# UTILITARIAN (E)CYCLING & HEALTH

90 minutes Mobilité

22 mai 2025


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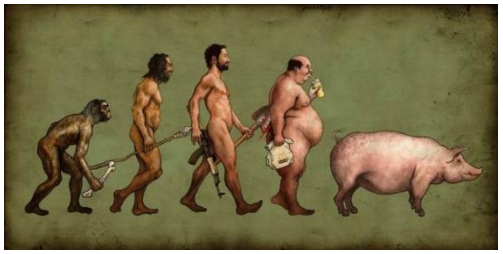
# Societal Challenges (in large cities)

- Health (care)

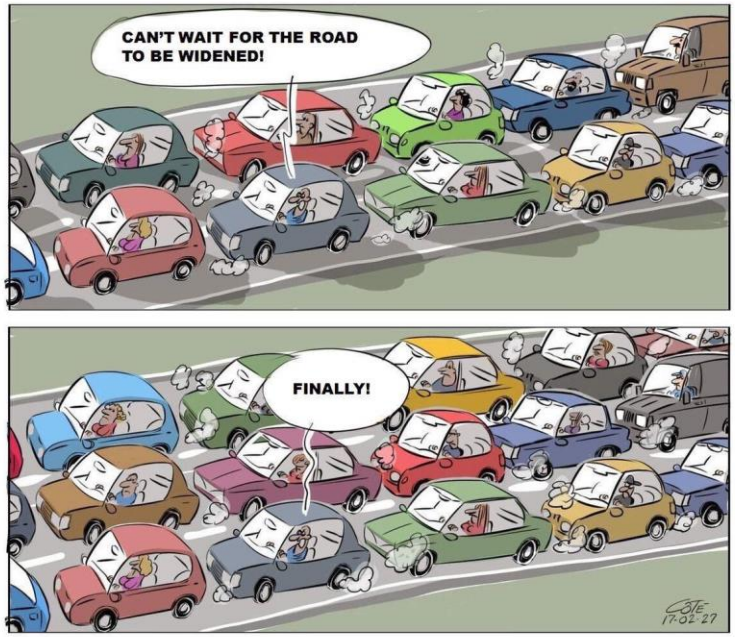


- Mobility – Public space

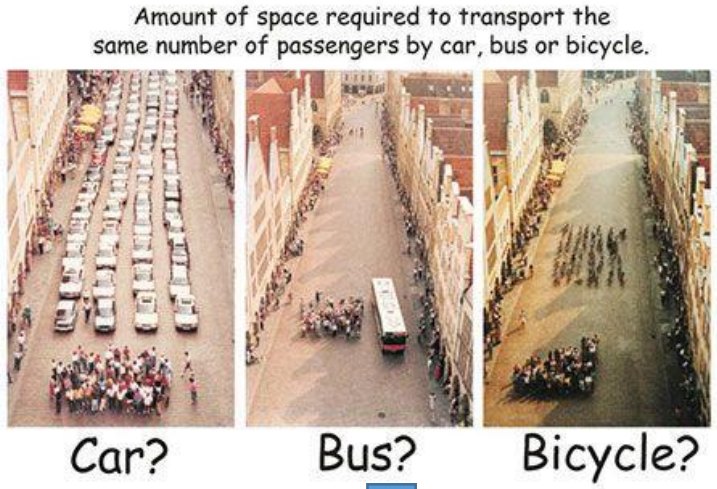
- Air & Noise pollution


- Climate change / fossil fuels

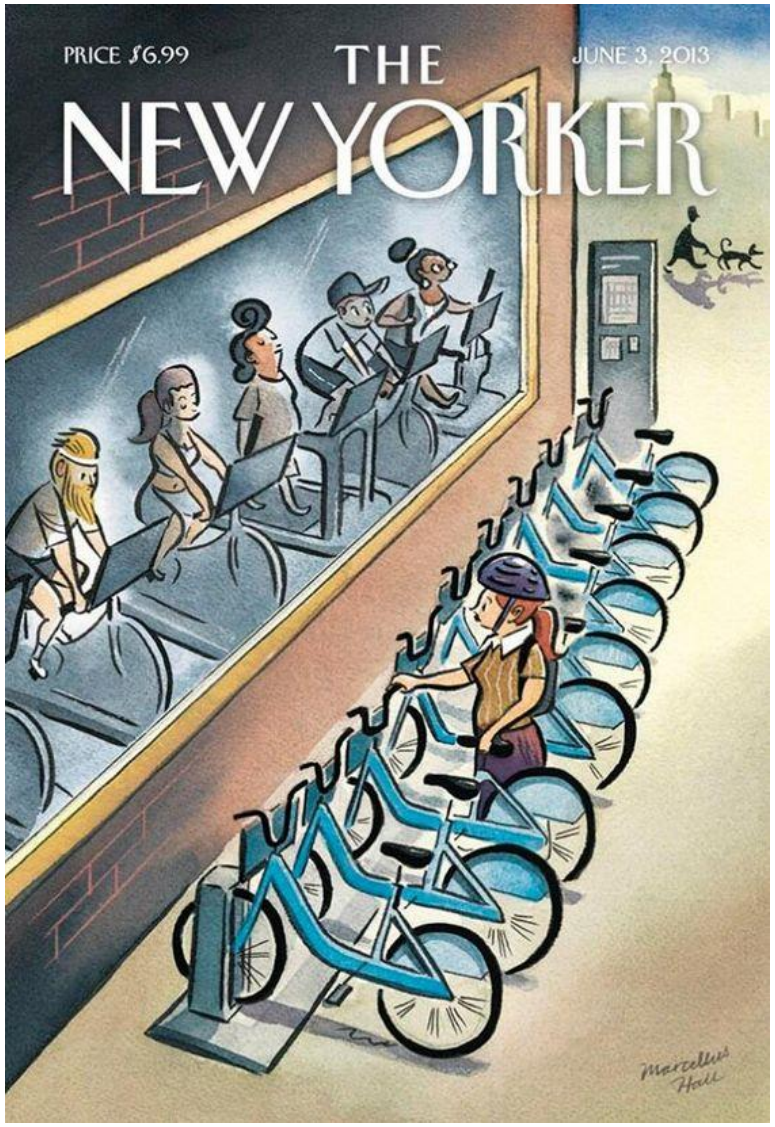
# Societal Challenges - Sustainability




(Anupriya et al, 2023)




# Get on your cycles!



# Google: Utilitarian Cycling and Health

# Google: Commuter Cycling and Health

## Hazards of cycling



The analogy: Will you drink dirty water then why you breathe dirty air, it is just brilliant! #AirPollution


1 Bénéfices du vélo classique et électrique ?

Coûts du vélo classique et électrique ?

3


Coûts/bénéfices du vélo classique et électrique ?

4

Coûts du vélo classique et électrique ?

2

# Is (utilitarian) Cycling good for Health?

Cycling for leisure/sport

Utilitarian Cycling

# What about e-cycles (≤250 Watt)?

E-cycle (≤250 Watt)

Conventional cycle

# 1. Health benefits of (e)cycling

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# Cycling & All-cause mortality

