



## **Cycling and urban form**

Evidence from the Danish National Transportation Survey

**Nielsen, Thomas Alexander Sick; Carstensen, Trine Agervig; Olafsson, Anton Stahl**

*Publication date:*  
2011

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Nielsen, T. A. S. (Author), Carstensen, T. A. (Author), & Olafsson, A. S. (Author). (2011). Cycling and urban form: Evidence from the Danish National Transportation Survey. Sound/Visual production (digital), DTU Transport.

---

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

# Cycling and urban form.

Evidence from the Danish National Transportation Survey

Thomas Sick Nielsen; [thnie@transport.dtu.dk](mailto:thnie@transport.dtu.dk)

Trine A. Carstensen

Anton S. Olafsson

$$P(i|V) = \frac{\partial \ln G(e^V)}{\partial V_i} \int_a^b \epsilon \Theta^{\sqrt{17}} + \Omega \int \delta e^{i\pi} = \{2.7182818284\} \chi^2 \Sigma! >> \text{,}$$

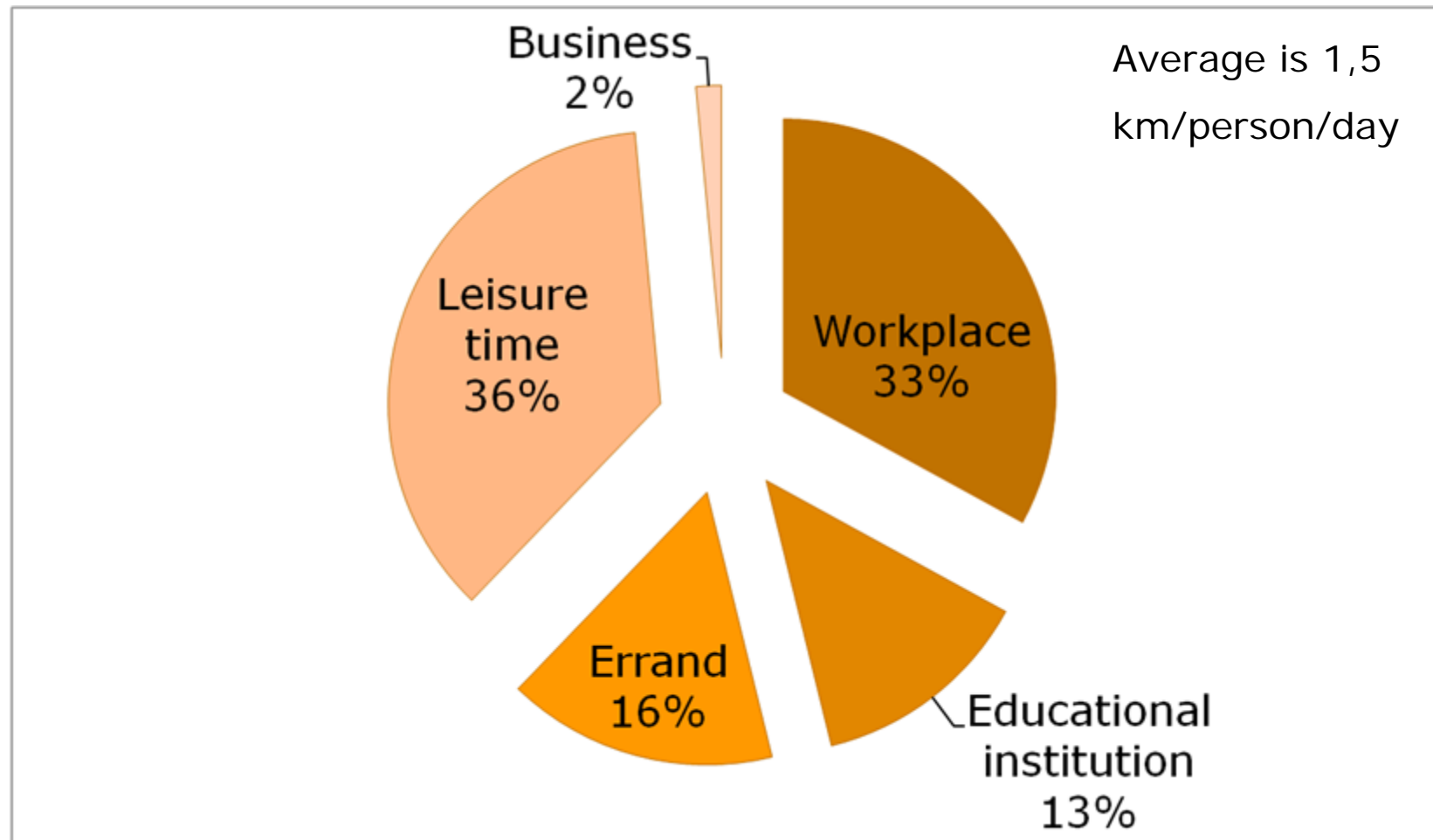
# Agenda

- The data used
- Cycling in Denmark
- Cycling and urban form: urban class; municipalities
- Detailed analysis of urban form and location correlates
- WP1s multi purpose survey – brief status

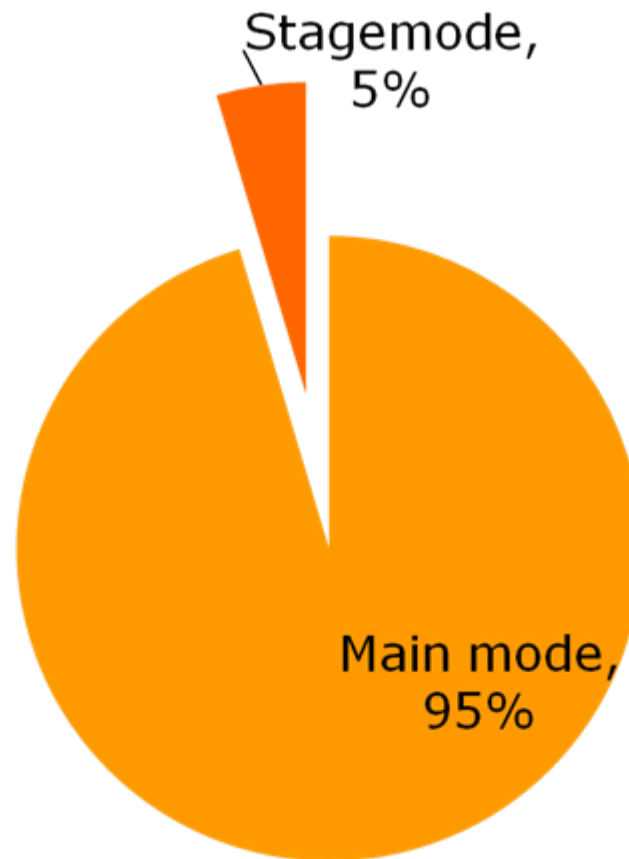
# The data used

- Danish National Travel Survey (NTS) 2006-2011
- Samples 10000 respondents/year (20000 in recent years)
- Combined online questionnaire and Computer Assisted Telephone Interviews (CATI)
- Questions yesterdays trip stages (to build trip and journey data), respondents, respondents household members, and household cars.
- CATI has been used to improve access/eggress surveying from early 2009 onwards. Thus analysis of cycling in the following rely mainly on 2009-2011 and some 40000 respondents tripstages.

## Distance cycled by trip purpose



# Cycling in combination with other modes



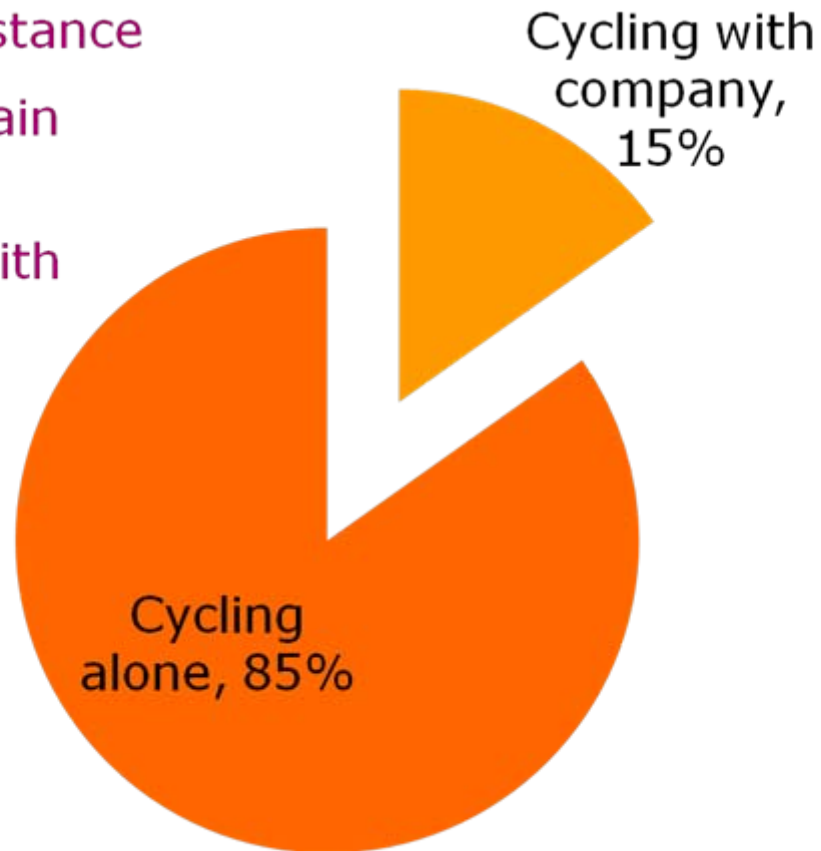
5% of cycling distance  
6% of cycling trips  
are combined with  
other modes...

