BICYCLIST CRASH RATES AND RISK FACTORS IN SEVEN EUROPEAN CITIES

CHATR
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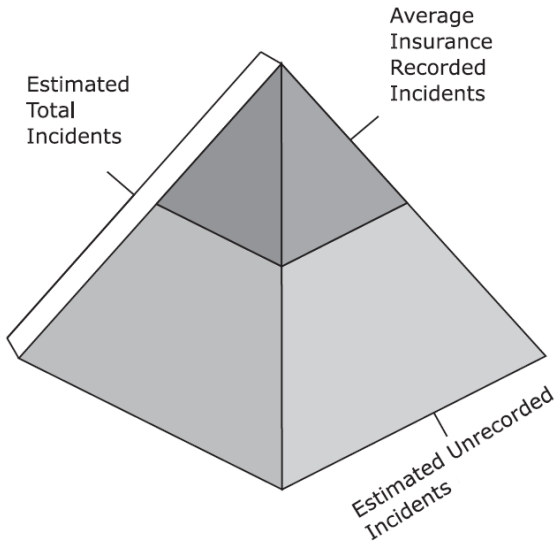
BICYCLIST CRASH RATES: CONFLATION OF SEPARATE EXPOSURE AND CRASH DATABASES

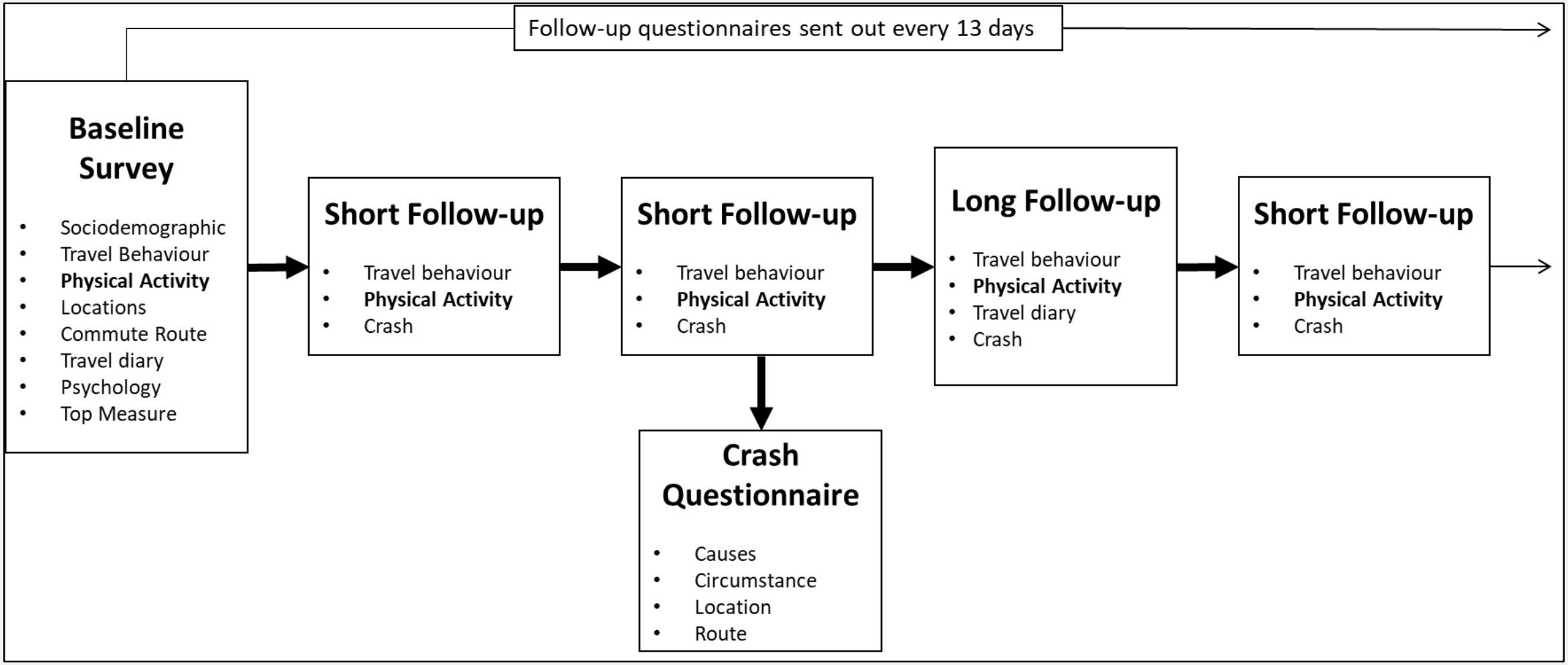
- Only limited number of strata to investigate risk factors (e.g. country, gender)
- Crashes biased towards severe injuries with motor vehicles