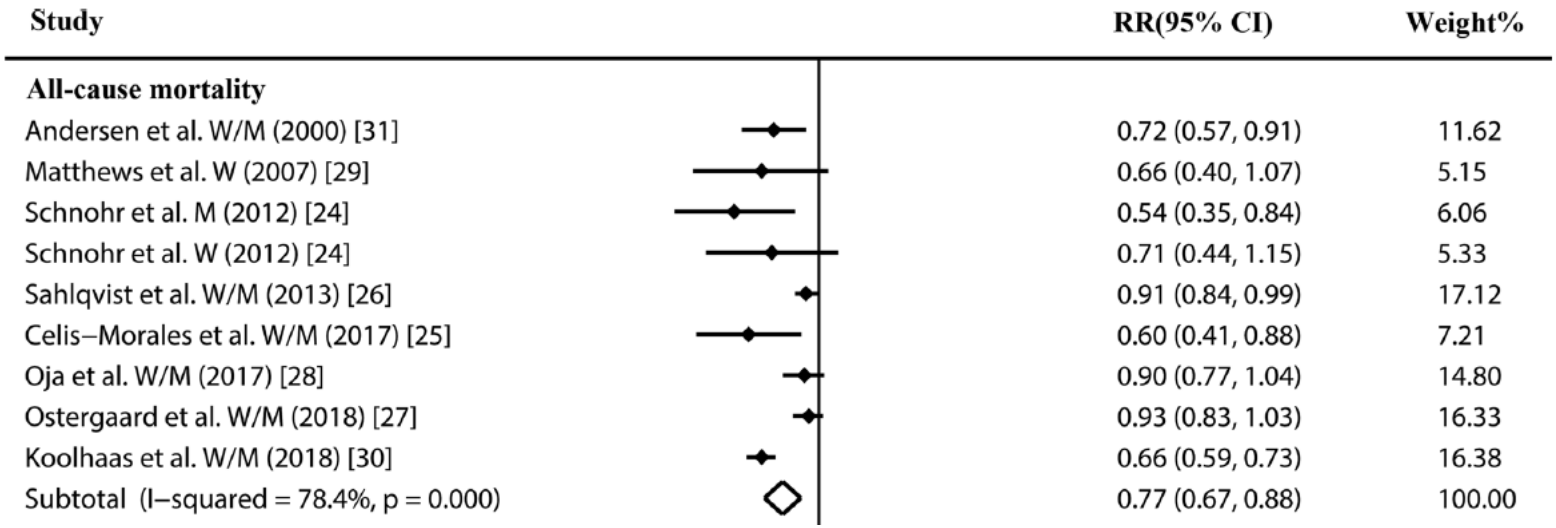



**Fig. 2** Forest plot of pooled relative risk for all-cause and cardiovascular disease (CVD) mortality with the highest versus lowest cycling level. *RR* relative risk, *CI* confidence interval, *M* men, *W* women

**Conclusions** Our findings based on quantitative data suggest that any level of cycling is better than none for all-cause mortality. However, for CVD mortality, one must choose an appropriate level of cycling, with an approximate optimum of 15 MET-h/week (equal to 130 min/week at 6.8 MET).



Zhao et al., 2021; https://doi.org/10.1007/s40279-021-01452-7

# Cycling - Mental Health

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

## Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey

Adam Martin [a,b,*], Yevgeniy Goryakin [a,b], Marc Suhrcke [a,b,c]

*Results.* After accounting for changes in individual-level socioeconomic characteristics and potential confounding variables relating to work, residence and health, significant associations were observed between overall psychological wellbeing (on a 36-point Likert scale) and (i.) active travel (0.185, 95% CI: 0.048 to 0.321) and public transport (0.195, 95% CI: 0.035 to 0.355) when compared to car travel, (ii.) time spent (per 10 minute change) walking (0.083, 95% CI: 0.003 to 0.163) and driving (−0.033, 95% CI: −0.064 to −0.001), and (iii.) switching from car travel to active travel (0.479, 95% CI: 0.199 to 0.758). Active travel was also associated with reductions in the odds of experiencing two specific psychological symptoms when compared to car travel.

# Cycling - Sickness absence & Productivity

Preventive Medicine 51 (2010) 132–135

Contents lists available at ScienceDirect

Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

The association between commuter cycling and sickness absence

Ingrid J.M. Hendriksen [a,b,*], Monique Simons [a,b,c], Francisca Galindo Garre [a], Vincent H. Hildebrandt [a,b]

*Conclusion.* Cycling to work is associated with less sickness absence. The more often people cycle to work and the longer the distance travelled, the less they report sick.

Journal of Transport Geography 76 (2019) 130–141

Contents lists available at ScienceDirect

Journal of Transport Geography

journal homepage: www.elsevier.com/locate/jtrangeo

Does daily commuting behavior matter to employee productivity?

Liang Ma[a,*], Runing Ye[b]

Overall, these findings support that commuting behaviors of employees influence their productivity at the workplace. Encourage active commuting not only improves the physical health of employees, but may also enhance their job performance, contributing to the economic benefits to employers and society.