## Social cycling

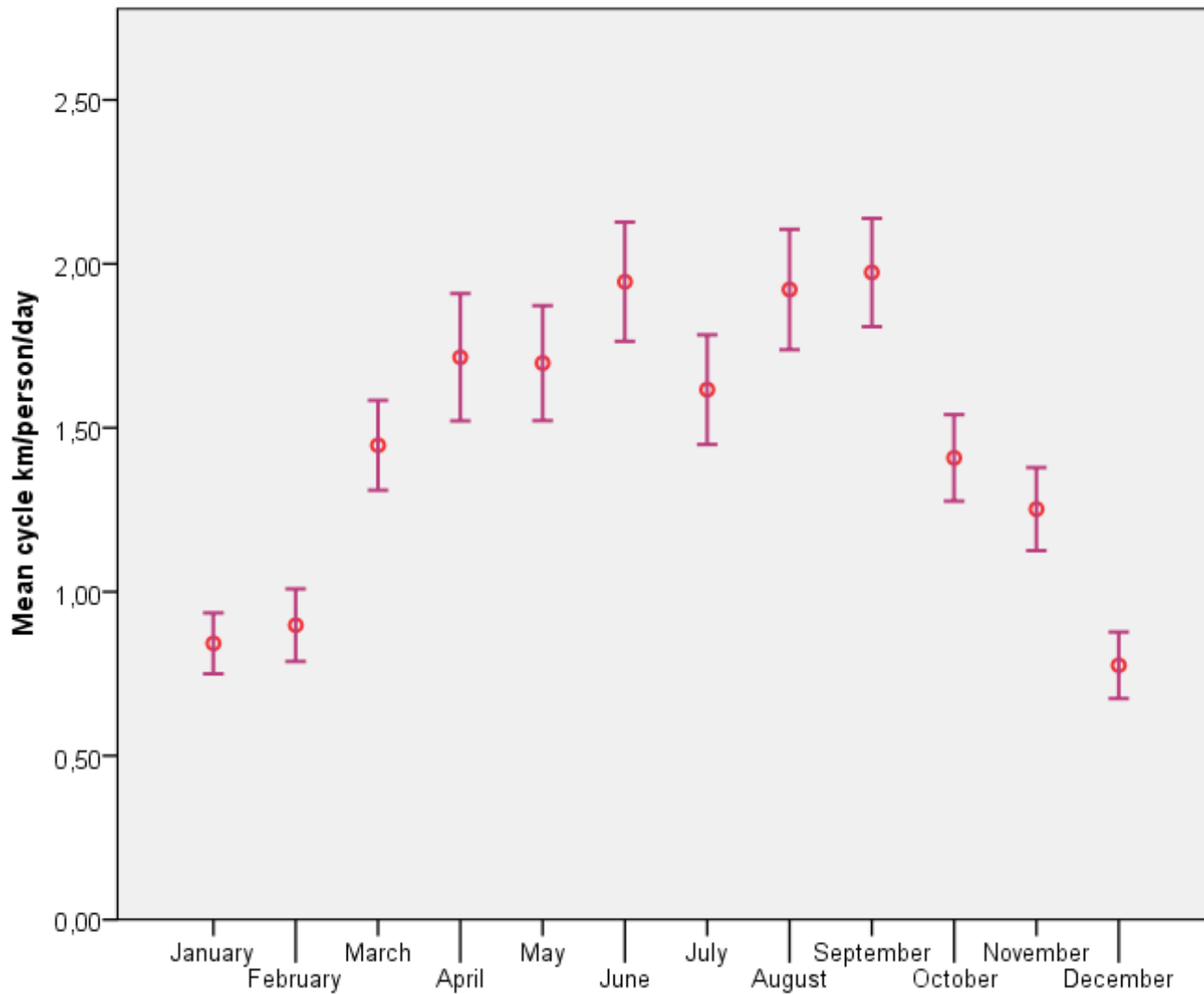
15% of cycling distance

15% of cycling main mode trips

Are in company with others – adults or children



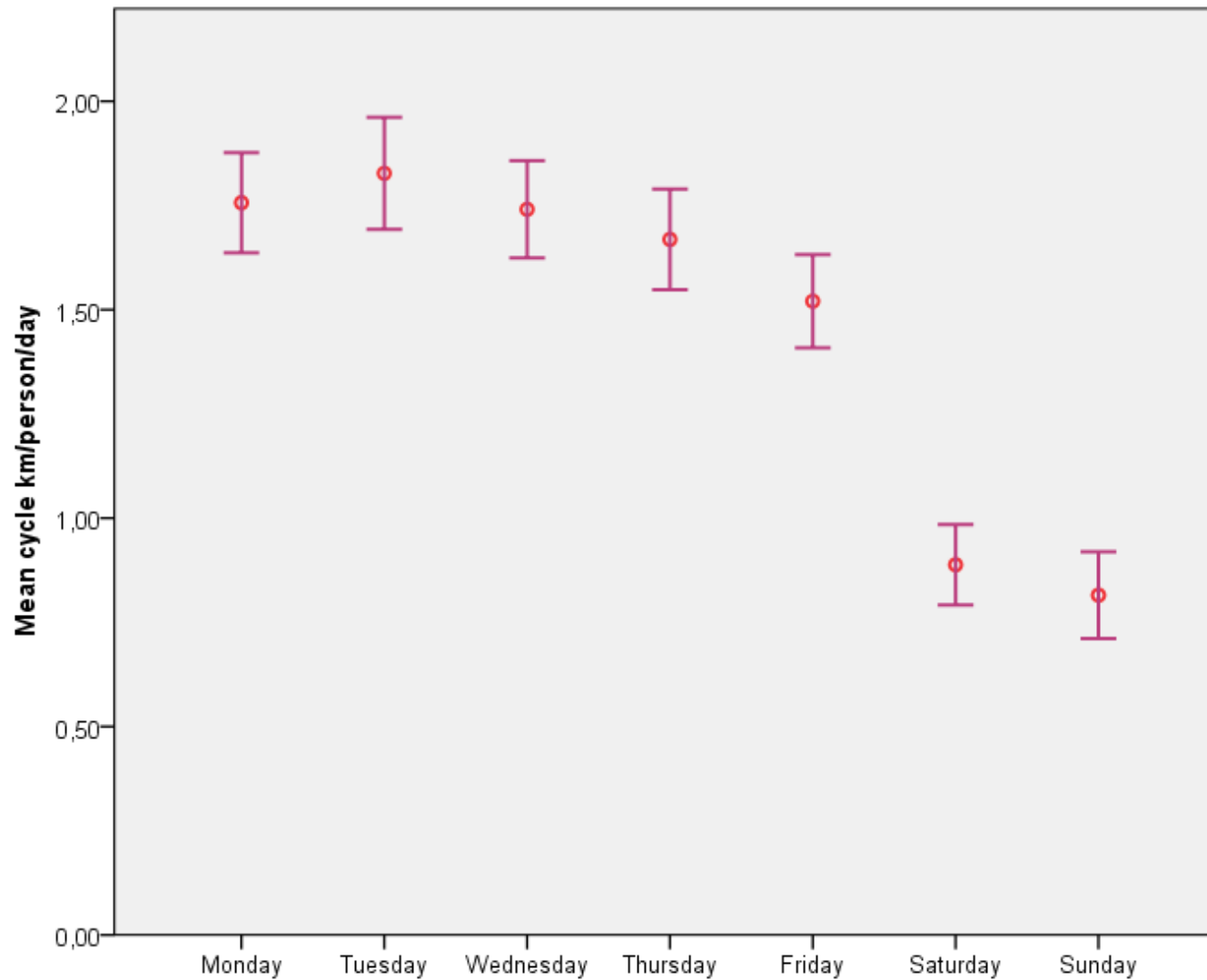
# Cycling by month



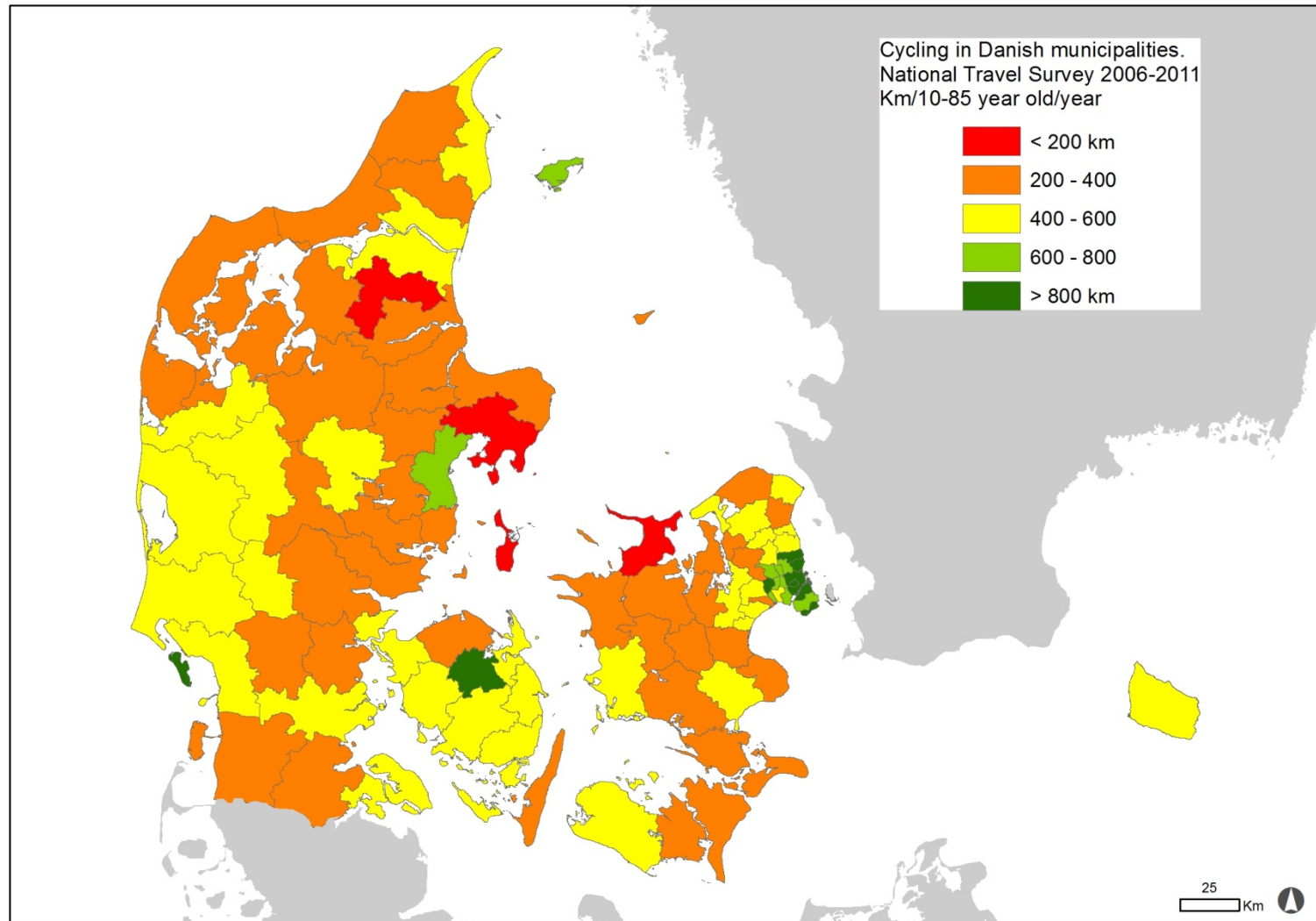
