

# **Fatal-crashes involving cyclists (1985-2009): Cyclist-, driver-, and environment-related factors associated with crash responsibility**

**Erica Sawula,  
Sacha Dubois,  
Bruce Weaver,  
Michel Bédard**



# Acknowledgments

- A quick thank-you to the project co-authors for their collaborative efforts
- The organizations below for their support



# Introduction

- Cycling is a healthy and environmentally-friendly mode of transportation
- However, cyclists have a higher risk of being injured in a road crash



# Introduction

- The identification of factors that may contribute to cyclist-related crashes can inform injury prevention-related efforts



# Research Question

- To identify cyclist-, driver-, and environment-related factors associated with being responsible for a fatal crash
- Keeping in mind that in most fatal crashes involving a cyclist, the cyclist dies



# Data Source

- Fatality Analysis Reporting System (FARS)
- Information on all fatal crashes in the USA
- Contains information on environmental, vehicle, and driver-related factors



# Crash Responsibility

- We assigned crash responsibility based on the presence of unsafe driving actions coded for either cyclist or drivers

Cyclist UDA	Driver UDA	Responsible
✓	x	
x	✓	
✓	✓	
x	x	

The basis for our responsibility scenarios

# Data Extraction

All cyclists involved in a fatal crash (1985-2009): 20,424

Cyclists involved in a paired crash (1 bike/1 vehicle): 18,077

Cyclists involved in another type of fatal crash: 2,347

Paired fatal crash with one other car type vehicle: 13,995

Cyclist  
at fault:  
5,510

Driver  
at fault:  
2,872

Both  
at fault:  
944

Neither  
at fault:  
4,669

Reference  
Group

Our responsibility scenarios

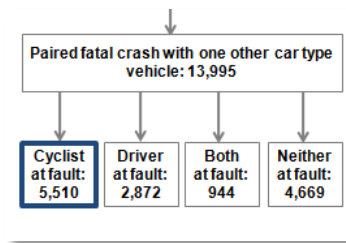
# Analyses

1. Using descriptive statistics, examine most common UDAs by responsibility scenario
2. Employed binary logistic regression (with generalized estimating equations) examining paired (i.e., one-bicycle, one-car) crashes by each responsibility scenario

# **ANALYSIS I**



**MOST COMMON UDAS BY RESPONSIBILITY SCENARIO**

# Most Common UDAs by Responsibility Scenario

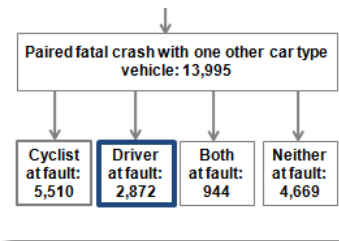


## CYCLIST RESPONSIBLE

### CYCLIST UDA %


	Failure to yield right-of-way	50.8
	Failure to obey traffic signs	18.6
	Failure to keep in proper lane	10.5
	Operating without required equipment	10.4
	Improper turn	7.9


# Most Common UDAs by Responsibility Scenario





## CYCLIST RESPONSIBLE

### CYCLIST UDA %

 Failure to yield right-of-way 50.8

 Failure to obey traffic signs 18.6

 Failure to keep in proper lane 10.5


 Operating without required equipment 10.4

 Improper turn 7.9


## DRIVER RESPONSIBLE


### DRIVER UDA %

 Speeding 30.8

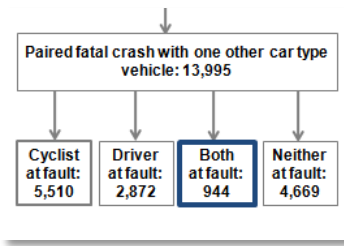
 Failure to keep in proper lane 22.9

 Failure to yield right-of-way 20.3

 Erratic Operation 18.8






 Failure to obey traffic signs 6.2

# Most Common UDAs by Responsibility Scenario

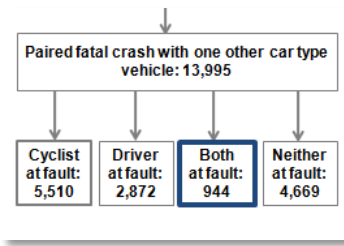


## BOTH RESPONSIBLE

### CYCLIST UDA %

	Failure to yield right-of-way	34.5
	Operating without required equipment	19.9
	Failure to obey traffic signs	12.5
	Failure to keep in proper lane	12.2
	Erratic Operation	10.4

# Most Common UDAs by Responsibility Scenario



## BOTH RESPONSIBLE

### CYCLIST UDA

%



Failure to yield right-of-way

34.5



Operating without required equipment

19.9



Failure to obey traffic signs

12.5



Failure to keep in proper lane

12.2



Erratic Operation

10.4

## BOTH RESPONSIBLE

### DRIVER UDA

%



Speeding

51.4



Erratic Operation

14.8



Failure to keep in proper lane

9.6



Failure to yield right-of-way

8.3



Improper tire pressure

6.2

# **ANALYSIS II**

EMPLOY BINARY LOGISTIC REGRESSION (WITH GENERALIZED ESTIMATING EQUATIONS) EXAMINING PAIRED (I.E., ONE-BICYCLE, ONE-CAR) CRASHES BY EACH RESPONSIBILITY SCENARIO

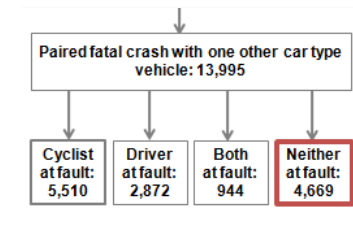
# Analysis II

- Recall we have three responsibility scenarios
  - Cyclist responsible
  - Driver responsible
  - Both responsible



# Analysis II

- We ran our binary logistic regression model for each scenario
- Those crashes where neither the cyclist or driver was at fault (“neither at fault”) was used as our reference group



Factors included in the model

# Analysis II

Our response variable is **Accidents**

Variable (Reference Category)	Both	95% CI	OR	95% CI
Cyclist Male (Female)	1.00		.85	(.73,.98)
Driver Male (Female)	1.00		1.37	(1.22,1.54)
Cyclist Age, Decades	1.00		1.29	(1.22,1.36)
Cyclist Age <sup>2</sup> , Decades	1.00		.96	(.95,.97)
Driver Age, Decades	1.00		.76	(.70,.83)
Driver Age <sup>2</sup> , Decades	1.00	(.99,1.01)	1.04	(1.02,1.05)
BadWeather	1.00	(.95,.73,1.23)	.95	(.73,1.23)
Straight	1.00	(.88,1.23)	1.04	(.88,1.23)
Dry (Not D)	1.00	(.88,1.37)	1.10	(.88,1.37)
Daylight (Nig	1.00	(1.10,1.32)	1.20	(1.10,1.32)
On Road (Off-	1.00	(.57,1.17)	6.85	(4.60,10.19)
Intersection (No	1.14	(.97,1.34)	1.49	(1.36,1.63)
Urban Road (Rura	1.24	(1.04,1.48)	1.15	(1.05,1.27)
Speed ≥ 50 MPH (<	.87	(.72,1.05)	1.08	(.97,1.19)
Constant	.20		.11	

ITS MUCH EASIER TO UNDERSTAND THIS TABLE IF WE PLOT THE ODDS RATIOS AND CIs

Merci!