PROSPECTIVE COHORT

- Collects exposure and crash data simultaneously
- Range of crash types can be reported

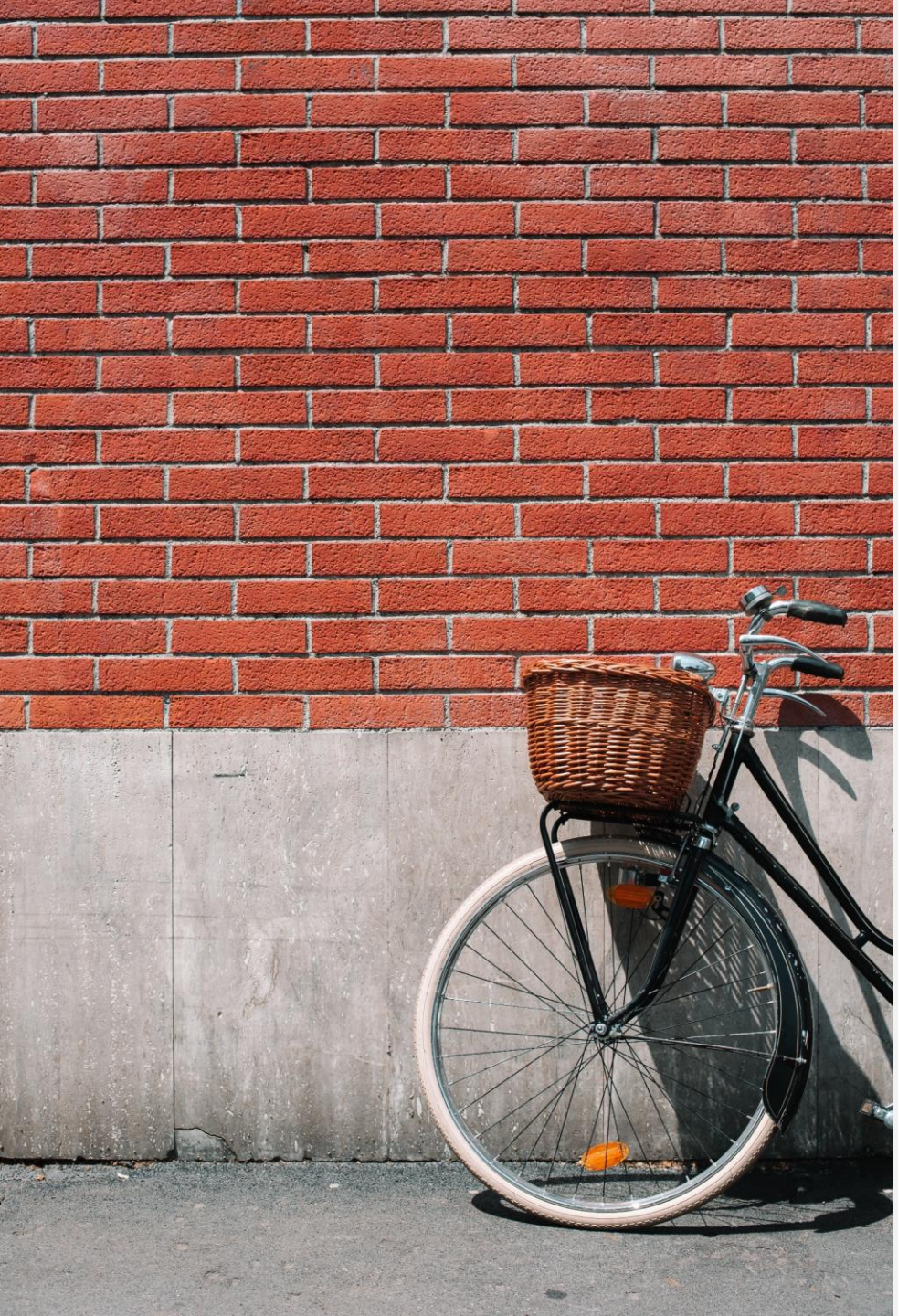
STUDY DESIGN



RESEARCH AIM

- The aim of this research is to assess exposure adjusted bicycling crash rates across seven European cities and explore crash risk factors using a large longitudinal survey.

MATERIALS & METHODS



EXPOSURE ESTIMATE

- 7-day recall of bicycling at each follow-up
  - Average over follow-ups
- Average 7-day bicycling X Number of weeks in study

DATA CLEANING

- 6,817 participants completed the baseline questionnaire and 1 follow-up
  - Removed participants who reported:
    - No bicycling (n=2,448)
    - over 8 hours of daily bicycling in 1 or more follow-ups (n=190),
    - being in the study for less than 13 days (n=12)
    - reported incomplete data on crash type and injury (n=62).
- 4,180 eligible participants

ANALYSIS

- ***Independent variables***
  - Sociodemographic characteristics: age, sex, education, BMI, and whether the bicyclist had a driver's license.
  - Attitudinal characteristics: perceptions of the safety of bicycling for travel with regards to traffic, bicycling is well regarded in their neighborhood, and comfortable they were in traffic
  - Built environment: bicycling infrastructure density, building density and a measure of "greenness" the Normalized Difference Vegetation Index (NDVI).