Error-bar represent 95% confidence interval of mean



# Cycling by weekday

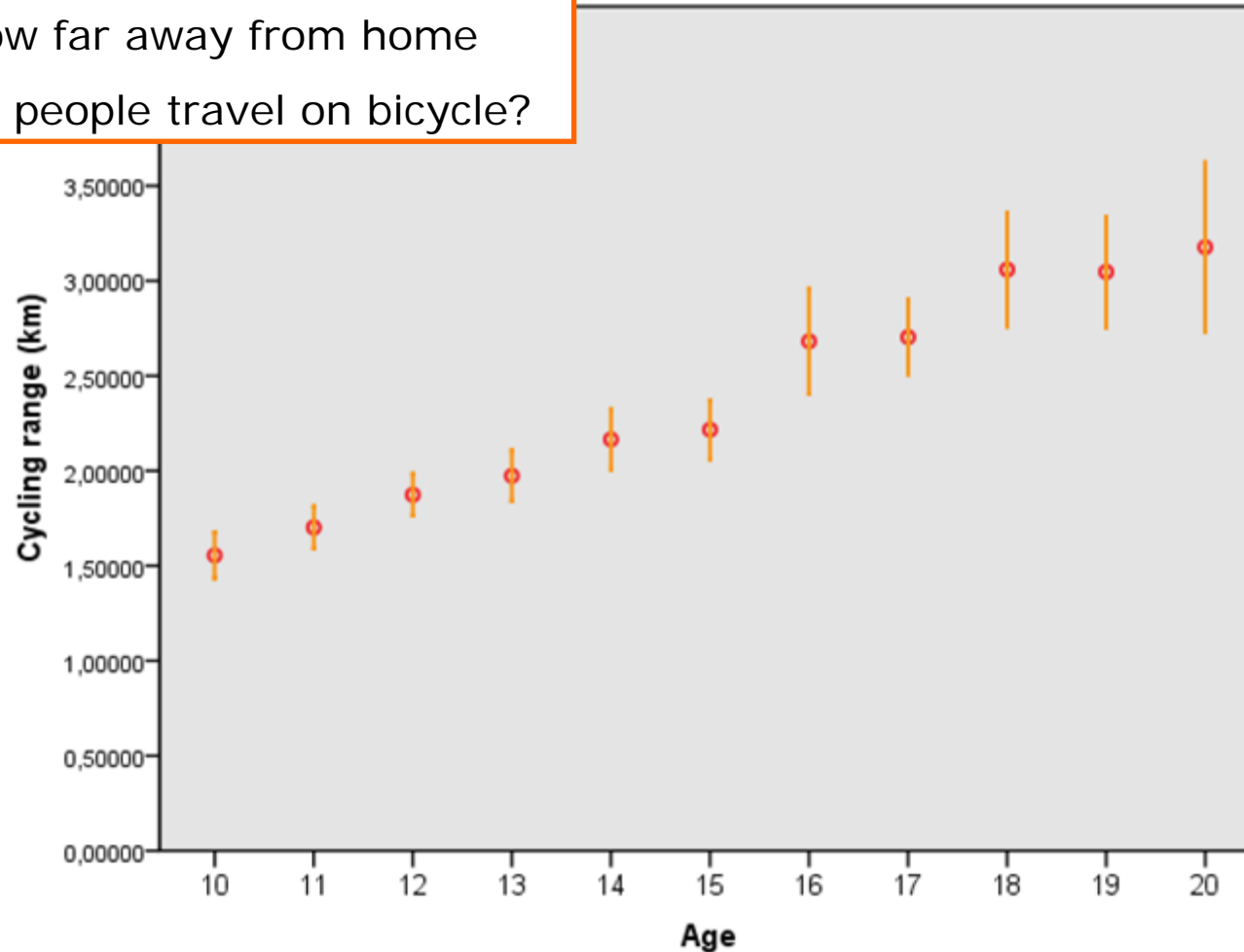


# Cycling by municipality



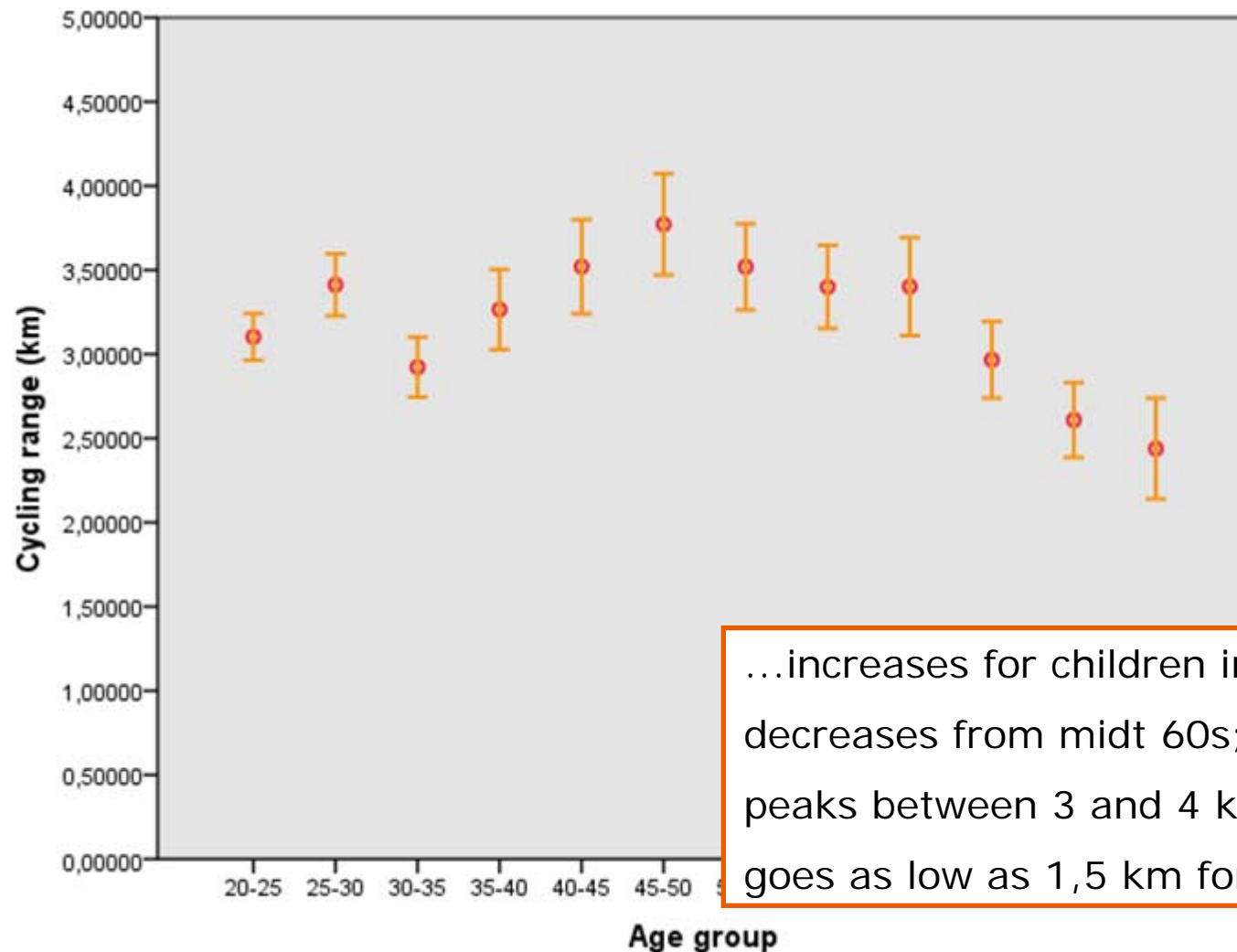
# Cycling range – children and youngsters

