5
1.0
0.5
All (N=51,801)
May-Sept (n=30,833)
Cherry harvest duties (Jun-Jul) (n=2,180)
Apple harvest duties (Aug-Oct) (n=4,033)
Excluding injury times before 12:30 pm (n=30,870)
Max daily Humidex (< 25)
25-29
30-33
≥ 34

What does it mean?

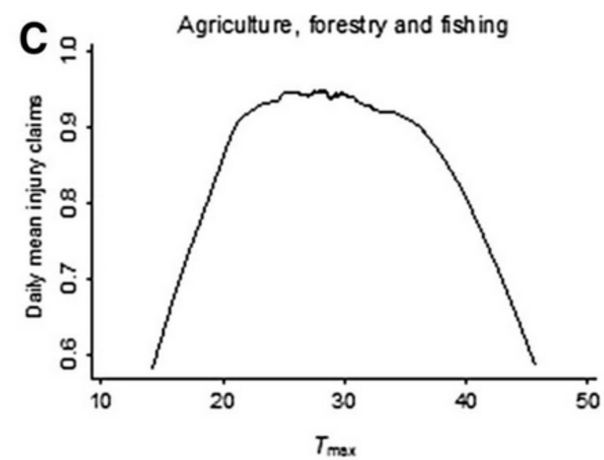
- ↑ risk WA agriculture workers' compensation injuries in warm conditions, particularly when Humidex 30-33 (compared to <25)

What does it mean?

- ↑ risk WA agriculture workers' compensation injuries in warm conditions, particularly when Humidex 30-33 (compared to <25)
- Particularly ↑ risk during cherry harvest duties, Jun-Jul
  - Early in season, warm
  - Workers more vulnerable?

"Reverse U-shaped" dose-response relationship

- Consistent with other studies
  - Better acclimatization when exposures higher?
  - Misclassification of exposures at higher exposures (work shifts end earlier)?



Xiang 2014.

What are the implications?

- High risk populations may benefit from combined injury and heat-related illness prevention efforts

- The potential benefits of heat prevention interventions, including policies, should take into account reductions in morbidity, mortality, and costs associated with heat-related injuries in addition to other heat-related outcomes

Climate change context: Risk of heat health effects may increase!

Increased frequency & severity of extreme heat events, increased temperatures

High risk industries include agriculture & construction

Adam-Poupart 2013