ANALYSIS

- ***Crude crash rates***
  - Within strata of independent variables divide sum of crashes by sum of exposure
- ***Adjusted risk factors***
  - *GLM with negative binomial error structure / fixed effects approach*
    - $\hat{E}(Y) = e^{\propto_0} \times EXP^{\propto_1} \times T^{\propto_2} \times e^{\sum b_i city_j}$
  - Stepwise procedure for parsimonious model, multiple imputation for missing baseline data

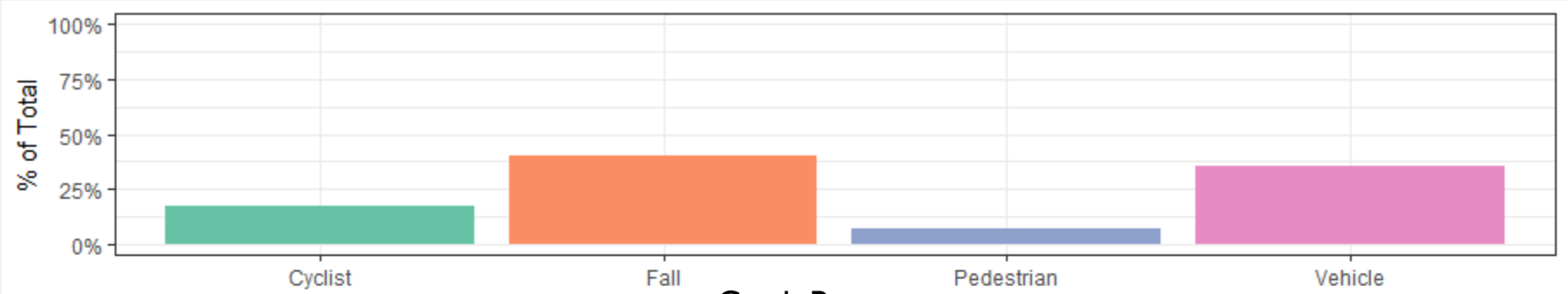
RESULTS

SAMPLE CHARACTERISTICS

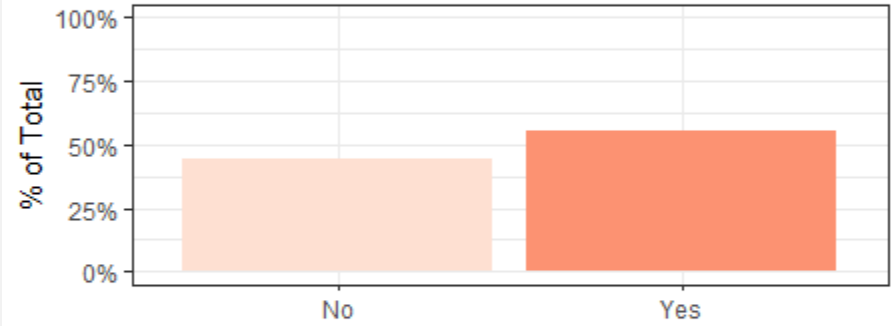
- Median of seven follow-up surveys over median of 7.3 months.
- Median daily average of 16.3 minutes over follow-ups.
- Experience a crash (10.2%)
- Average age of 39 years at baseline
- Daily or almost daily bicyclists at baseline (60.3%)
- Equal proportion of males and females
- Most agreed that bicycling for transport was comfortable (72.9%)
- Most did not agree that bicycling for transport was safe from traffic (45.6%).
- Most agreed cycling in their neighbourhood was well regarded (49.5%) and common (41.9%).