How far away from home do people travel on bicycle?



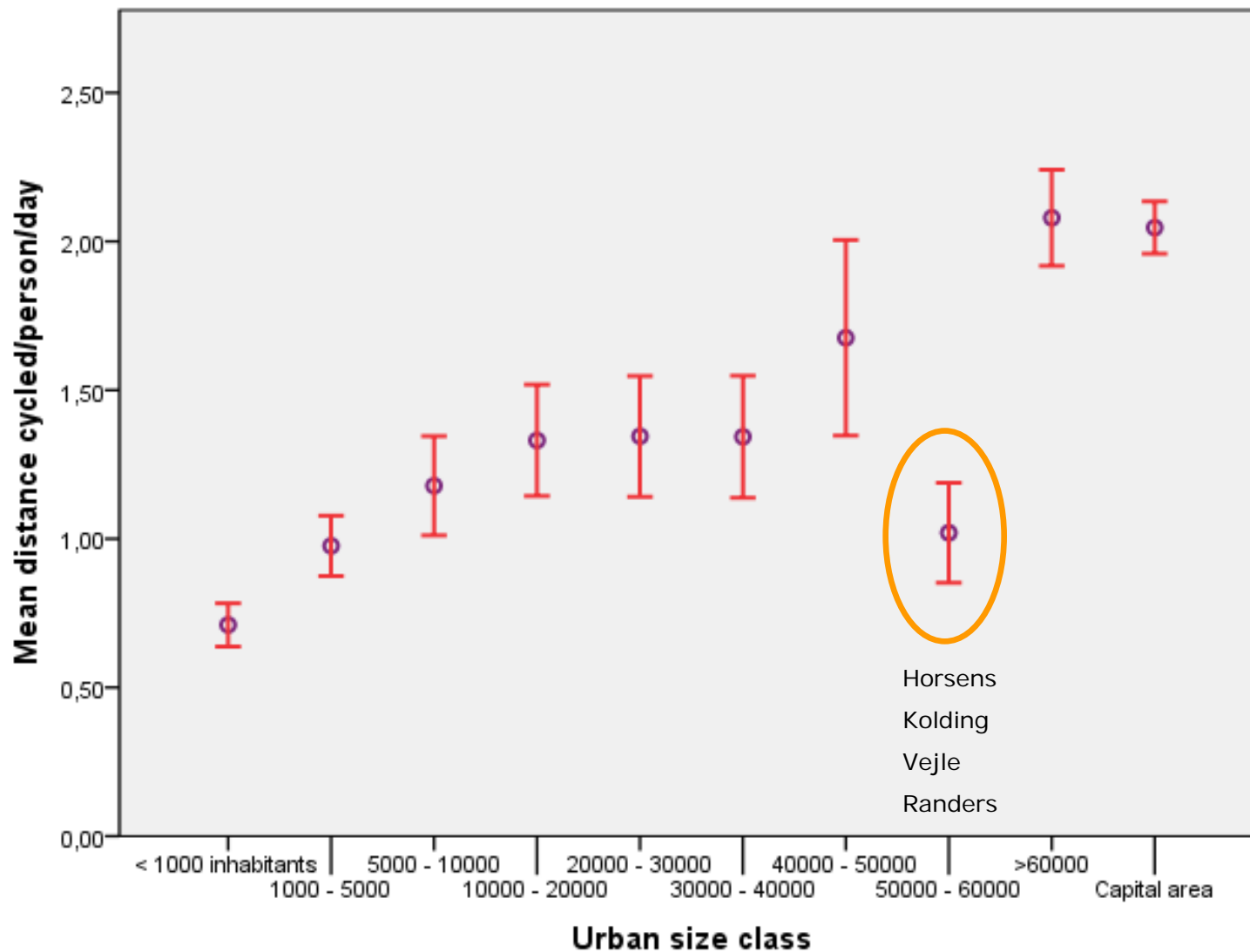
Means and 95% confidence intervals

## Cycling range – persons >20

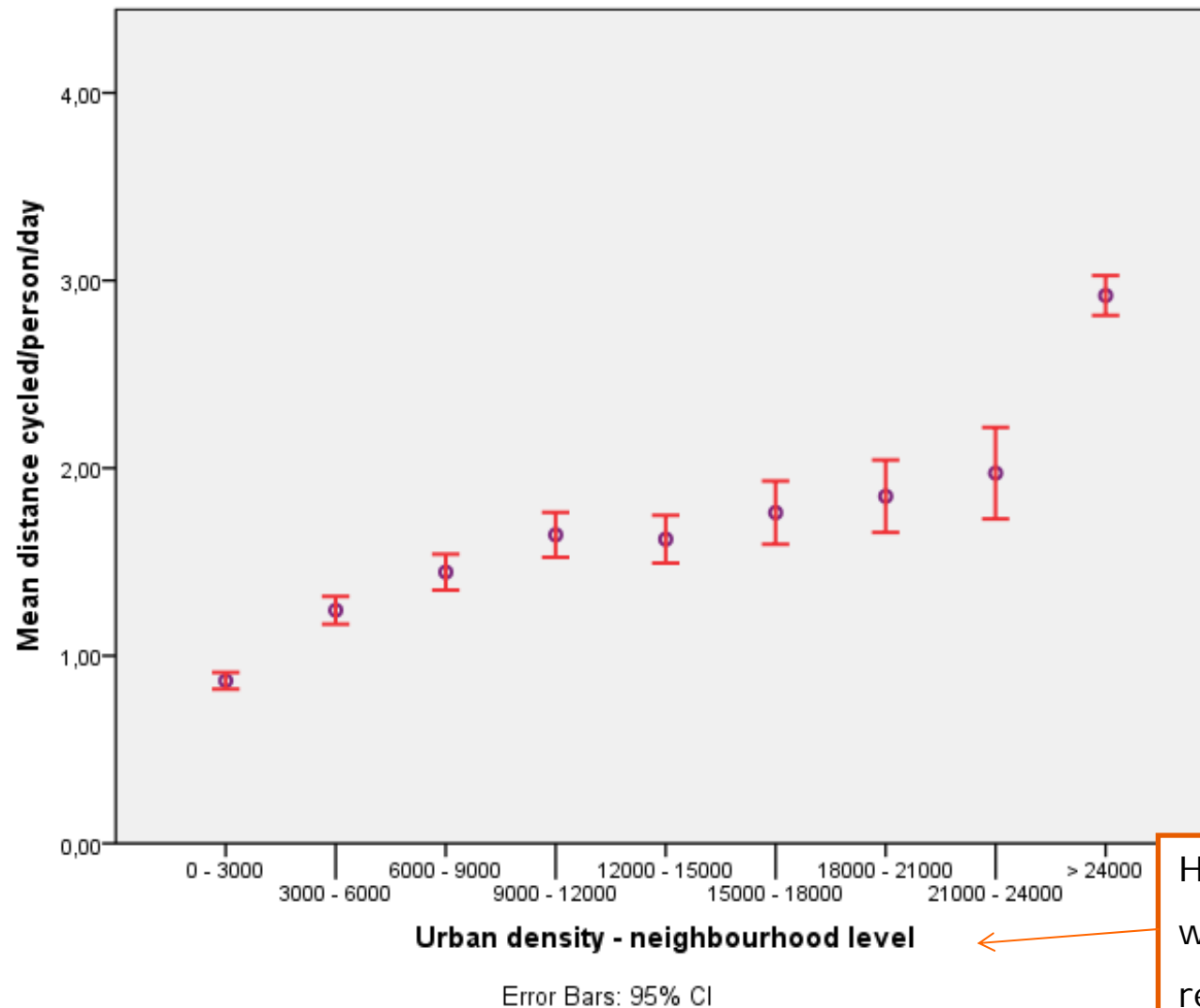


...increases for children into adulthood;  
decreases from midt 60s;  
peaks between 3 and 4 km, but  
goes as low as 1,5 km for the yongest