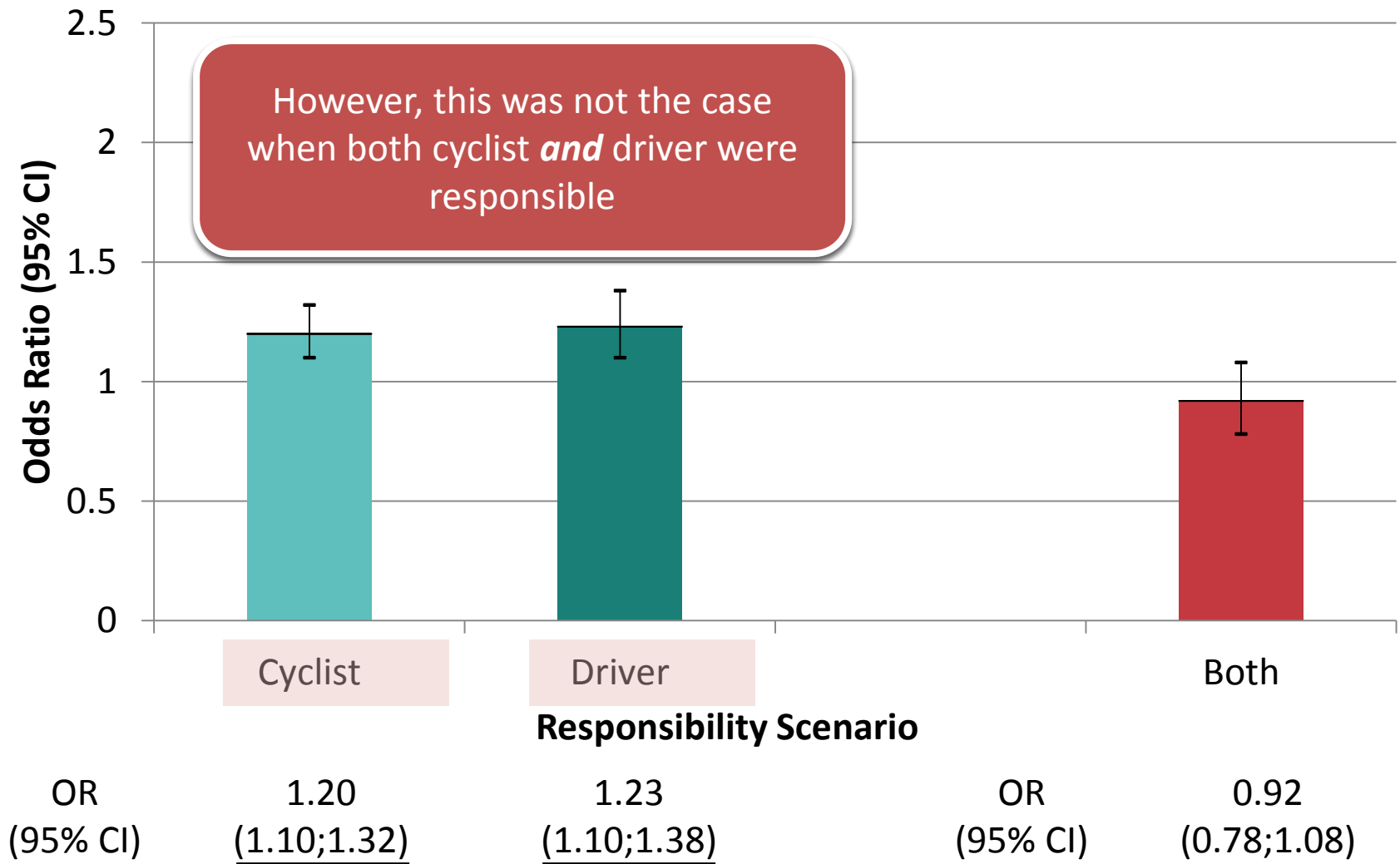
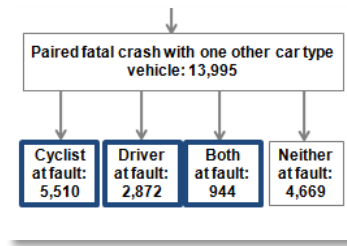
Odds Ratios with 95% CIs



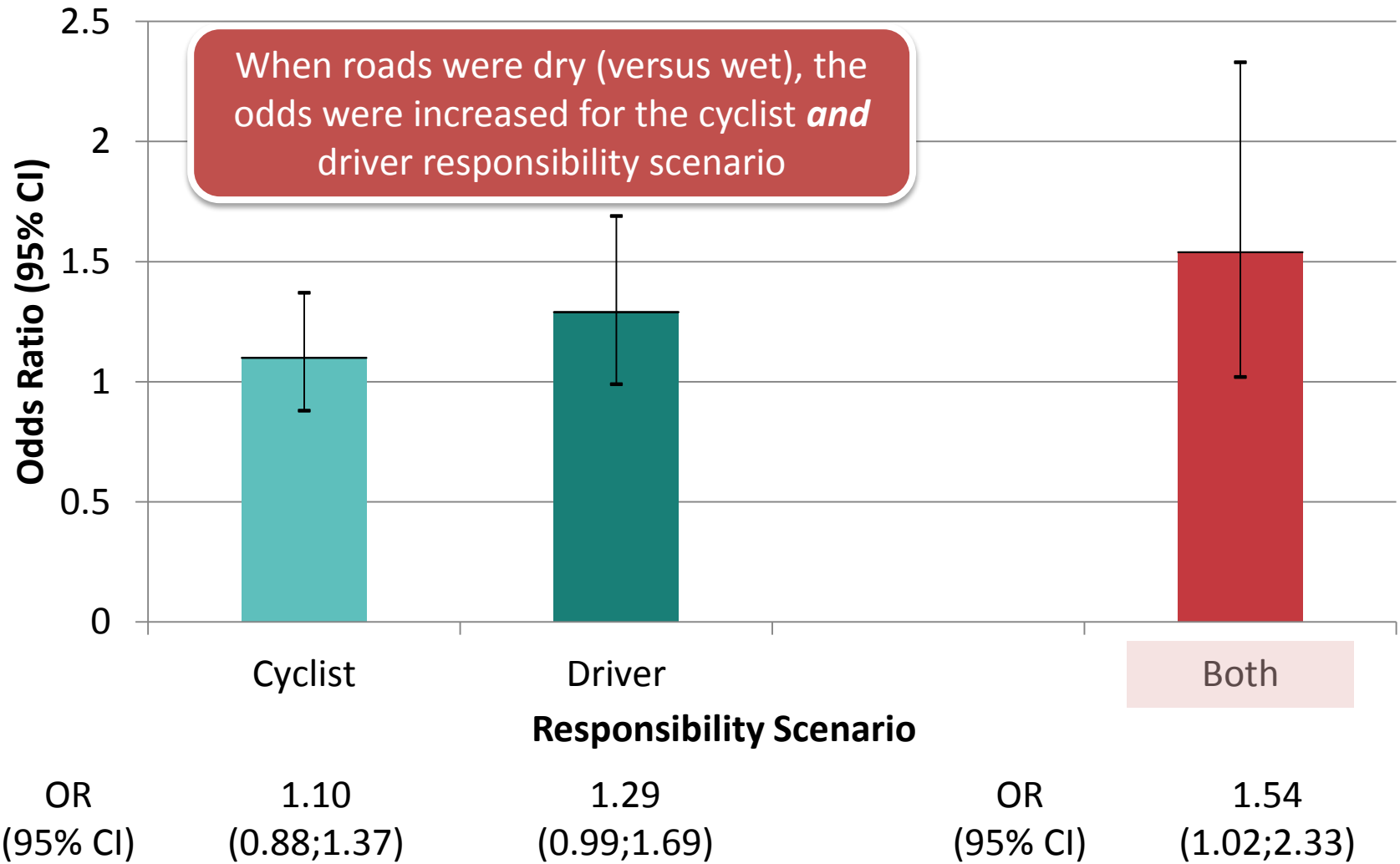
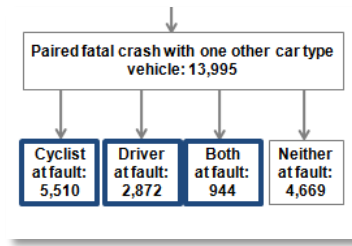
# **ANALYSIS II**