# Intervention studies - Fitness

Scand J Med Sci Sports 2009: 19: 179–187
Printed in Singapore. All rights reserved
DOI: 10.1111/j.1600-0838.2008.00776.x



SCANDINAVIAN JOURNAL OF MEDICINE & SCIENCE IN SPORTS

**Commuter cycling: effect on physical performance in untrained men and women in Flanders: minimum dose to improve indexes of fitness**

B. de Geus, J. Joncheere, R. Meeusen

Concluding we can state that, based on the results of this study, cycling to work has the potential to increase physical performance in an untrained study population. The maximal external power and peak oxygen uptake significantly changed over time when the IG and CG were compared. Weak, but significant correlations were found between the peak oxygen uptake and total volume in the first period.



de Geus et al., 2009

# Intervention studies – CVD risk factors - QOL - Vitality

*Scand J Med Sci Sports 2008: 18: 498–510*
*Printed in Singapore . All rights reserved*
*DOI: 10.1111/j.1600-0838.2007.00729.x*



SCANDINAVIAN JOURNAL OF
MEDICINE & SCIENCE
IN SPORTS

## Cycling to work: influence on indexes of health in untrained men and women in Flanders. Coronary heart disease and quality of life

B. de Geus[1], E. Van Hoof[2,3], I. Aerts[1], R. Meeusen[1]

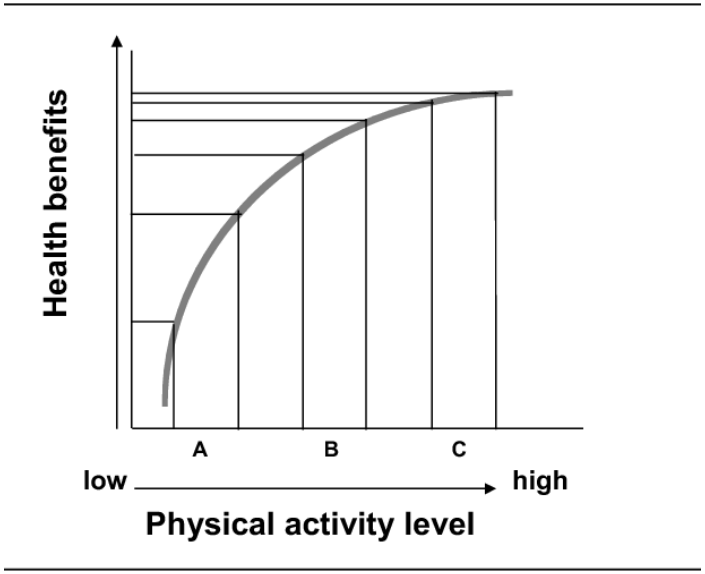
We conclude that this lifestyle intervention study, where subjects had to cycle to and from work for 1 year, had a positive influence on CHD risk factors and was likely to improve the health-related QOL of previously untrained healthy adults.



de Geus et al., 2008

# E-cycling & Health benefits

e-cycling ⟷ health benefits ??




Physical activity level (dose) =
Intensity x Frequency x Duration

# E-cycling Intensity

- WHO guidelines: health effect → intensity of 3-6 METS

**Table 2**
Descriptive statistics field tests (N=75 trips).

| | CC (N=38) | EAC (N=37) |
|---|---|---|
| **Distance** (km) | 7.28 ± 1.28 | 8.08 ± 2.08[a] |
| **Speed** (km/h) | 15.9 ± 2.3 | 18.7 ± 3.0[a] |
| **Travel time** (min) | 26 ± 5 | 24 ± 4 |
| **Height gain** (m) | 87.0 ± 25.4 | 87.4 ± 36.7 |
| **Slope_P90** | 2.96 ± 0.99[a] | 2.42 ± 0.85 |
| **Stops** | 2.5 ± 2.6 | 2.9 ± 3.4 |
| **METs** | 6.61 ± 1.62[a] | 4.89 ± 1.41 |
| **Ventilation** (L/min) | 49.49 ± 11.95[a] | 35.58 ± 7.87 |
| **Heart rate** (bpm) | 129 ± 18[a] | 108 ± 18 |
| **%HRmax** | 70.51 ± 8.69[a] | 58.99 ± 7.88 |

Legend: CC: Conventional; EAC: E-bike



Lathouwers et al., 2021

# E-cycling Frequency & Duration

- Fyhri et al 2020:

We found that people who purchased an e-bike increased their bicycle use from 2.1 to 9.2 km per day on average, representing a change in bike as share of all transport from 17 to 49 percent.