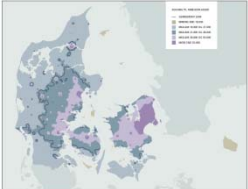
# Cycling by urban class



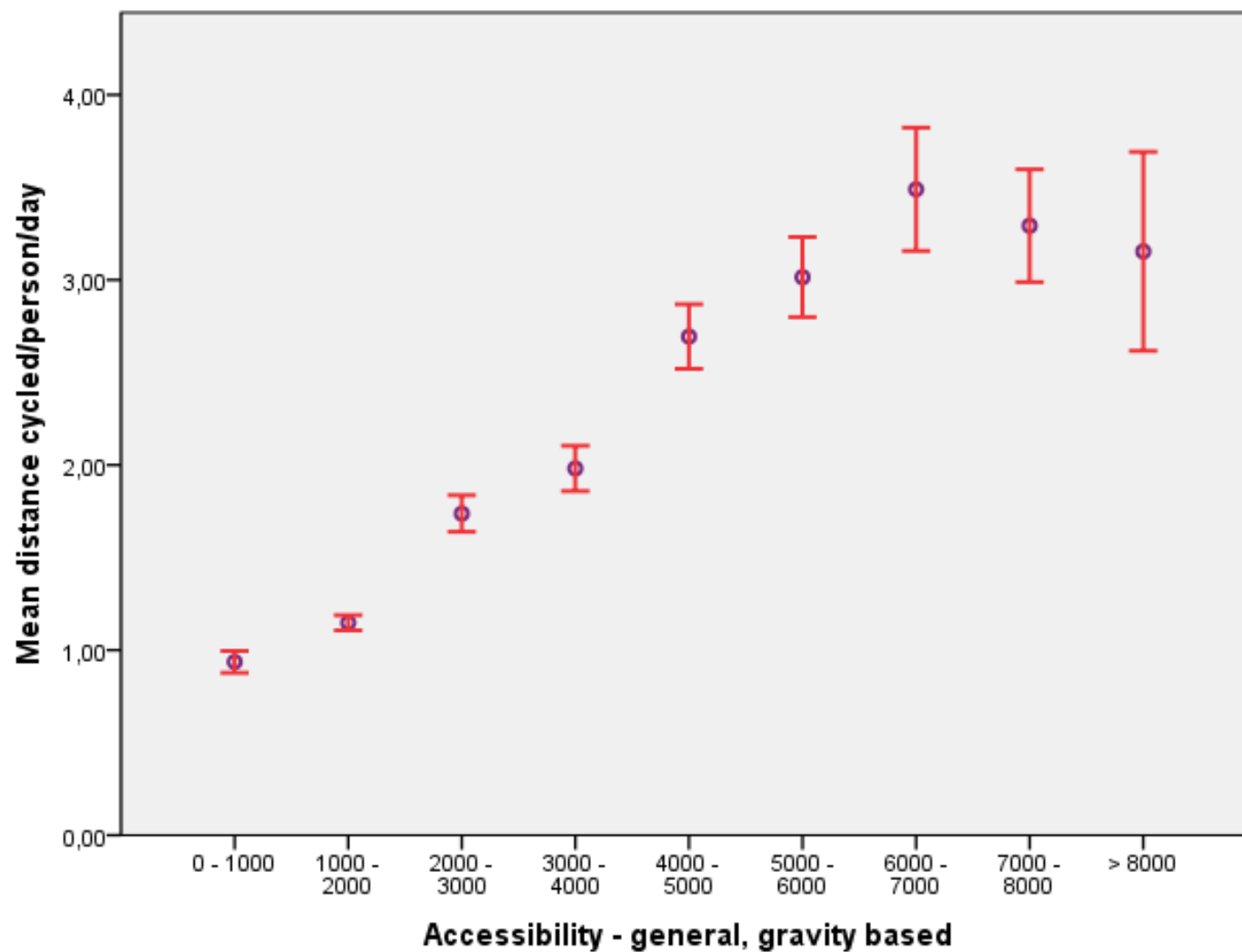
# Urban density at neighbourhood level



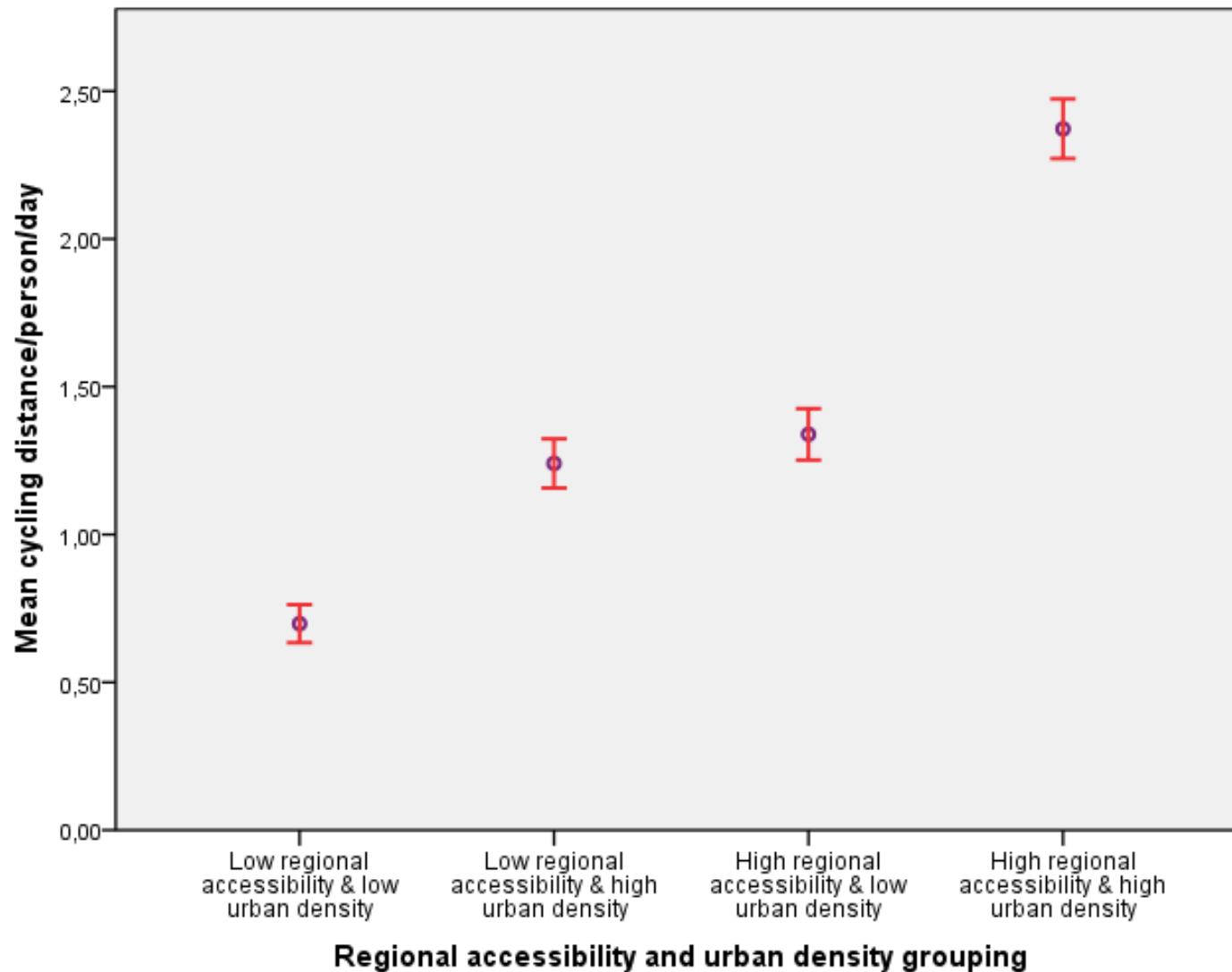
How many people live within 1,5 km from respondents home.



# Regional accessibility



# Regional accessibility and local density





# Detailed analysis of urban form and location correlates of cycling

- Based on National Travel Survey data 2009/10 & 2010/11.
- Urban form and location variables are added to NTS data.
- Focus is on urban form and location as an attribute of the home address.
- The variable of interest is the volume or consumption of cycling. However, this is only observed if the respondent has been cycling on the day of the survey.
- A sample selection model is developed (Heckman) – analysing the probability of cycling; and distance cycled as a function of the probability and other variables of interest.