ENVIROMENTAL AND ROAD CONDITIONS (*HIGHLIGHTS*)

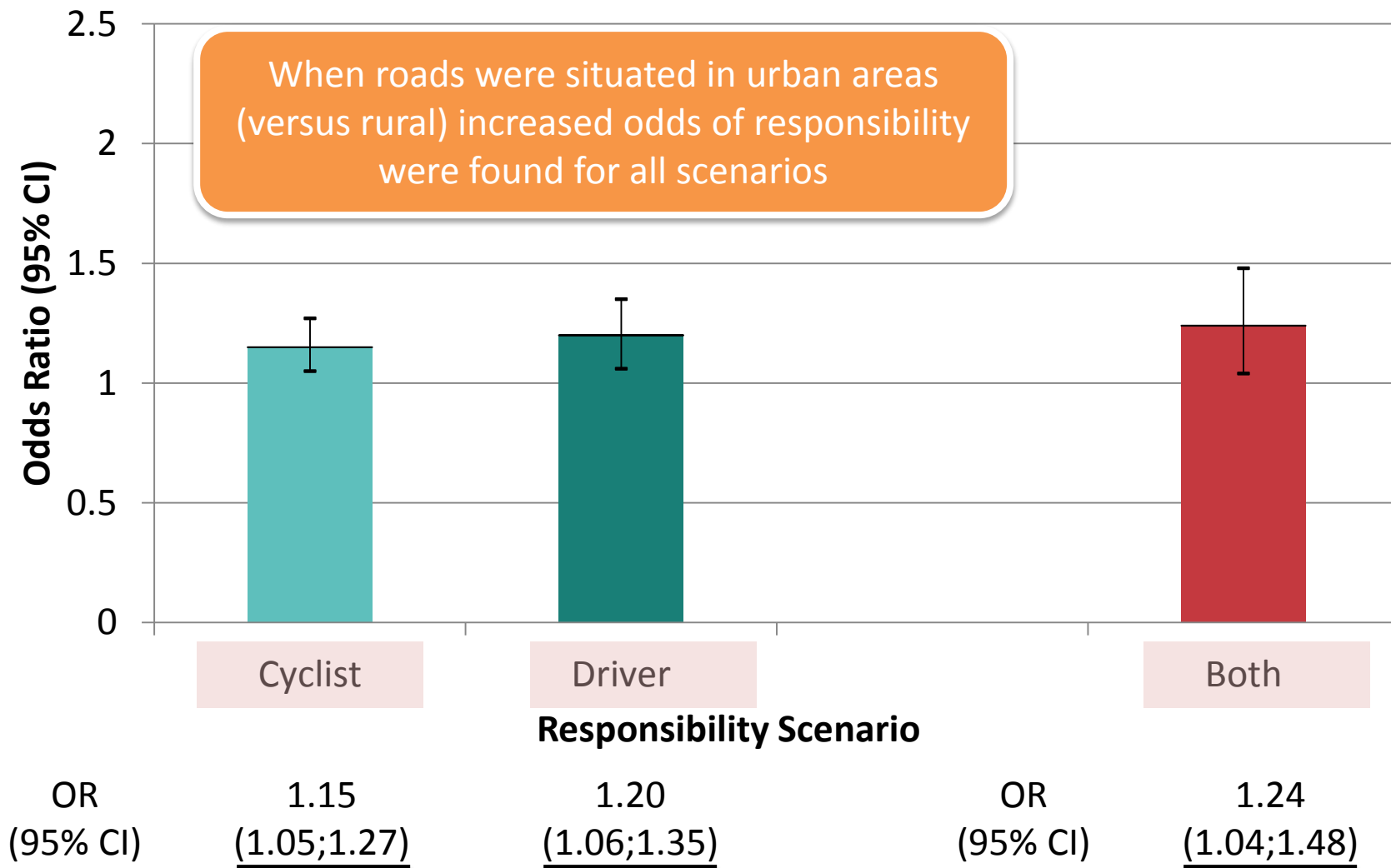
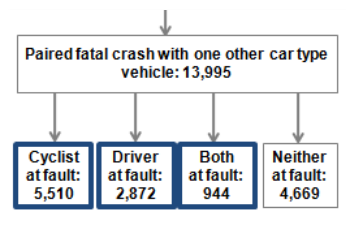
# All Responsibility Scenarios Responsibility by Daylight



# All Responsibility Scenarios Responsibility by Dry Surface

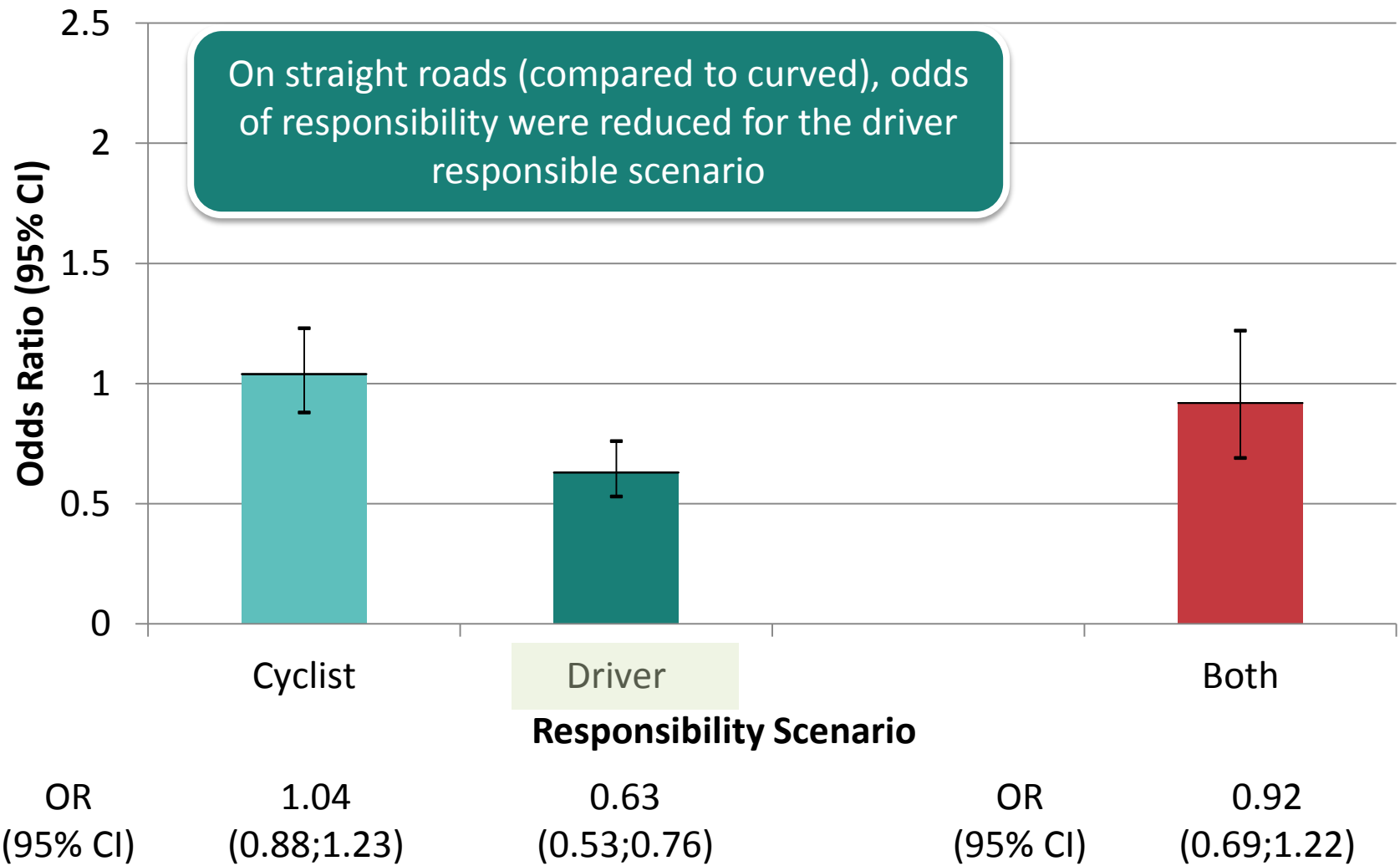
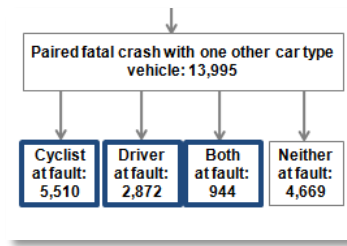


