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## Personal monitoring of exposure to Black Carbon

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# Introduction

*DIRECTIVE 2008/50/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL  
of 21 May 2008  
on ambient air quality and cleaner air for Europe*

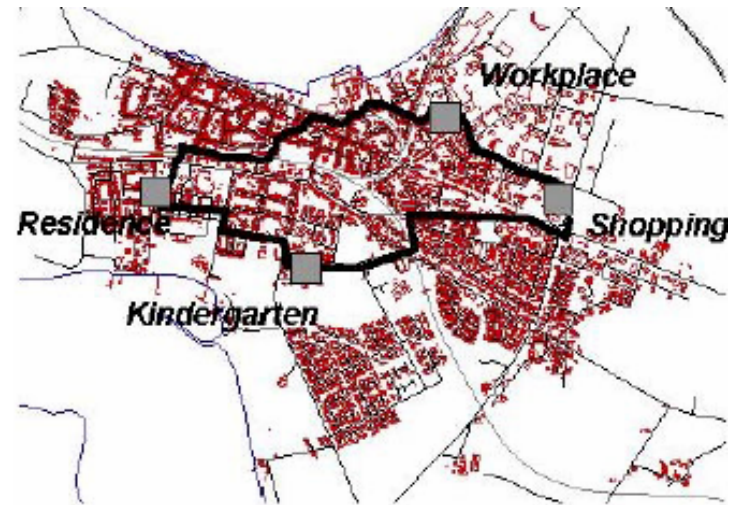
- » EU Air Quality Directive (PM2.5)
  - » From limit values to exposure concentration obligation (ECO)
  - » ECO stricter than limit values

	PM2.5 conc	Deadline
Limit value – Stage 1	25 µg/m <sup>3</sup>	2015
Limit value – Stage 2	20 µg/m <sup>3</sup>	2020
ECO	20 µg/m <sup>3</sup>	2015

- » ECO based upon measurements in urban background locations in zones and agglomerations throughout the territory of a Member State

# Introduction

- » Fixed monitoring stations as surrogates for personal exposure
- » Problems associated:
  - » Concentrations vary substantially on a local scale
  - » Individuals travel to execute activities
  - » Indoor - outdoor
- » (Avery, et al., 2010): correlation between FMS and personal exposure



(Jensen, 1999)

Avery, C. L. et al. (2010). Estimating error in using ambient PM<sub>2.5</sub> concentrations as proxies for personal exposures: A review. *Epidemiology*, 21 (2): 215-223.

Jensen, S. S. (1999). A geographic approach to modelling human exposure to traffic air pollution using GIS. Department of Atmospheric Environment. Denmark, National Environmental Research Institute.

# Study design

- » Measurement: Aethalometer microAeth® Model AE51  
5 min time base, flow rate of 100 mL/min
- » PDA with activity diary (accurate at 5 min) and GPS logger (1 sec time base)
- » Sampling period: 1 week
- » Participants: 8 couples with one partner being a homemaker, the other a fulltime worker



Aethalometer  
(black carbon)



PDA with  
PARROTS

# Study design

- » Black carbon:
  - » Light absorbing carbon
  - » Used as an indicator of exposure to diesel exhaust
  - » 'Blackness' of materials and buildings / reduced visibility
  - » Contributor to global warming
  - » Short and long term health effects
    - » cardiovascular and respiratory



# Study design

- » PDA with PARROTS:
  - » Used in transportation research (approx. 600 people)
  - » Reduces respondent burden & enforces all attributes to be filled in



**universiteit hasselt**

Dagboekje

Vergrendelen Afsluiten

**mob** INSTITUUT VOOR MOBILITEIT

**Activiteit eigenschappen, deel 1**

☒ Uitgevoerd ☐ Gepland

Activiteit:

Datum:

Locatie:

Soort:

Specificeer:  N

OK Annuleren

**Activiteit eigenschappen, deel 2**

Start tijdstip:  u  min

Eind tijdstip:  u  min

☐ Volgende dag

Aantal personen:

Met wie:

☐ Partner

☐ Kind(eren)

☐ Andere

OK Annuleren





# Results

## » Participants:

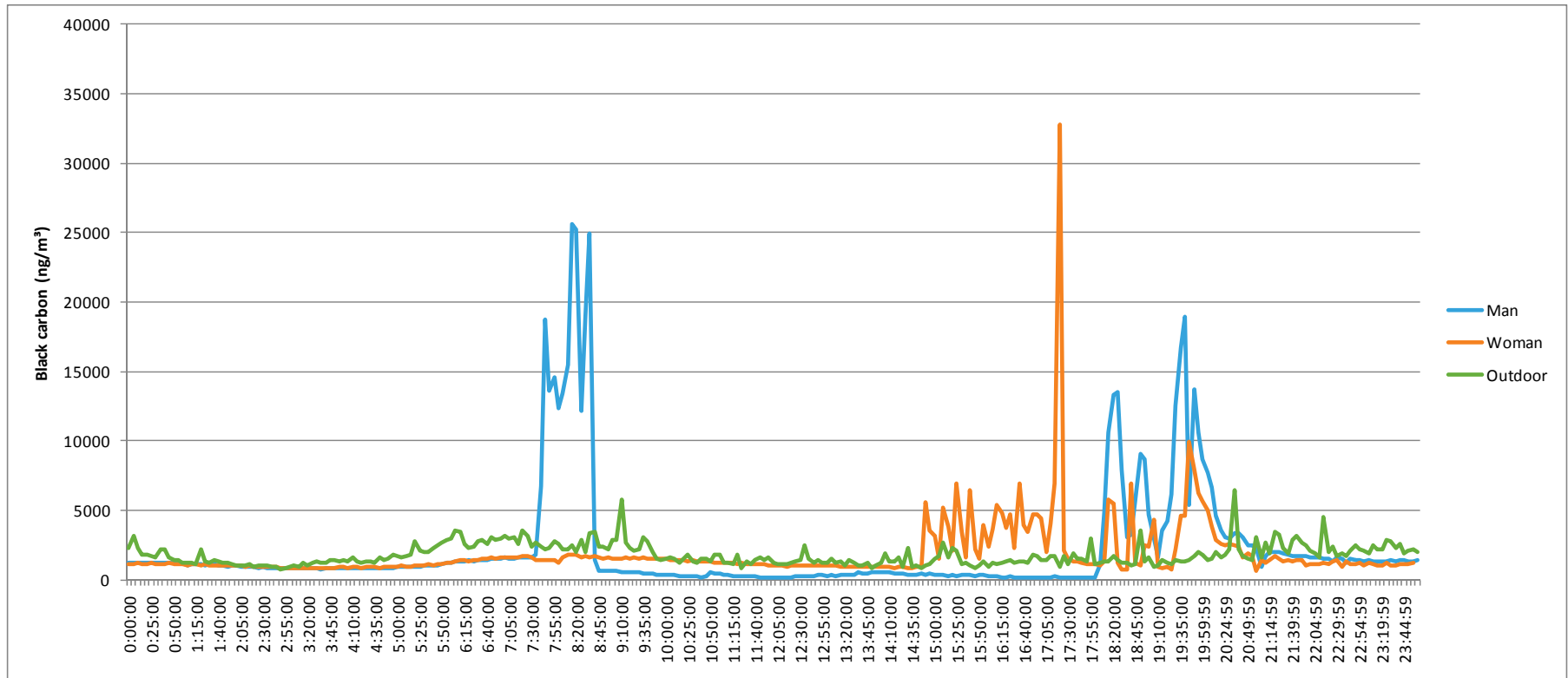
Birth year	1951-1960	1961-1970	1971-1980	1981-1990
# Persons	2	7	5	2

- » 8 male / 8 female
  - » All of them have a driving license
  - » All drive diesel cars
  - » No smokers or passive smokers
  - » Bias towards higher education
- 
- » Place of residence
    - » 2 city centre, 2 suburbs, 4 Campine region (rural)