- Castro et al, 2019:

| | E-bike | Conventional bike |
|---|---|---|
| Trip distance | 9,4 km | 4,8 km |

# E-cycling Dose

- Castro et al, 2019:

| | E-bike | Conventional bike |
|---|---|---|
| MET min/wk (=dose) | 4463 | 4085 |

- Shift from Conventional → e-bike: ↓ 200 MET min/week
- Shift from car → e-bike: ↑ 550 MET min/week
- Shift from public transport → e-bike: ↑ 800 MET min/week

# Systematic Reviews – Health benefits of (e-)cycling

Review

**Health benefits of cycling: a systematic review**

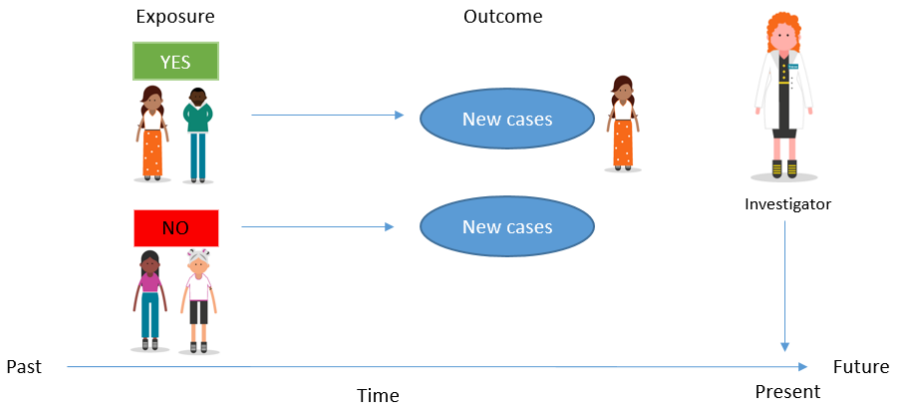
P. Oja[1], S. Titze[2], A. Bauman[3], B. de Geus[4], P. Krenn[2], B. Reger-Nash[5], T. Kohlberger[2]

REVIEW Open Access

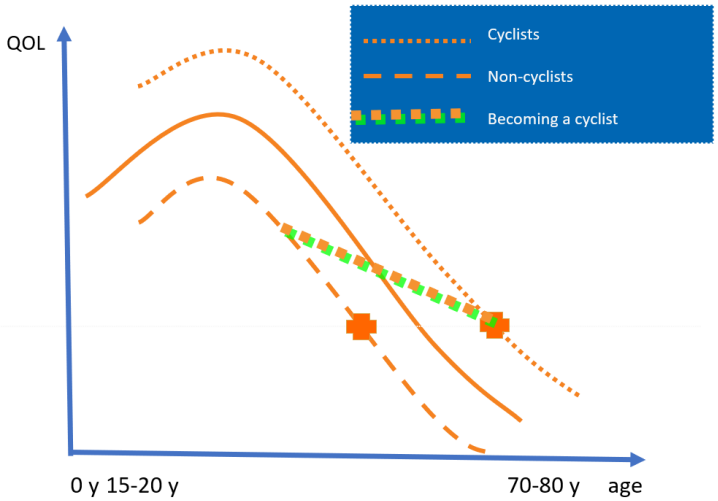
Health benefits of electrically-assisted cycling: a systematic review

Jessica E. Bourne[1,2*], Sarah Sauchelli[2], Rachel Perry[2], Angie Page[1,2], Sam Leary[2], Clare England[1,2] and Ashley R. Cooper[1,2]

**Cohort Studies (Retrospective/Historical)**




Quality of Life (QOL)

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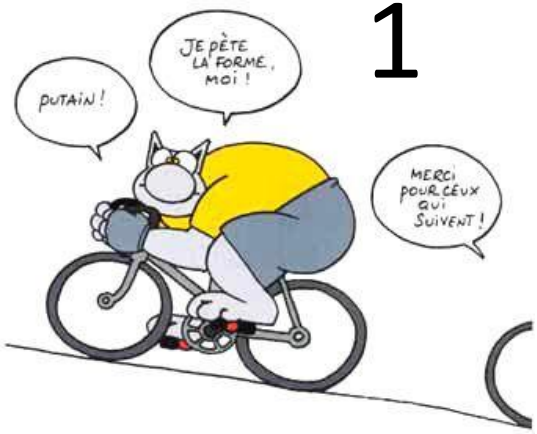
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HEALTH