# All Responsibility Scenarios Responsibility by Road Location



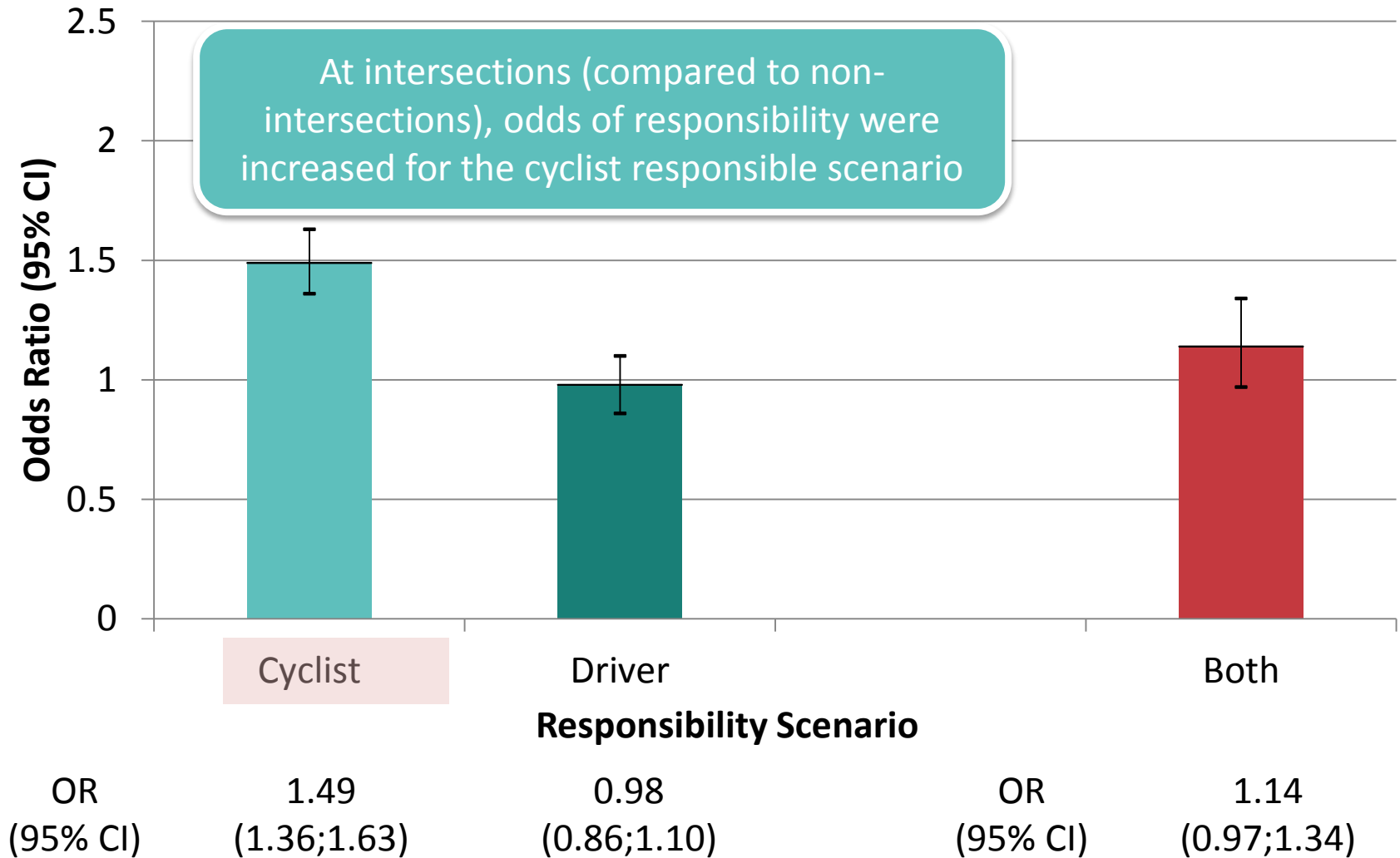
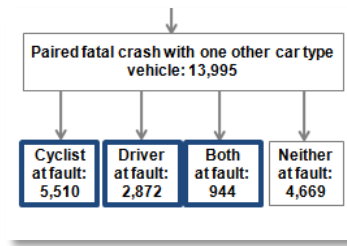
# All Responsibility Scenarios