# Urban form and location variables

Two scales for  
neighbourhood  
measures:

500 m

&

1500 m

<b>Density and diversity</b>	Density	Population; jobs; retail
<b>Diversity</b>	Land use	Dry land; urban land; green areas
<b>Design</b>	Network and traffic environment	Intersections Road classes: traffic; distributor; local
	Built environment	Age as proxy for cycling suitability; building heights
<b>Destination accessibility</b>	Distance to functions	School and grocery shop
	Distance to centres	Job and retail concentrations of different size/scale
<b>Distance to transit</b>	Train stations and PT generally	Distance; departures within range (NTM data)
<b>Demand management</b>	Road/parking aspects	Build pct. within 150 meter (parking proxy); dist. to mw or large roads
	+	Topography Koter in zone

(6 'D' framework by Ewing and Cervero 2011)

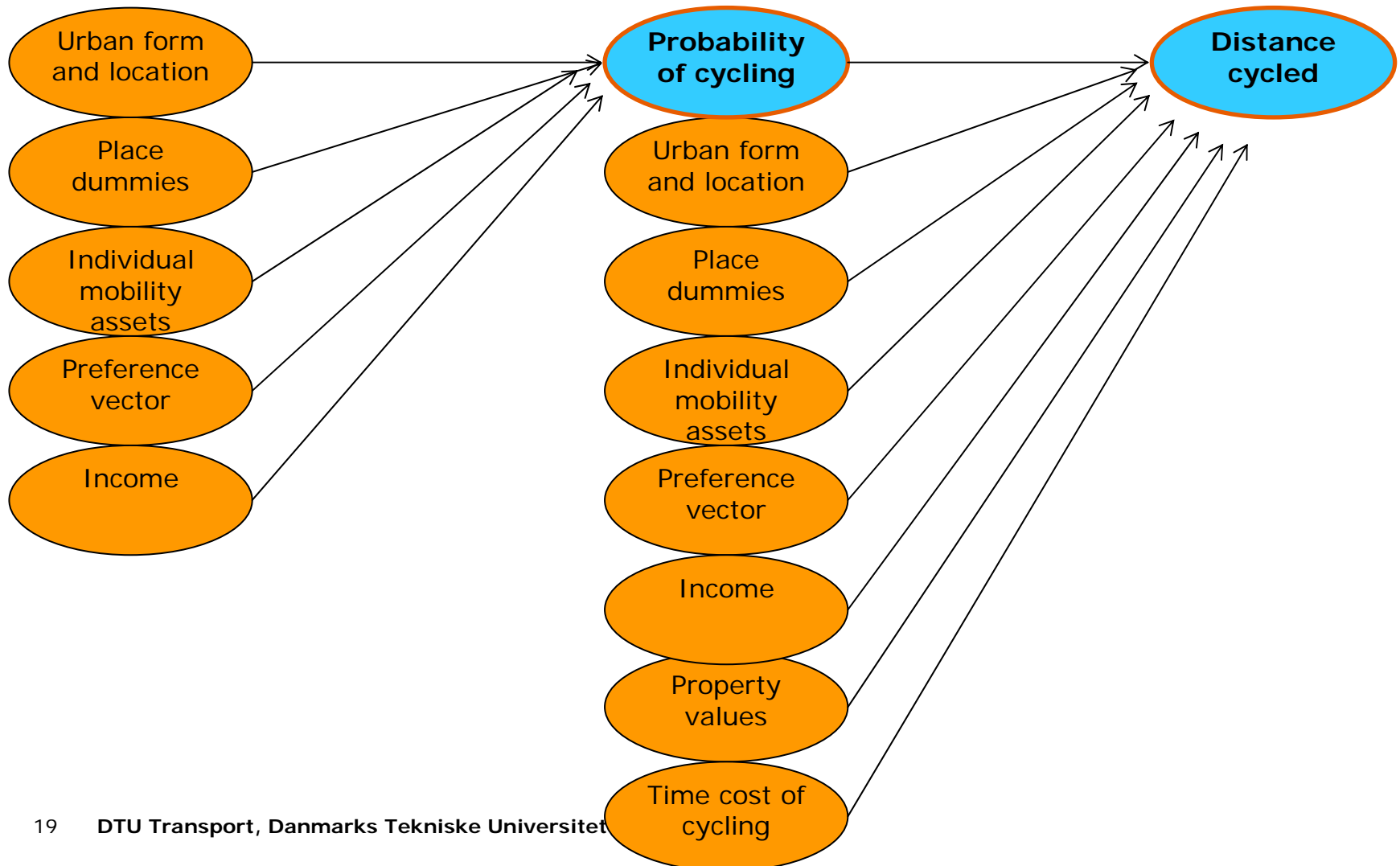
## Additional control elements

- Property values – DKK/Sqm. – based on sales registers (ESR; SVUR). Added to respondents home address based on spatial statistic drawn from sales.
- Time cost of cycling. Extracted as median time/km cost from respondents cycle trip stages.
- Both variables allow to control for money and time budgets impact on travel patterns.

# General result

*Selection model*

*Cycling distance model*



# Urban form and location variables in model

+ place dummies

*Selection model (probab. of cycling)*

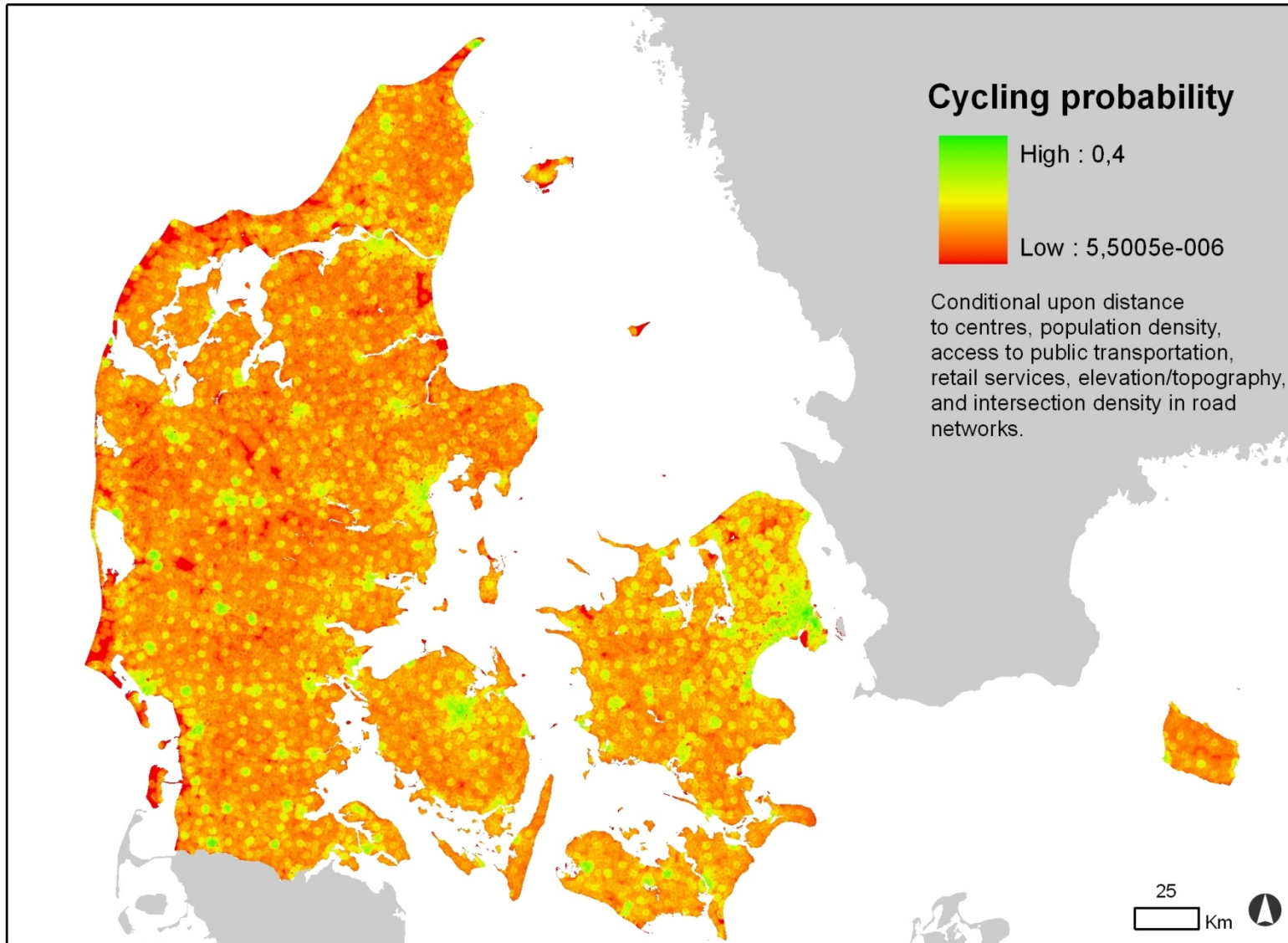
Distance to retail concentration (rel. criteria, level 5)	-0.072
Train station within 1000 m	-0.107
Population density within 1500 m	0.156
Public transport departures within 500 m	-0.021
Retail jobs/resident within 500 m	-0.591
Topography as elevation range within 1500 m	-0.123
Intersection density in network within 1500 m	0.139
Intersection density in network within 500 m	-0.126
Accommodation is a flat (lejlighed)	-0.232
Dummy: Copenhagen/Frederiksberg	0.176
Dummy: Odense	0.122