2

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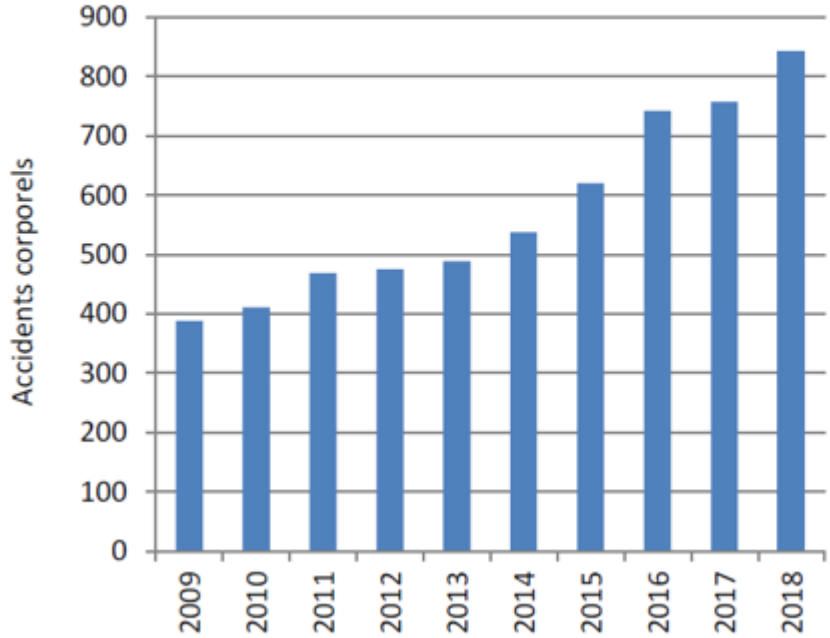
# 2. (e-)cycle crashes

# Absolute number of cycle accidents with corporal damage in BCR

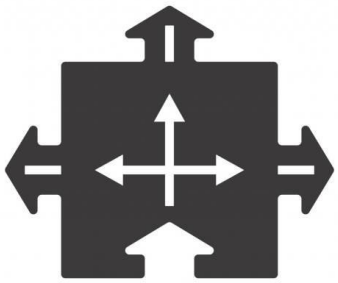
**Evolution du nombre absolu d'accidents corporels impliquant un cycliste en Région de Bruxelles-Capitale entre 2009 et 2018**

Source : Police fédérale/DGR/DRI/BIPOL. Infographie : Vias Institute

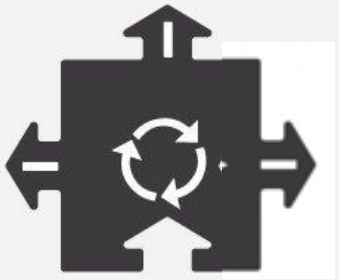



# Bicycle crashes - Exposure

- Bicycle crashes:
  - Incidence = # crashes
  - Incidence rate = # crashes / exposure = **risk**