## Responsibility by Road Curvature



# All Responsibility Scenarios

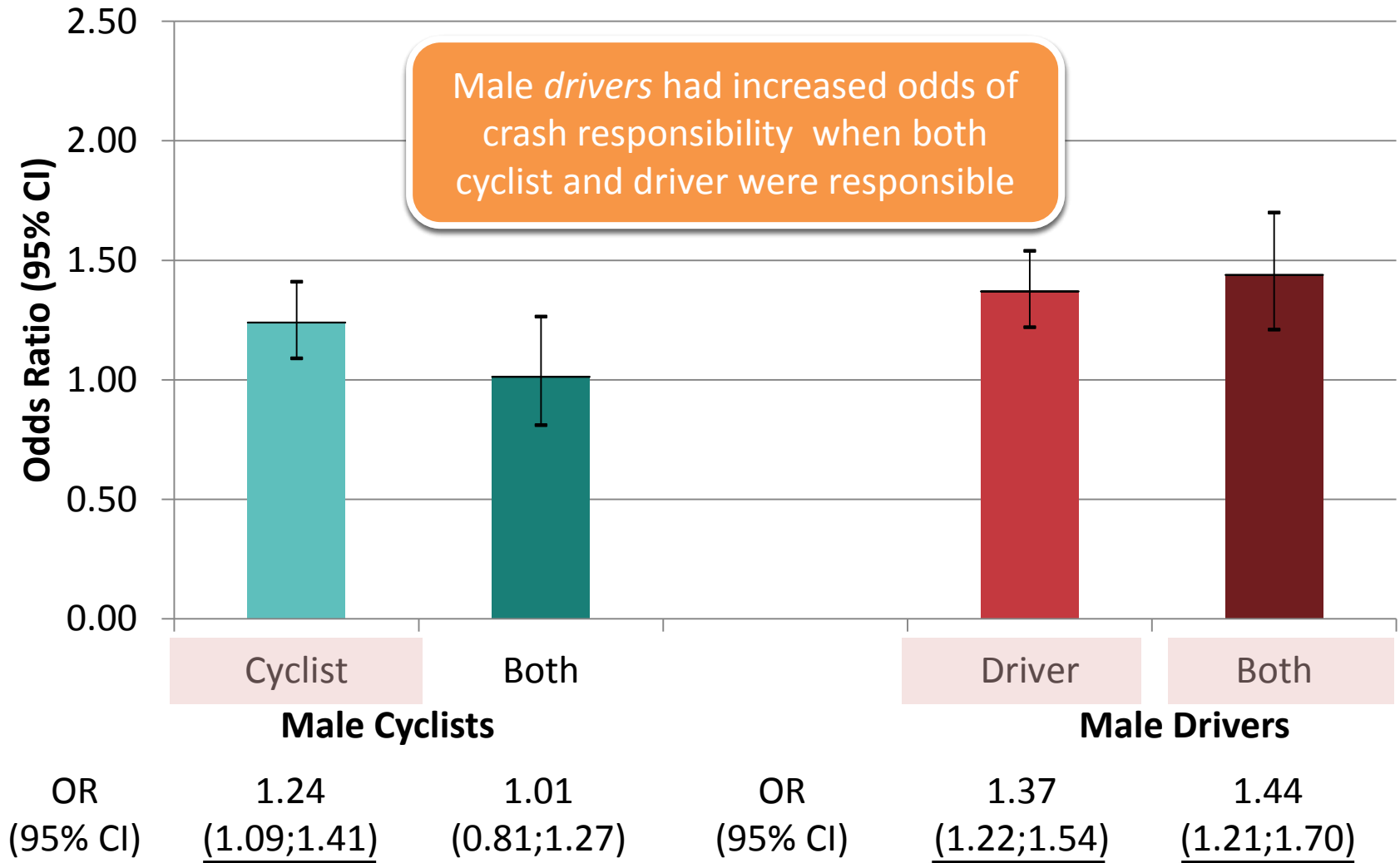
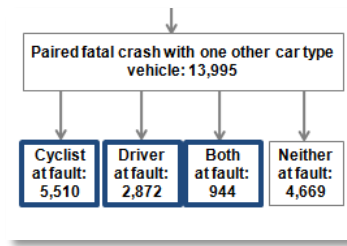
## Responsibility by Intersection



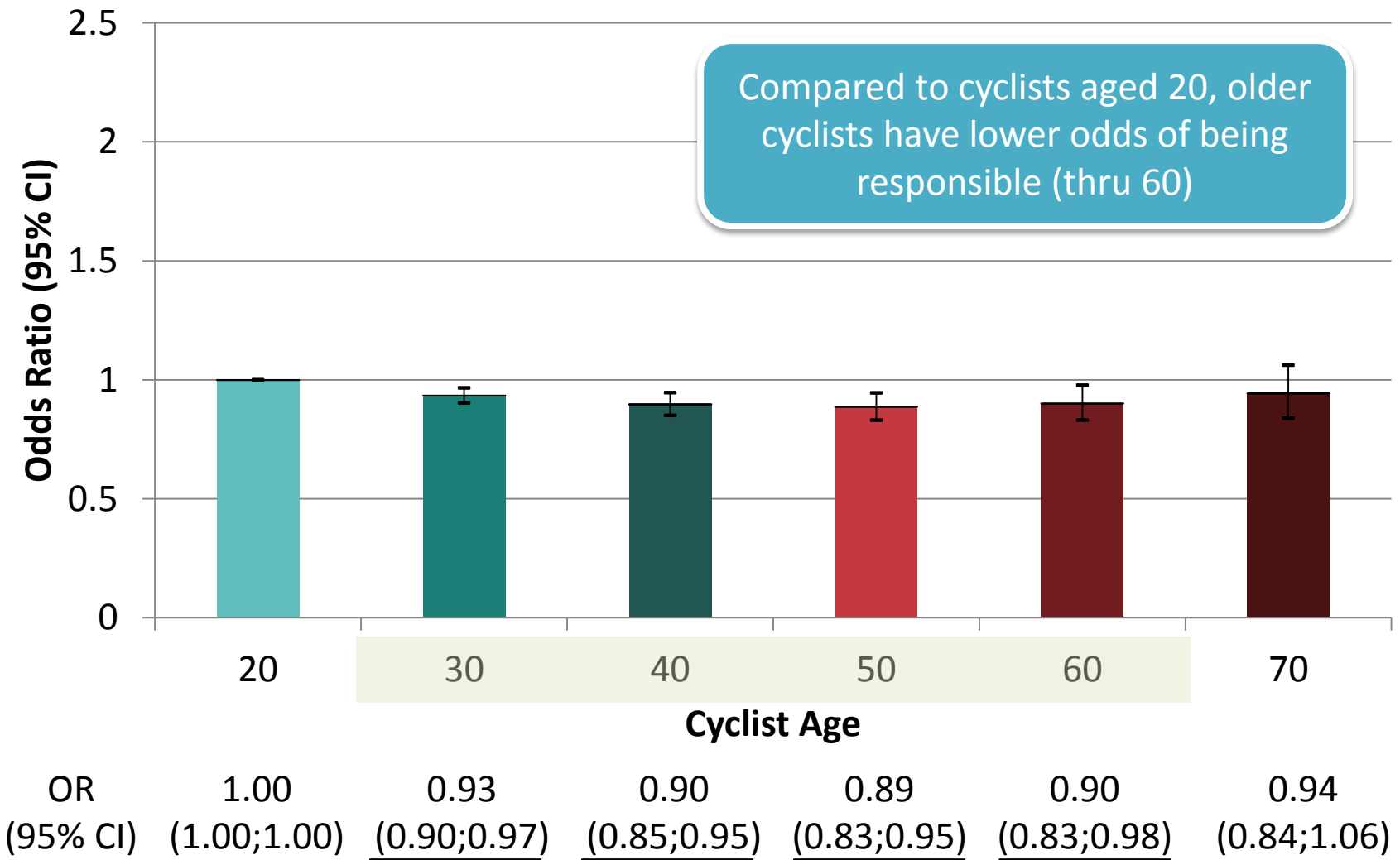
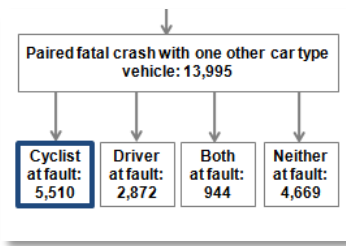
# **ANALYSIS II**