*Cycling distance model*

Distance to retail concentration (abs. criteria, level 3)	-0.046
Population density within 1500 m	-0.097
Intersection density in network within 500 m	-0.109
Dummy: Copenhagen/Frederiksberg	0.291
Dummy: Odense	0.200
Dummy: Aarhus	0.077

# Parts of a conclusion

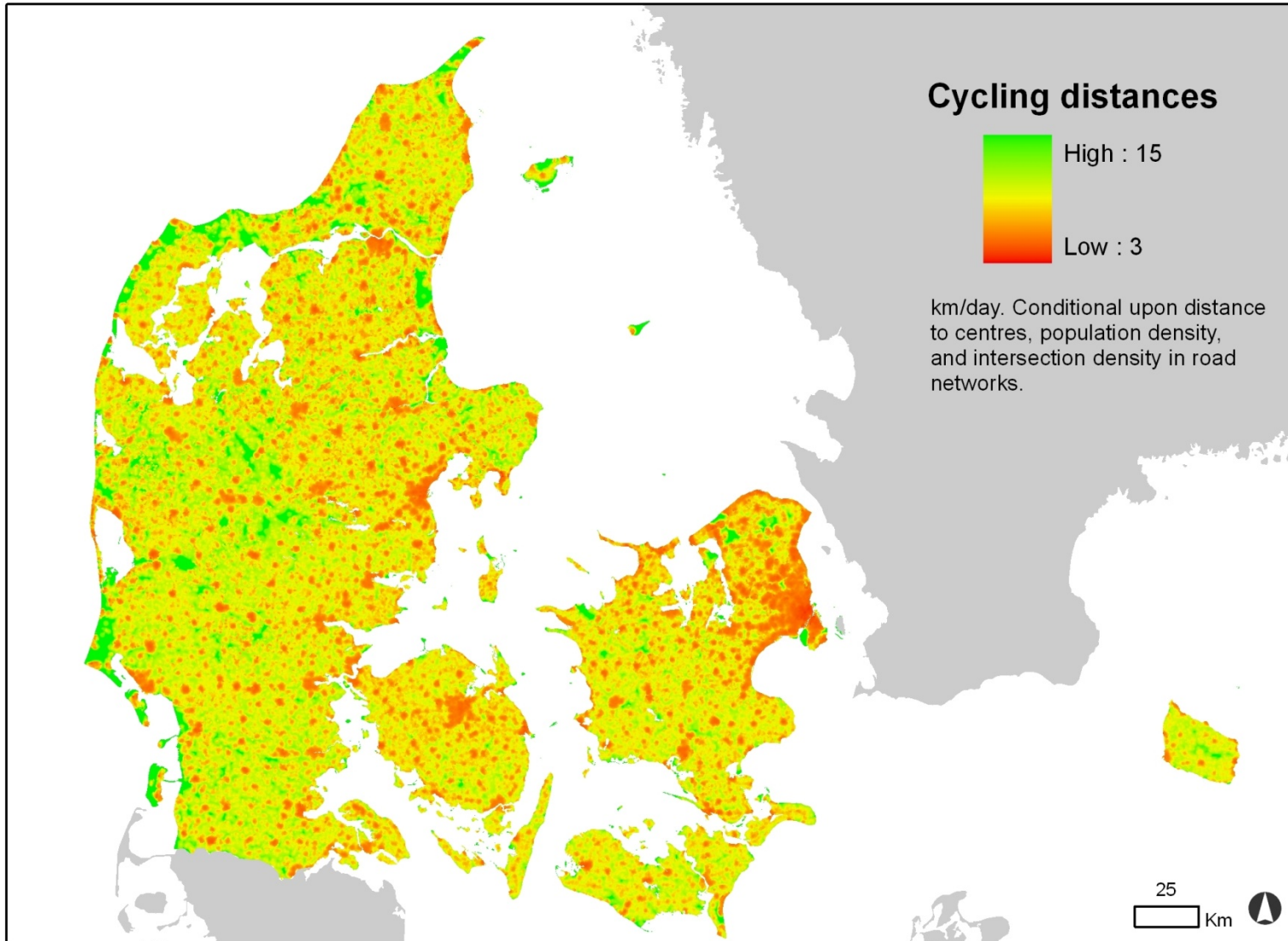
- **Probability of cycling relate....**
  - positively to destination accessibility
  - positively to population density within 'cycling range'
  - positively to connectivity of network at 'cycling scale'
  - negatively to distance to transit/LOS
  - negatively to central area mix within walking range
  - negatively to connectivity of network at 'walking range'
  - negatively to slopes within 'cycling range'
- **Distance cycled relate....**
  - positively to destination accessibility (large volumes)
  - negatively to population density within 'cycling range'
  - negatively to connectivity of network at 'walking range'



## Cycling distances



km/day. Conditional upon distance to centres, population density, and intersection density in road networks.





## WP1 multiple purpose survey

- Setting cycling in context of other travel behaviours and activities
- Relating cycling to urban form – taking lifestyle and self selection aspects into consideration.
- Analysing cycling in Theory of Planned Behaviour framework.
- Analysing cycling routes and experiences (national sample and recreational emphasis).

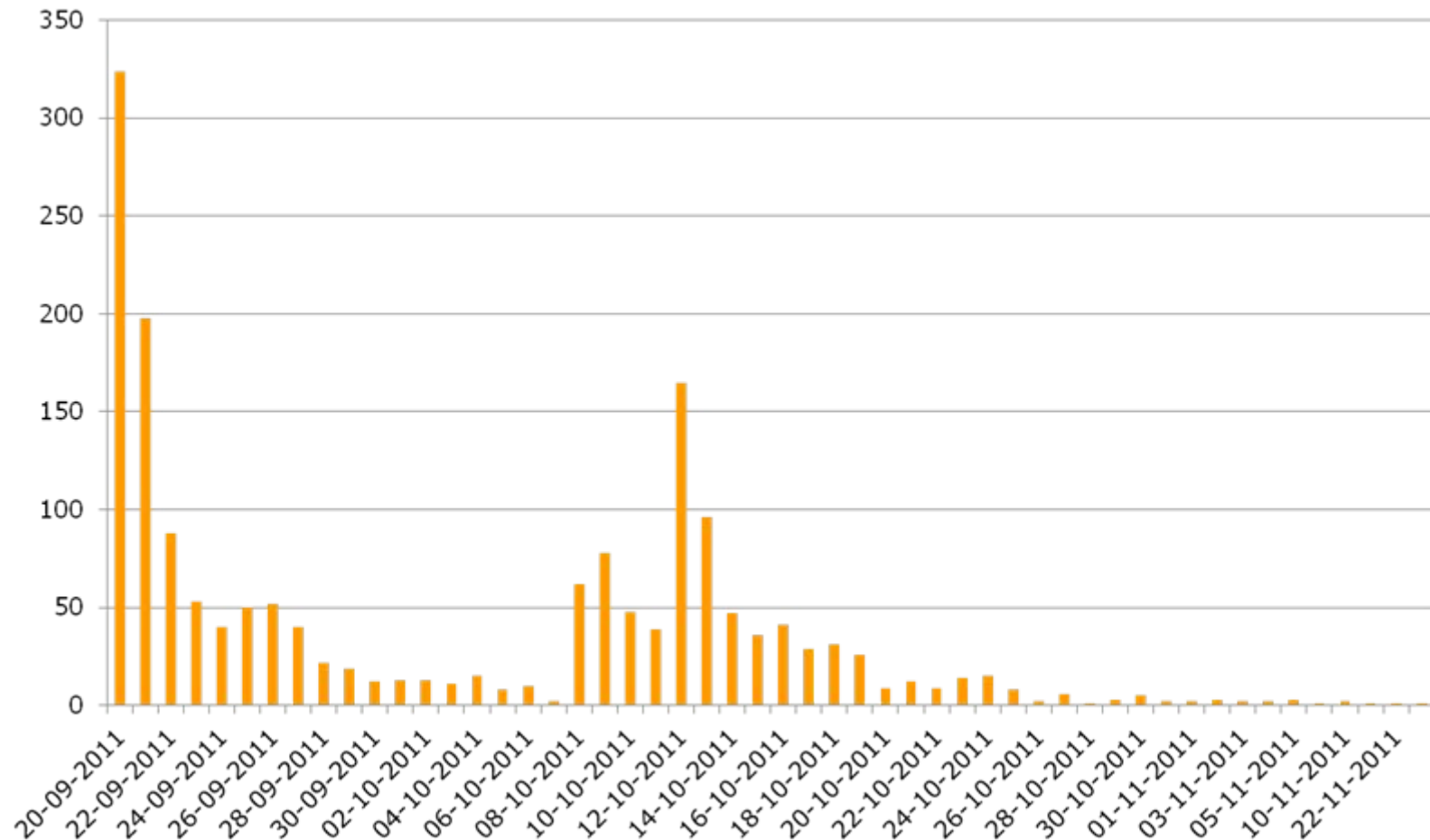
# WP1 survey contents

- Activities, transportation and cycling habits
- Residential preferences
- Health indicators (BMI + non-cycling physical activity)
- Behavioral intentions towards cycling
- Subjective norm
- Perceived behavioral control (including perception of policy/planning interventions)
- Attitudes towards cycling
- Background information (income, education, household type etc.)