CRASH CHARACTERISTICS

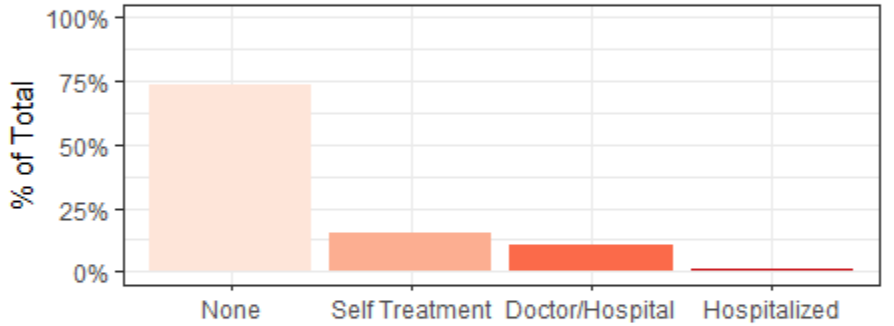
N = 535



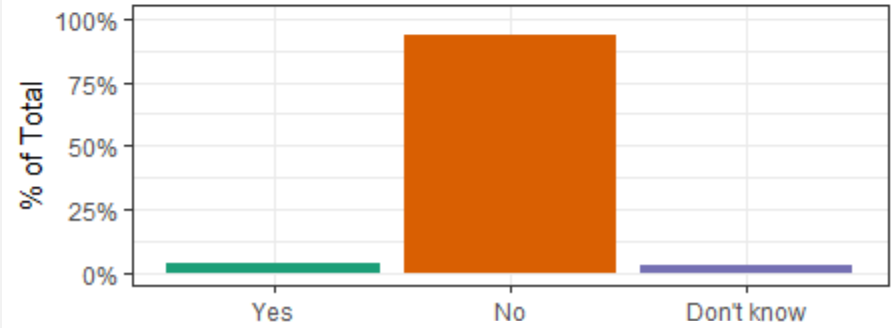
Crash Partner



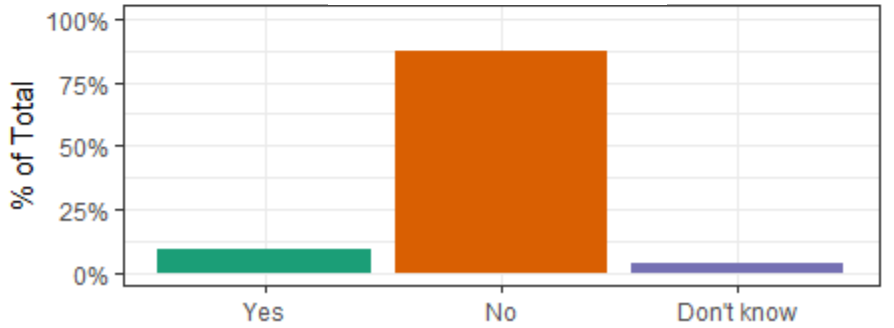