**CYCLIST AND DRIVER CHARACTERISTICS**

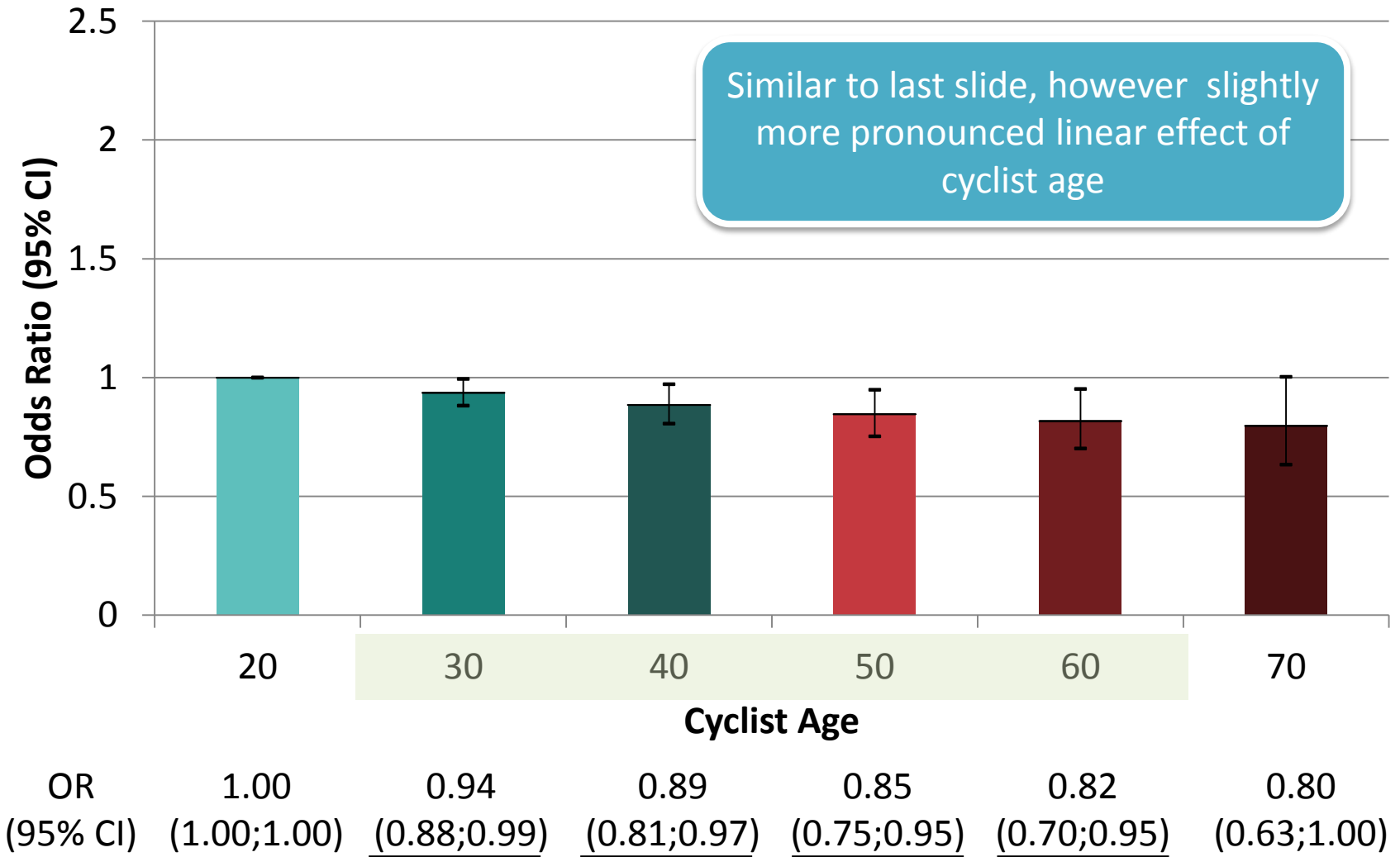
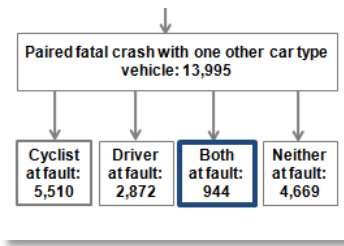
# All Responsibility Scenarios Responsibility by Sex



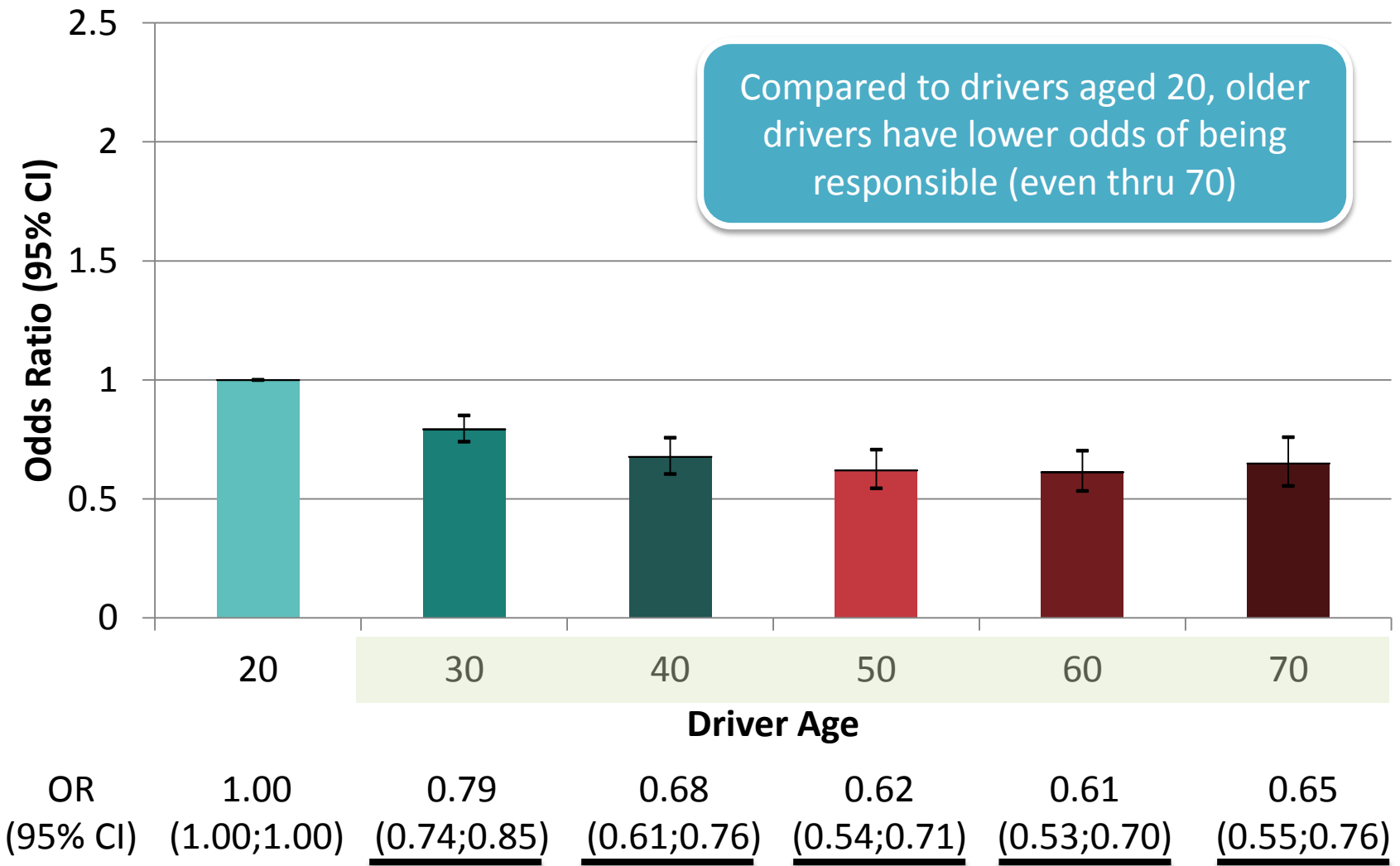
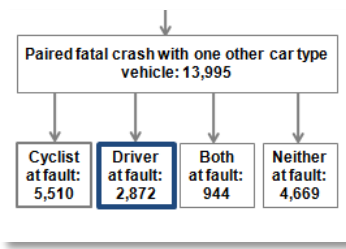
# Cyclist Responsible Responsibility by Cyclist Age