# Results

## » Personal measurements





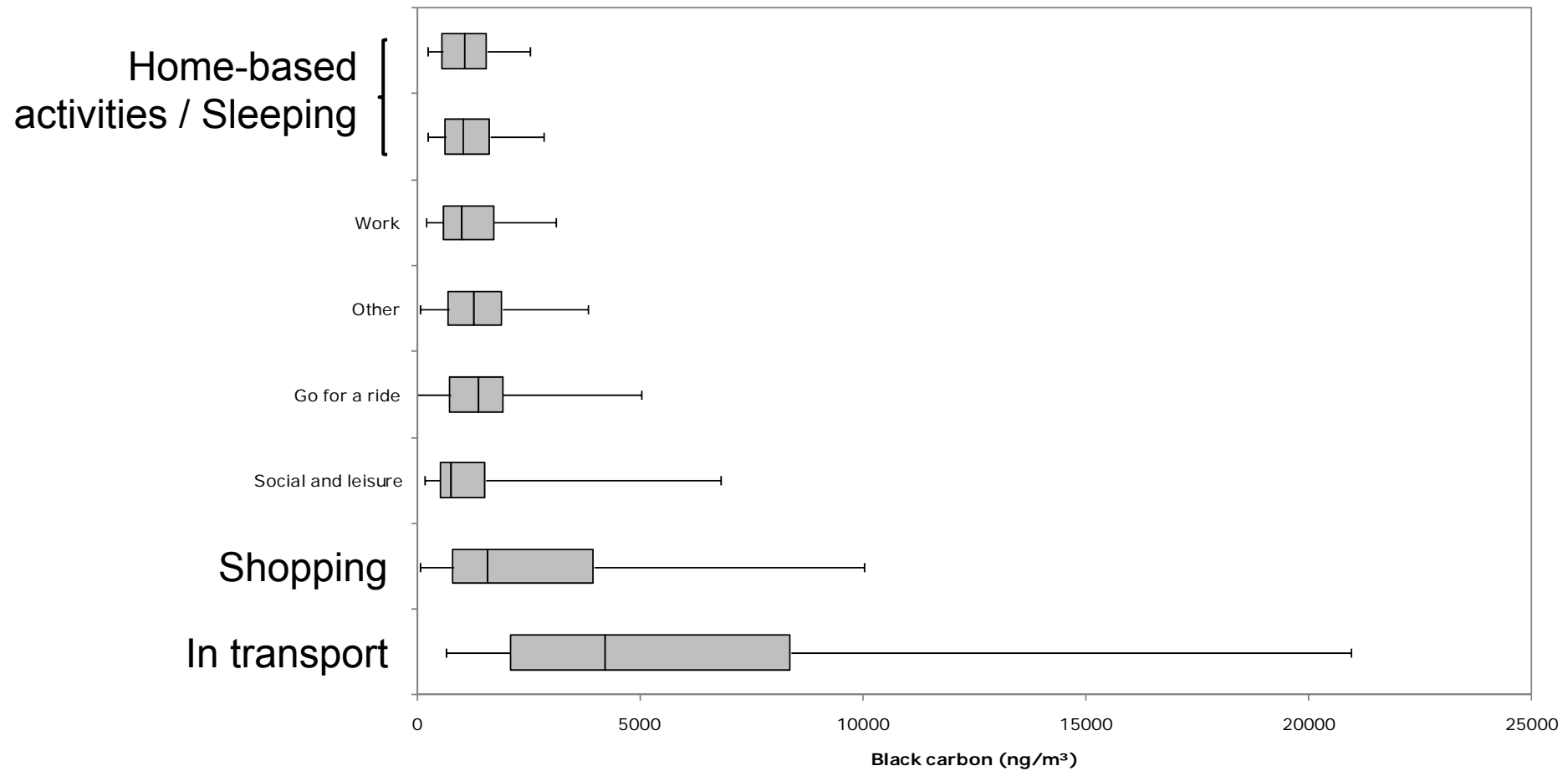
# Results

	Background (fixed monitor AL01) (ng/m <sup>3</sup> )	Outdoor (home) (ng/m <sup>3</sup> )	Average exposure full- time worker (ng/m <sup>3</sup> )	Average exposure homemaker (ng/m <sup>3</sup> )	Difference full- time worker and homemaker
HH1	960	1160*	1465	1023	-30%
HH2	1003	2138	2079	1869	-10%
HH3	1459	1694	2071	1750	-15%
HH4	1183	1313	1428	1530	7%
HH5	1559	1367	2130	1830	-14%
HH6	679	611 <sup>+</sup>	885	773	-13%
HH7	2020	1130	1929	1413	-27%
HH8	1400	1200	1580	1582	0%