Injury Crash



Injury Treatment



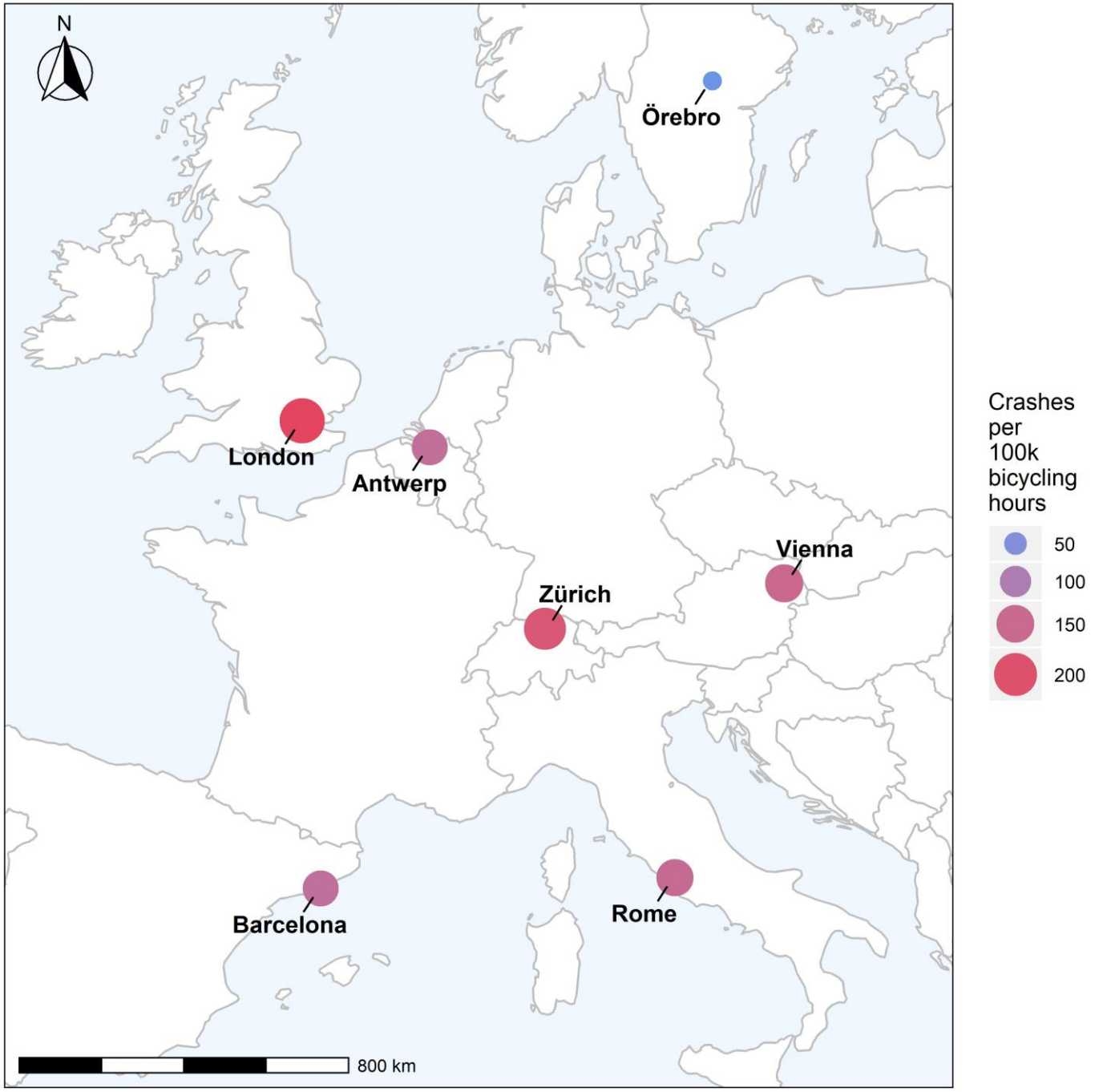
Reported to Police



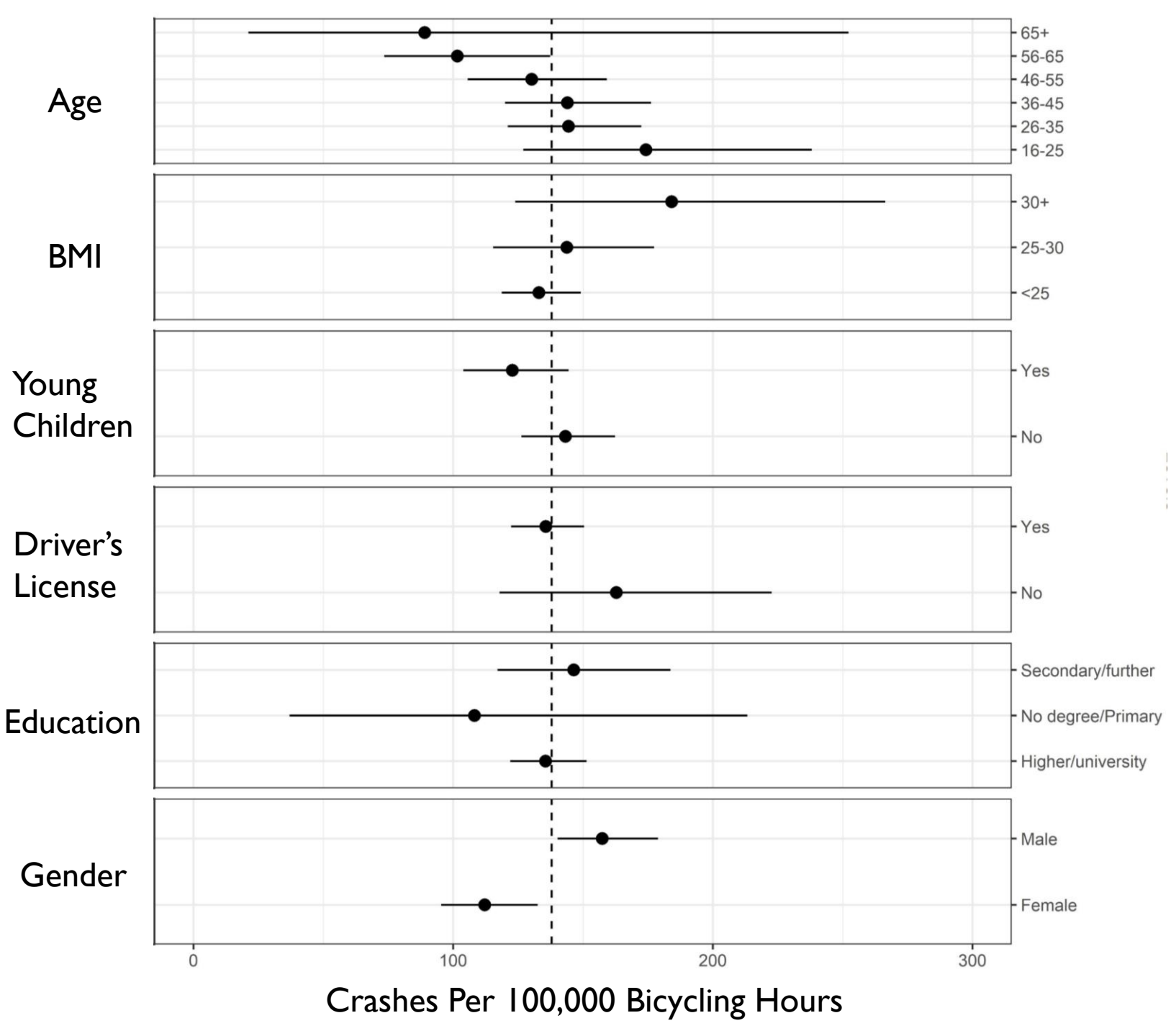