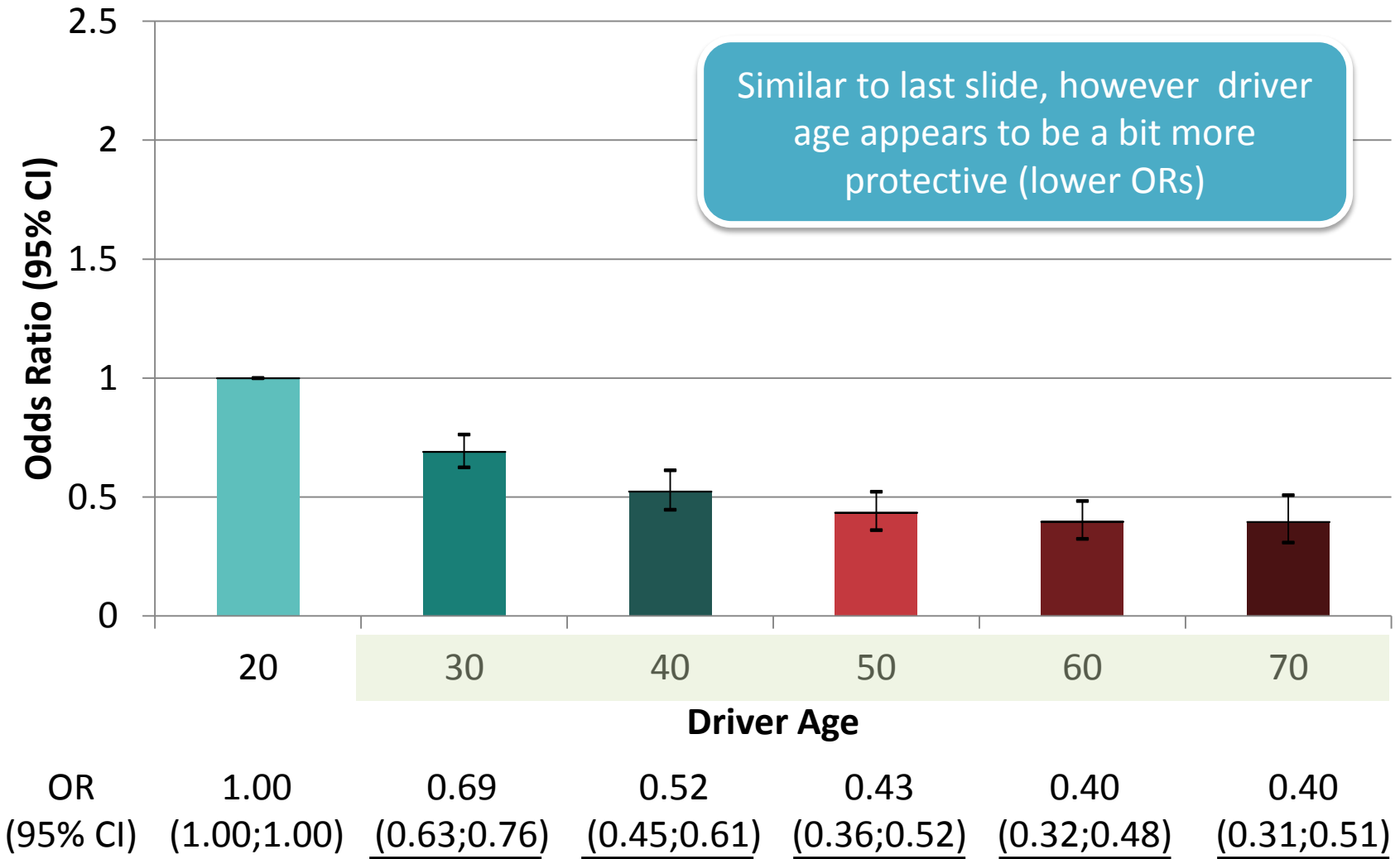
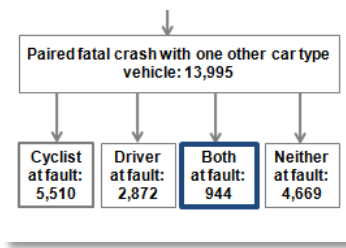
# Both Responsible Responsibility by Cyclist Age



# Driver Responsible Responsibility by Driver Age



# Both Responsible Responsibility by Driver Age



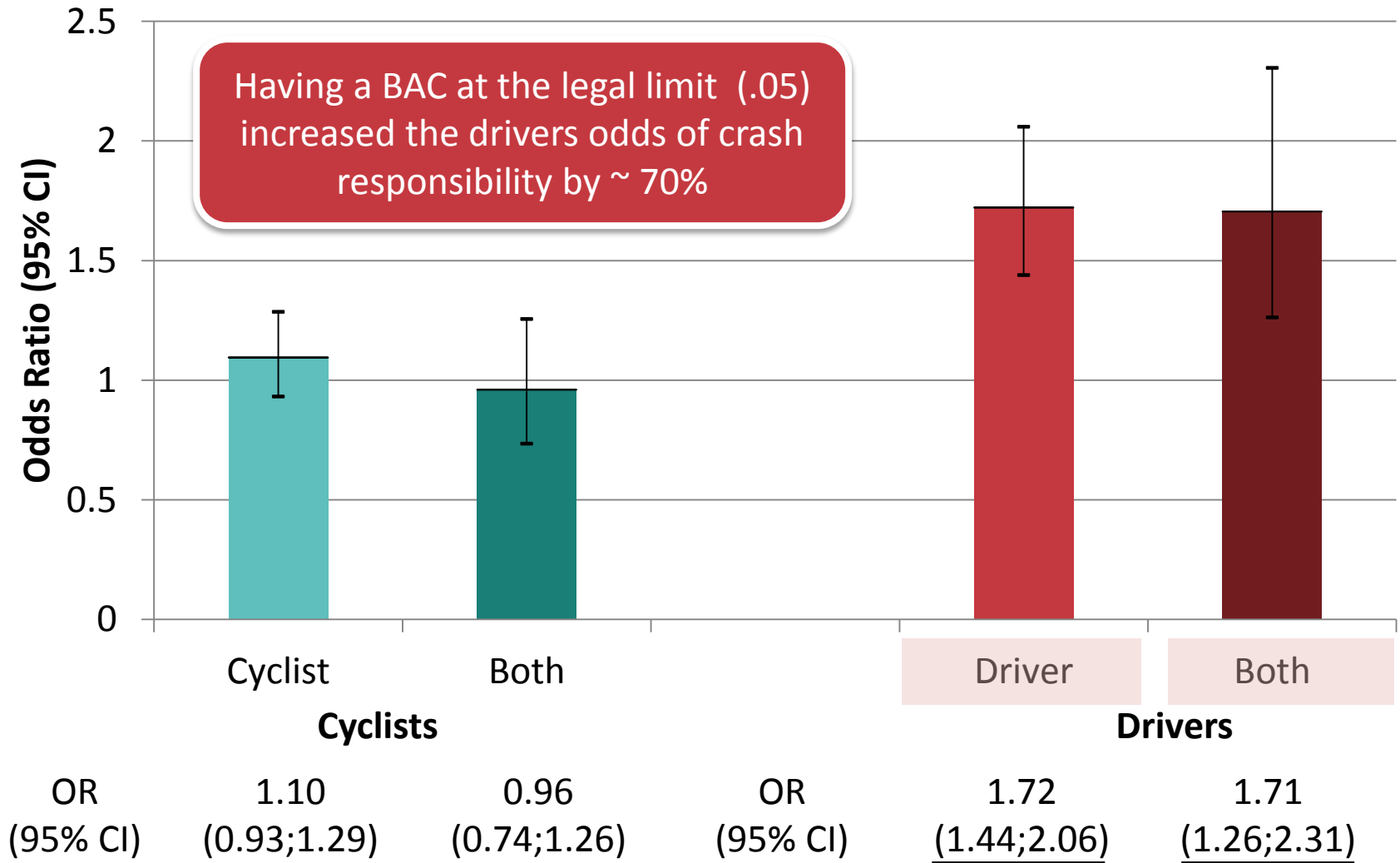
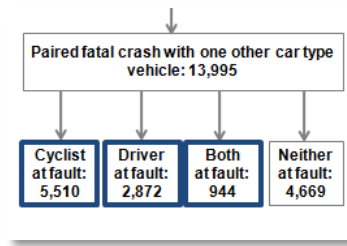
# **ANALYSIS IIb**