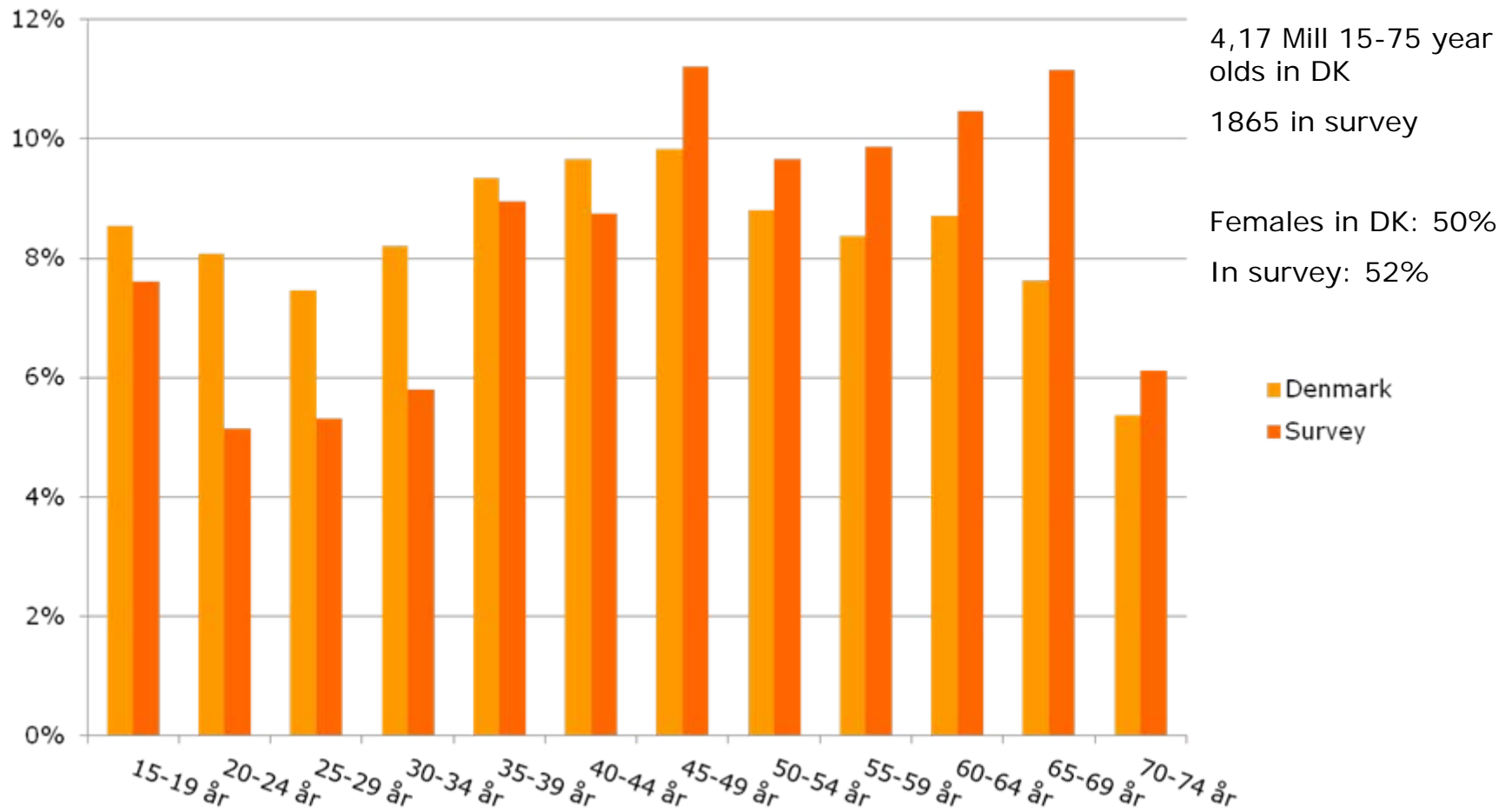
# WP1 survey implementation

- Contact data for representative sample of 6000 15-75 year olds living in Denmark acquired from 'Sundhedsstyrelsen' (Danish register of persons). Due to contact constraints registered in CPR register we were only allowed to contact 5124 of the sample.
- Survey developed and tested as online survey (survey exact).
- 5124 respondents was invited to participate by conventional mail mid September 2011.
- A reminder was sent out early October – also by conventional mail.
- Most activities ended last week of October. Survey finally closed November 22nd.
- A total of 1970 respondents have responded fully or partially to the questionnaire.
- The reponse rate was 38% when measured against the 5124 person sample which we were allowed to contact.
- Given the survey format and response rates in other transportation surveys this is highly satisfactory.

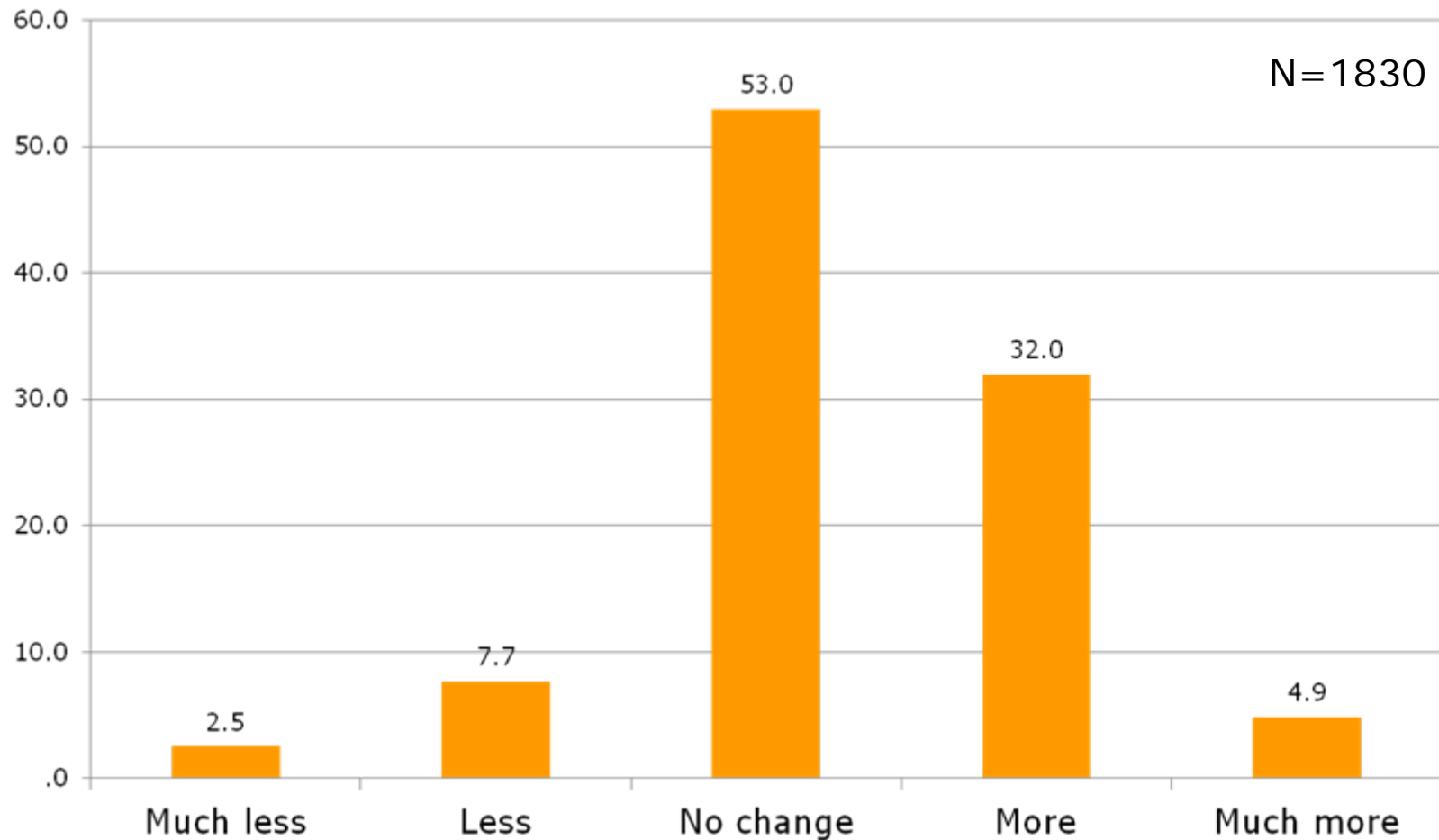
# Survey responses by date



# Comparing survey respondents to population



# Will you be cycling more or less 5 years from now?











A white silhouette of a bicycle is painted on a dark asphalt road. The road is covered with many fallen autumn leaves in various shades of brown, tan, and grey. A semi-transparent white horizontal band is overlaid across the middle of the image, containing the text "Thank you for your attention." in a bold, orange, sans-serif font.

**Thank you for  
your attention.**