Reported to Insurance

CRUDE CRASH RATES: **CITY**

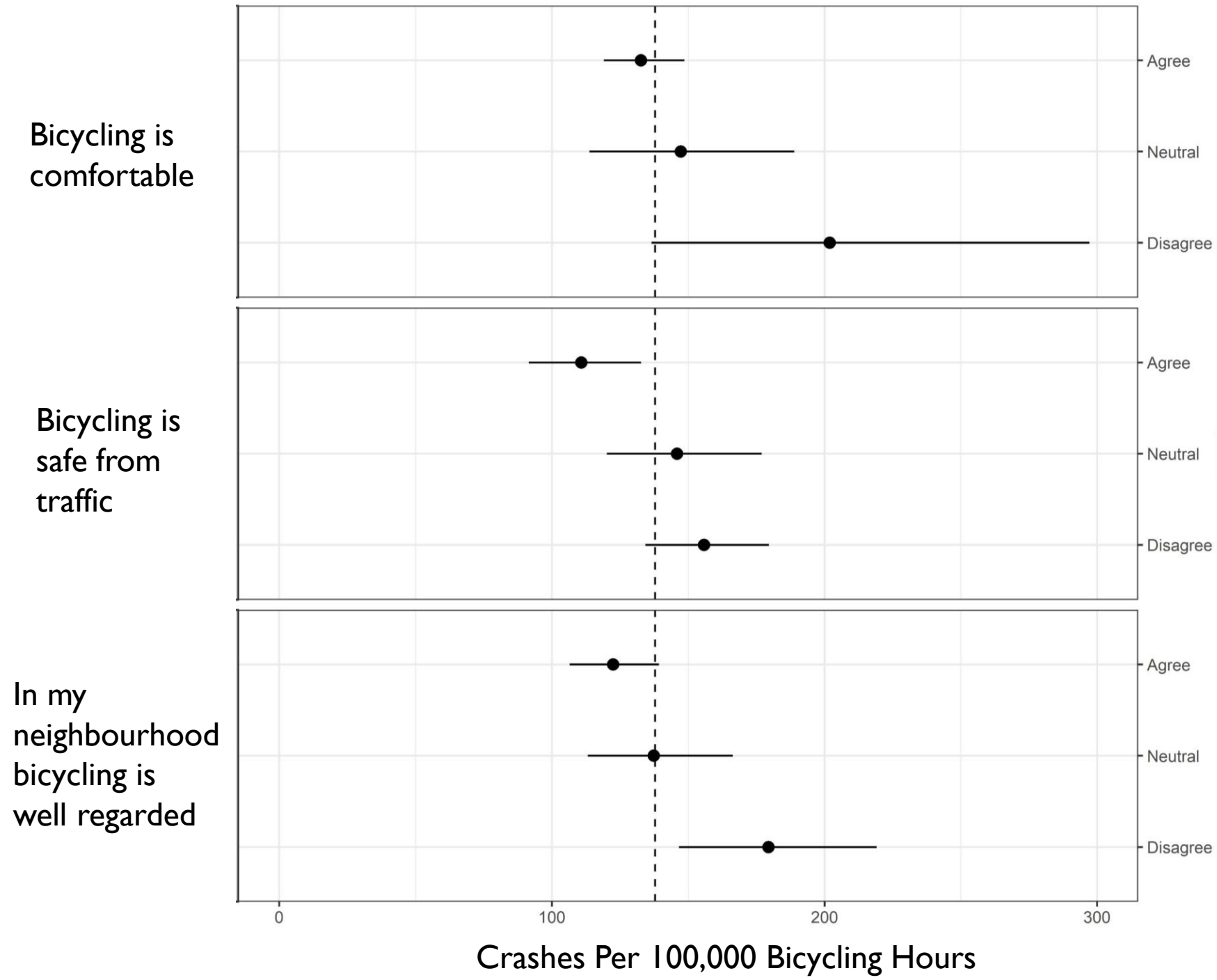
Crude Crash Rates in the Seven European PASTA Cities