ALCOHOL AND DRUGS

# Analysis IIb

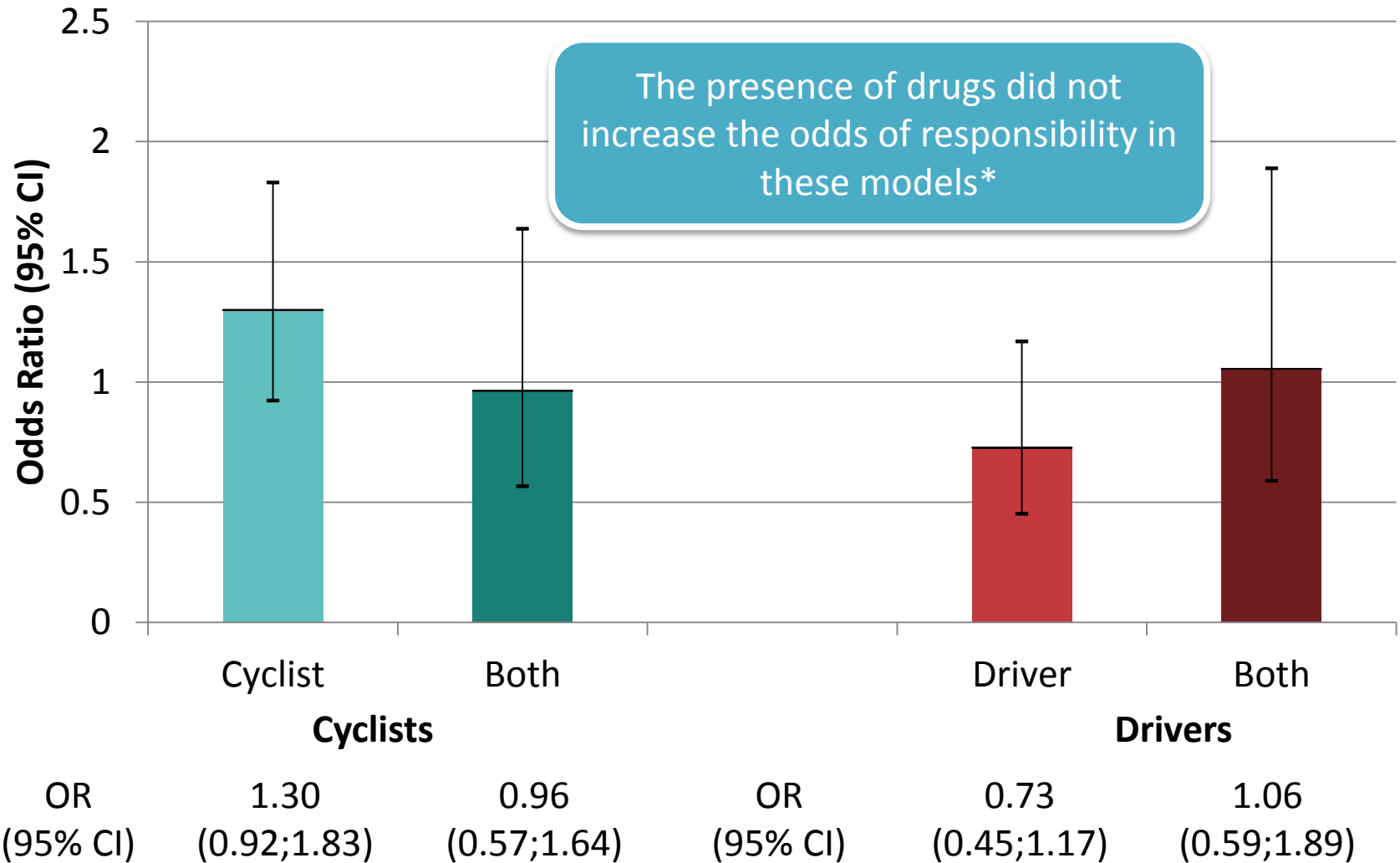
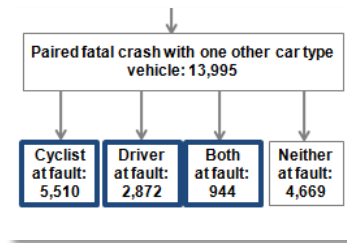
- For those cyclists and drivers with alcohol and drug data available, we also examined the odds of responsibility by drug presence
- This model included all previously presented factors but added both BAC values and drug presence

# All Responsibility Scenarios Responsibility by Alcohol



# All Responsibility Scenarios

## Responsibility by Drugs



# Discussion

- Cyclists can play an active role in the crash they are involved in
- Unsafe driving actions are similar to those described for drivers of motorized vehicles

# Discussion

- The influence of environmental, road, and cyclist/driver characteristics can differ by responsibility scenario
  - For certain factors (e.g., urban location) odds of responsibility increased regardless of scenario
  - Other factors (e.g., road intersection) increased the odds for certain responsibility scenarios but not others

# Some limitations

- Fatal crashes only
- No valid exposure estimates of distance or time driven by cyclists



# Implications

- Efforts to prevent cyclist-related crashes should focus on both measures:
  - Which improve the cycling environment
  - Aimed at controlling cyclist- and driver- related factors (including information, legislation, and education)



# Contact Info



Ms Erica Sawula

[esawula@lakeheadu.ca](mailto:esawula@lakeheadu.ca)

Mr Sacha Dubois

[duboiss@tbh.net](mailto:duboiss@tbh.net)

Mr Bruce Weaver

[bweaver@lakeheadu.ca](mailto:bweaver@lakeheadu.ca)

Dr Michel Bédard

[mbedard@lakeheadu.ca](mailto:mbedard@lakeheadu.ca)