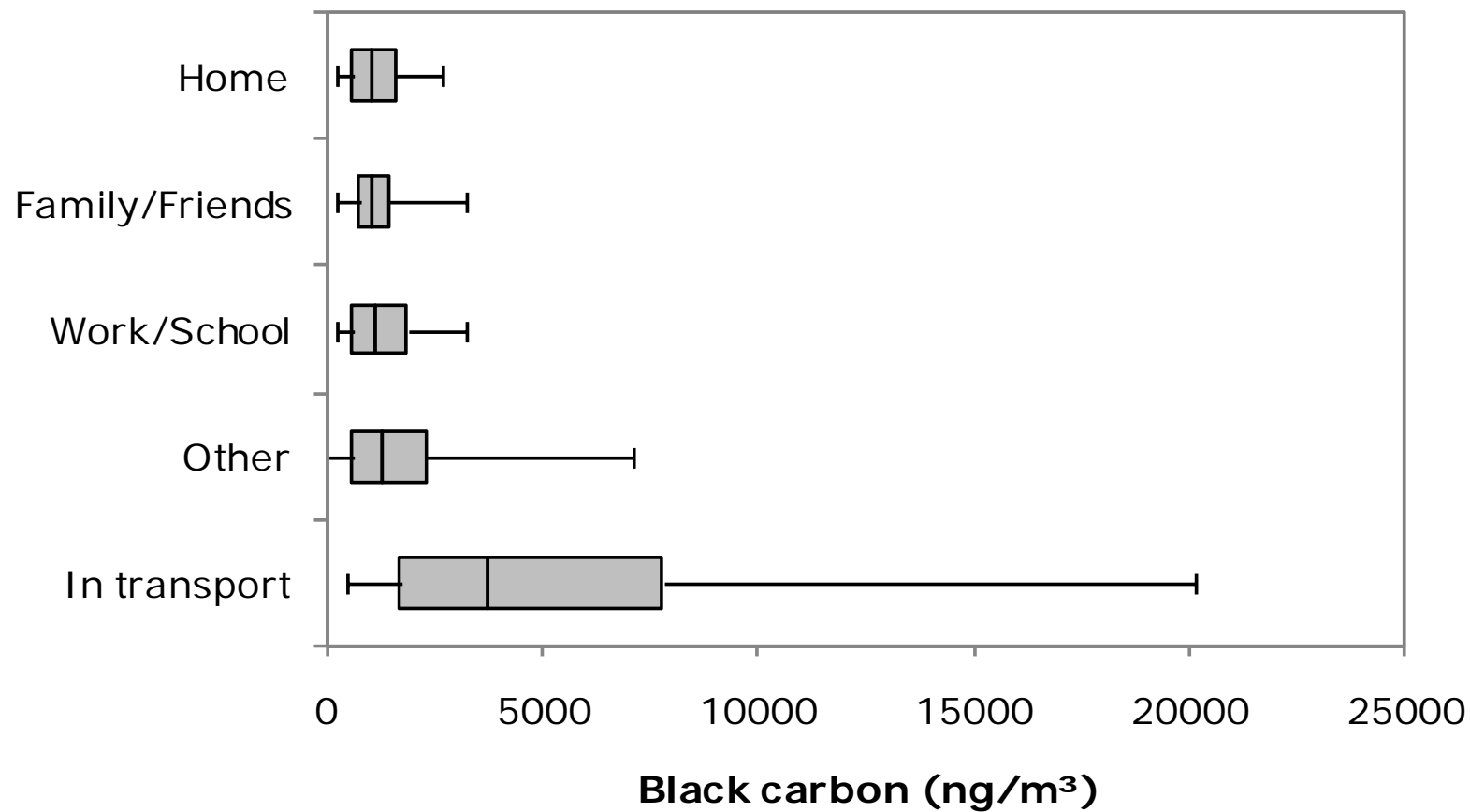
\* Limited dataset, N=561

<sup>+</sup> At the back of the house

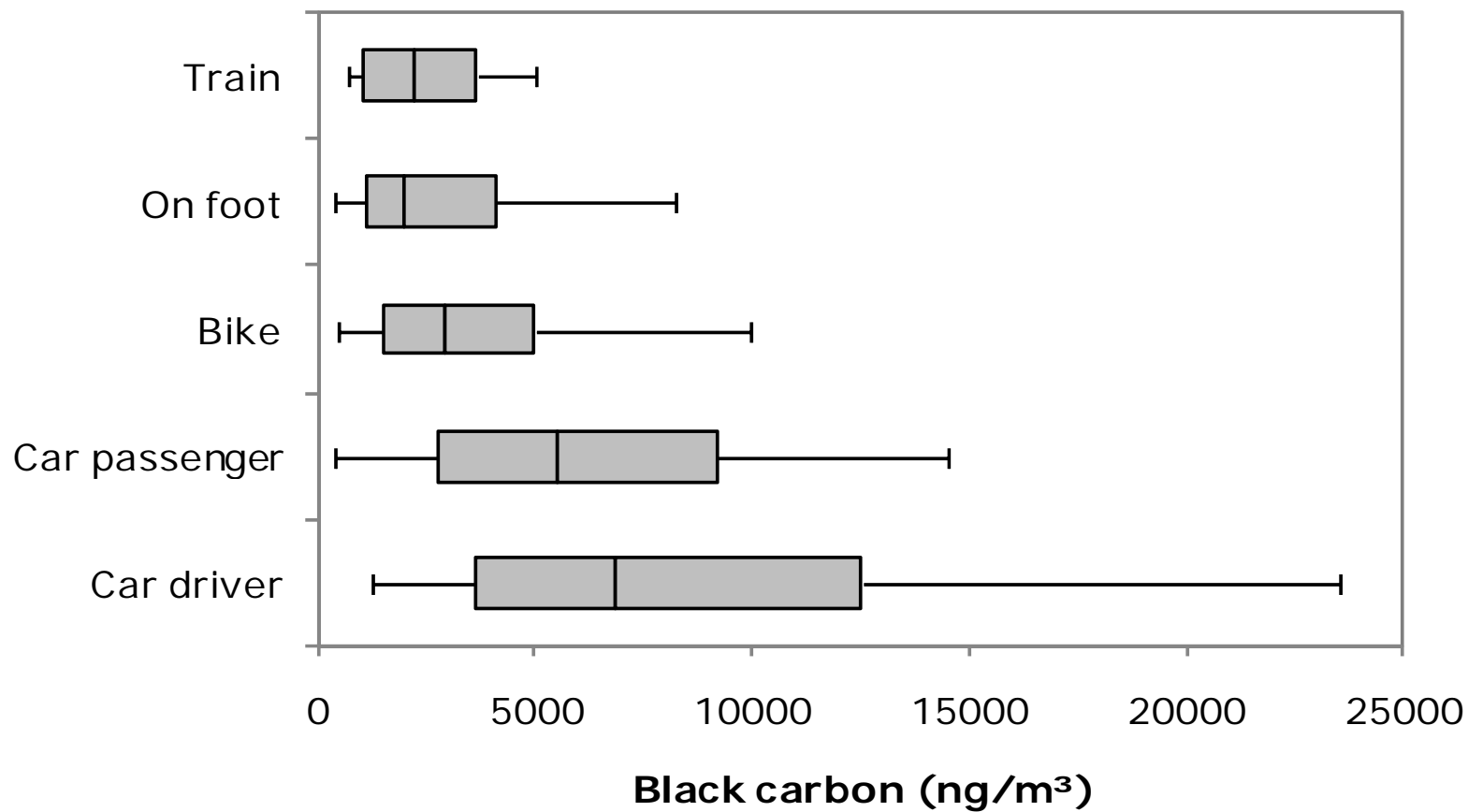
# Results



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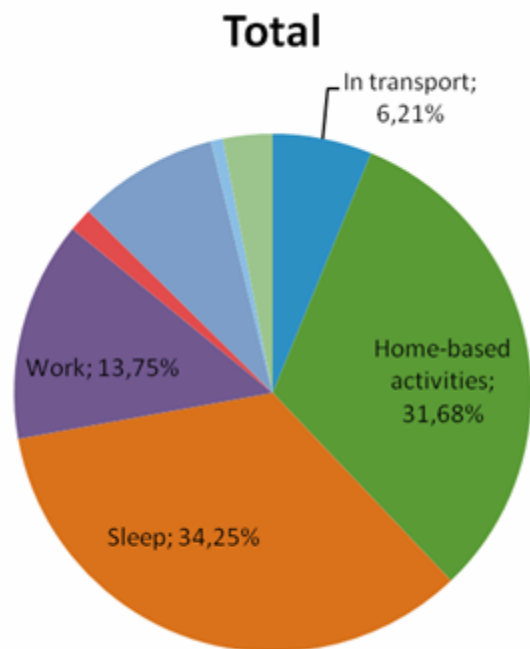