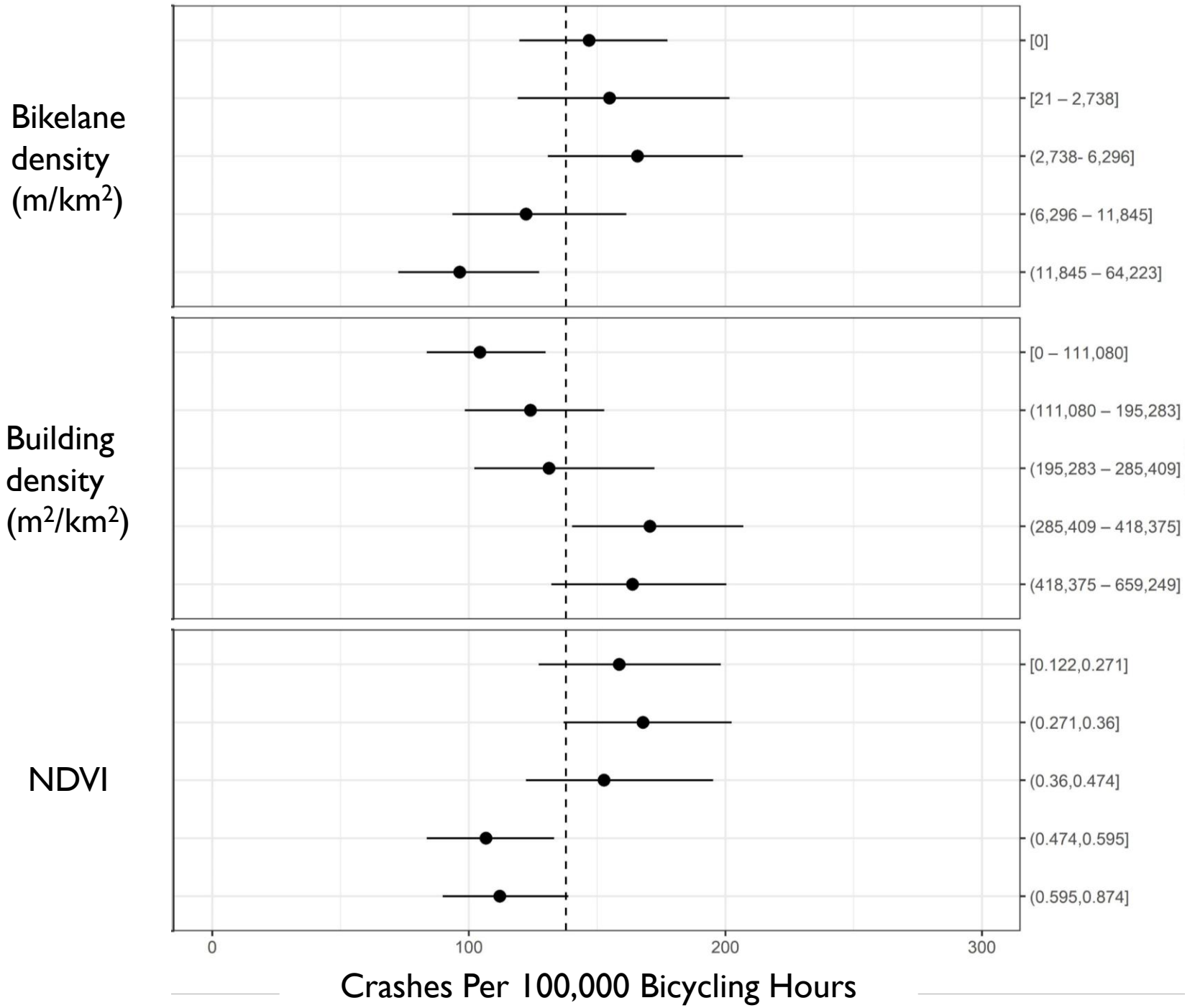
CRUDE CRASH RATES: **SOCIODEMOGRAPHIC CHARACTERISTICS**



CRUDE CRASH RATES: **ATTITUDINAL CHARACTERISTICS**



CRUDE CRASH RATES: **NEIGHBOURHOOD CHARACTERISTICS**



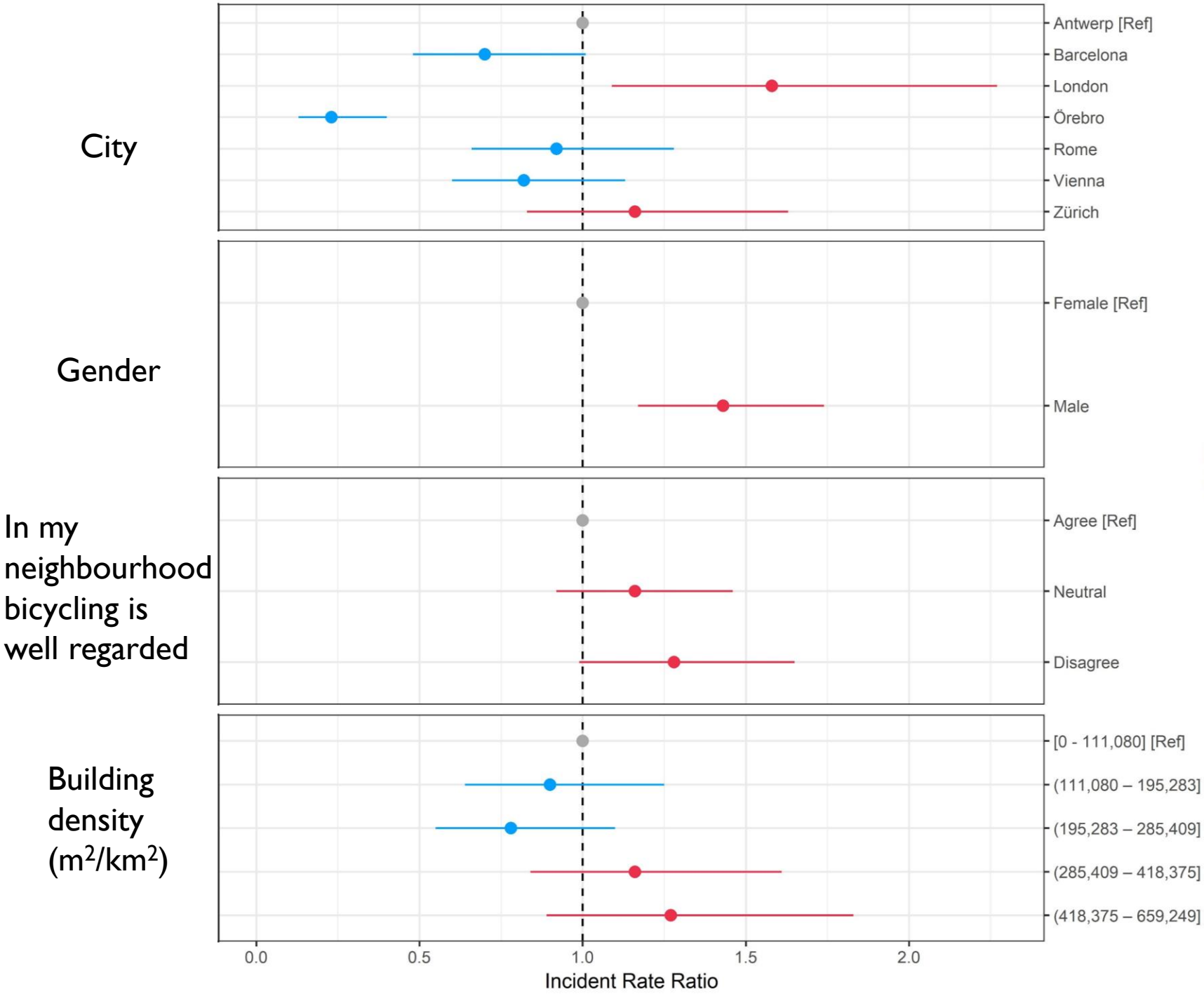
ADJUSTED MODEL

SAFETY IN FREQUENCY

- $\hat{E}(Y) = 0.0005 \times \boldsymbol{EXP}_{\boldsymbol{MonthlyAvg}}^{\mathbf{0.58}} \times T_{Months}^{0.80}$
  - Non-linear risk for individual bicycling frequency, since exponent <1
    - More frequent bicyclists have lower risk of a crash, holding city level effects and other significant risk factors constant
  - Participants who were in the study for longer also had lower risk, suggesting attrition bias

SIGNIFICANT RISK FACTORS

- Adjusting for non-linearity in exposure-risk relationship, significant factors include mix of city-level, neighbourhood level, attitudinal and sociodemographic factors
  - Residents of London/Zurich, Males, those who disagree that bicycling is a well regarded mode of transport, and live in a neighbourhood with higher building density are at higher risk of a crash



DISCUSSION

- Massive survey
- Prospectively collected data = detailed exploration of risk factors
- Certain populations of bicyclists are at higher risk for minor crash,
- Minor crashes occur much more frequently than traditional crash data suggest
  - ~1 in 10 reported to insurance, < 1 in 20 to police
  - Minor crashes important to consider in the context of health promotion and reduced uptake
- Self-selection when considering city-level safety
  - E.g. is the bicycling environment in Rome truly safer than Antwerp or have conditions selected the most skillful?
  - Data on route characteristics for participants could help shed light on this issue
- Limited to minor crashes

LESSONS FOR CANADIAN CONTEXT

- No national travel survey in Canada to estimate exposure and provide basic crash rate information between and within modes
- A large scale prospective travel survey in Canadian cities similar to PASTA but designed specifically for crash analysis but with:
  - Bicyclists route characteristics within survey design
  - Linkage to traditional crash databases (police, hospital and insurance)
  - Could provide critical information on crash risk of differing severity at multiple scales of influence (individual, route, neighbourhood, city) and fill the gap left by lack of national travel survey.

ACKNOWLEDGEMENTS

Bicyclist crash rates and risk factors in seven European cities

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