# Results

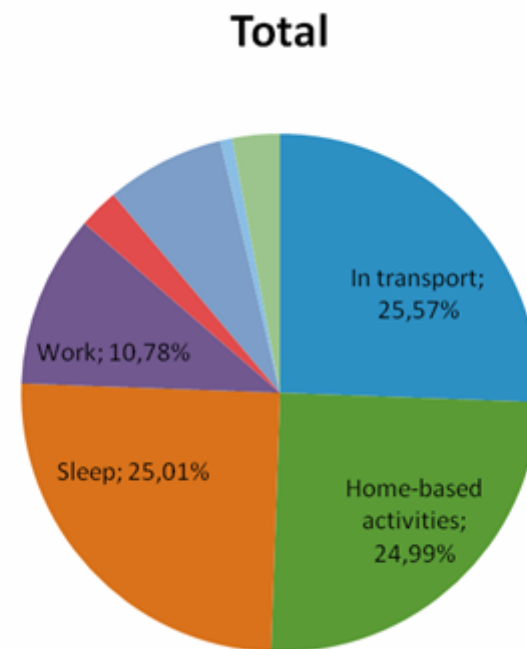


# Results

## » Time-activity pattern



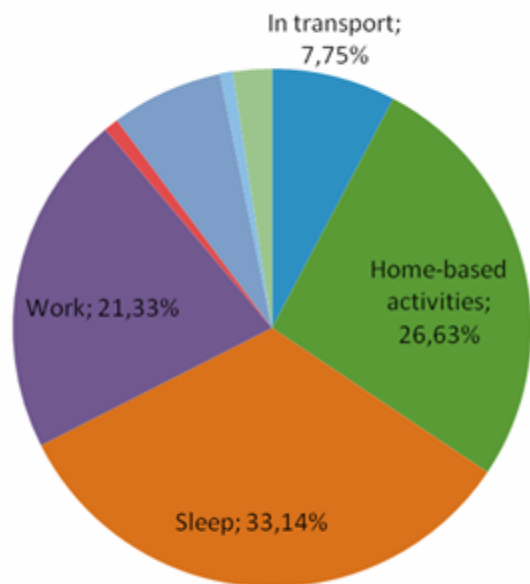
## » Contribution to exposure



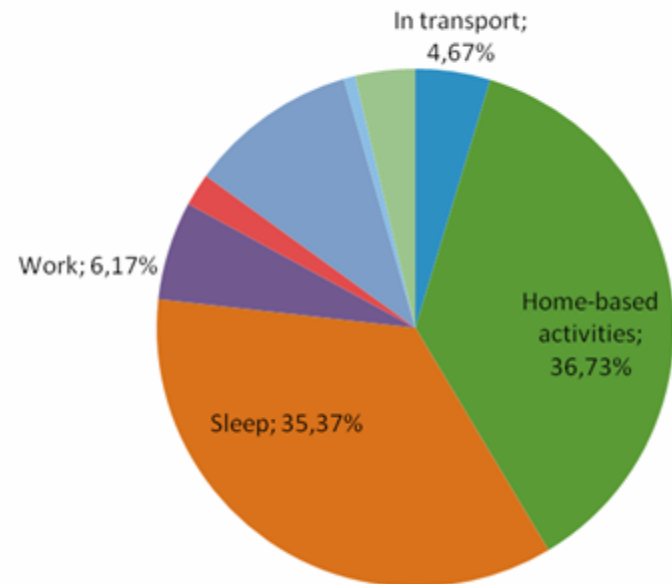
# Results

## » Time-activity pattern

**Full-time worker**



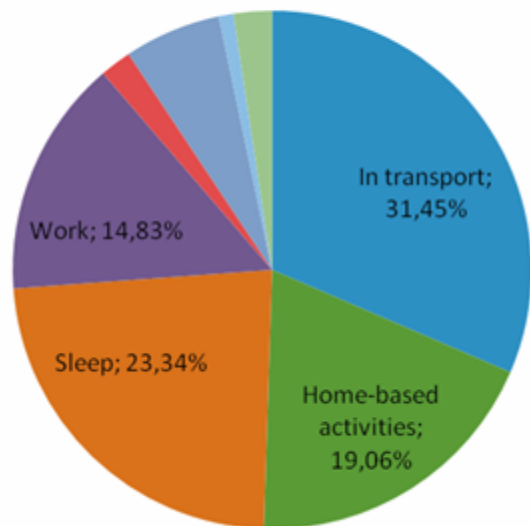
**Housewife / househusband**



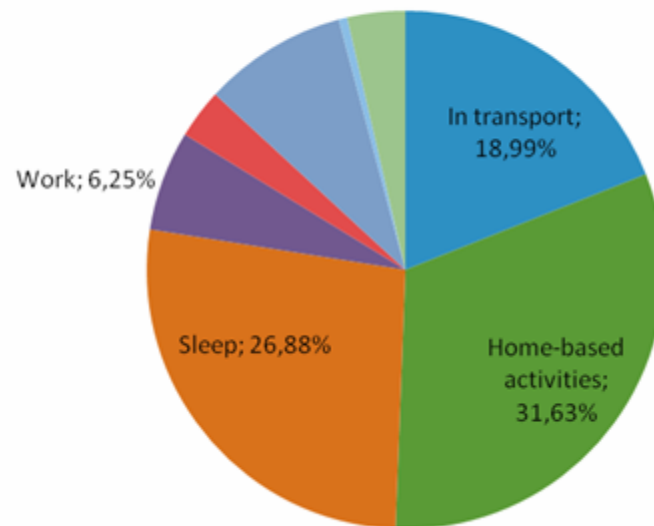
# Results

## » Contribution to exposure

**Full-time worker**



**Housewife / househusband**







# Discussion & conclusions

## » Discussion:

- » Seasonal difference: probably present → winter measurements ongoing
- » Sequential measurements → simultaneous measurements ongoing
- » Possibility to combine with breathing rates
- » Study, as it is now, not feasible in elderly or children

## » Conclusions

- » Limited time in transport (6%) accounts for 26% of total exposure
- » Difference between partners, although living at the same location, can amount to 30%
- » These results only reflect black carbon exposure or pollutants highly correlated with BC (e.g. EC, UFP, soot, NO<sub>2</sub>)



**Thank you for your attention.**

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