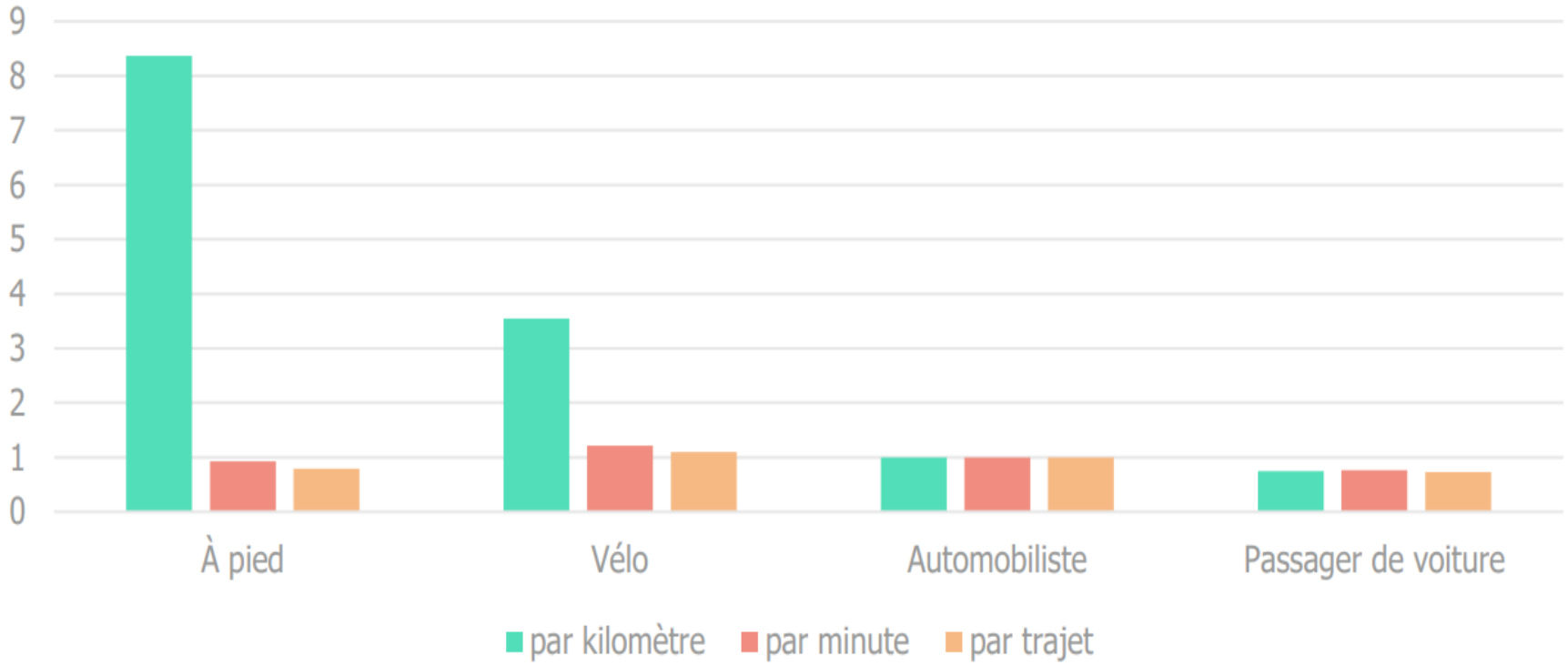


Incidence: 10 crashes / year
Exposure: 1,000 trips / year
Incidence rate: 0.01 crashes / year



Incidence: 10 crashes / year
Exposure: 10,000 trips / year
Incidence rate: 0.001 crashes / year

# Risque d'accident mortel relatif par type d'usagers de la route et unité d'exposition utilisé.






Source : Pelssers, 2020

# Risque d'accident mortel relatif par mode de transport et par tranche d'âge en fonction du nombre de **kilomètres parcourus** (en millions) en Belgique

| | À pied | Vélo | PTW | Automobiliste | Passager de voiture | En bus |
|---|---|---|---|---|---|---|
| **6-17** | 4,8 | 2,0 | 32,5 | N/A | 0,3 | 0,0 |
| **18-24** | 5,3 | 1,0 | | 2,3 | 1,7 | 0,0 |
| **25-44** | 4,2 | 1,1 | 40,3 | 0,9 | 0,7 | 0,0 |
| **45-64** | 6,5 | 2,8 | 14,0 | 0,7 | 0,5 | 0,1 |
| **65-74** | 12,4 | 8,8 | 127,6 | 0,9 | 0,7 | 0,2 |
| **75 et +** | 54,2 | 16,0 | | 2,1 | 1,8 | 0,5 |
| **Total** | **8,4** | **3,5** | **27,0** | **1,0** | **0,7** | **0,1** |

PTW (Powered Two-Wheelers): Les deux-roues motorisés tels que les cyclomoteurs ou les motocyclettes



Source : Pelssers, 2020

# Incidence rate (risk) – minor bicycle crashes

**Table 1**
Incidence, exposure and incidence rate per region.

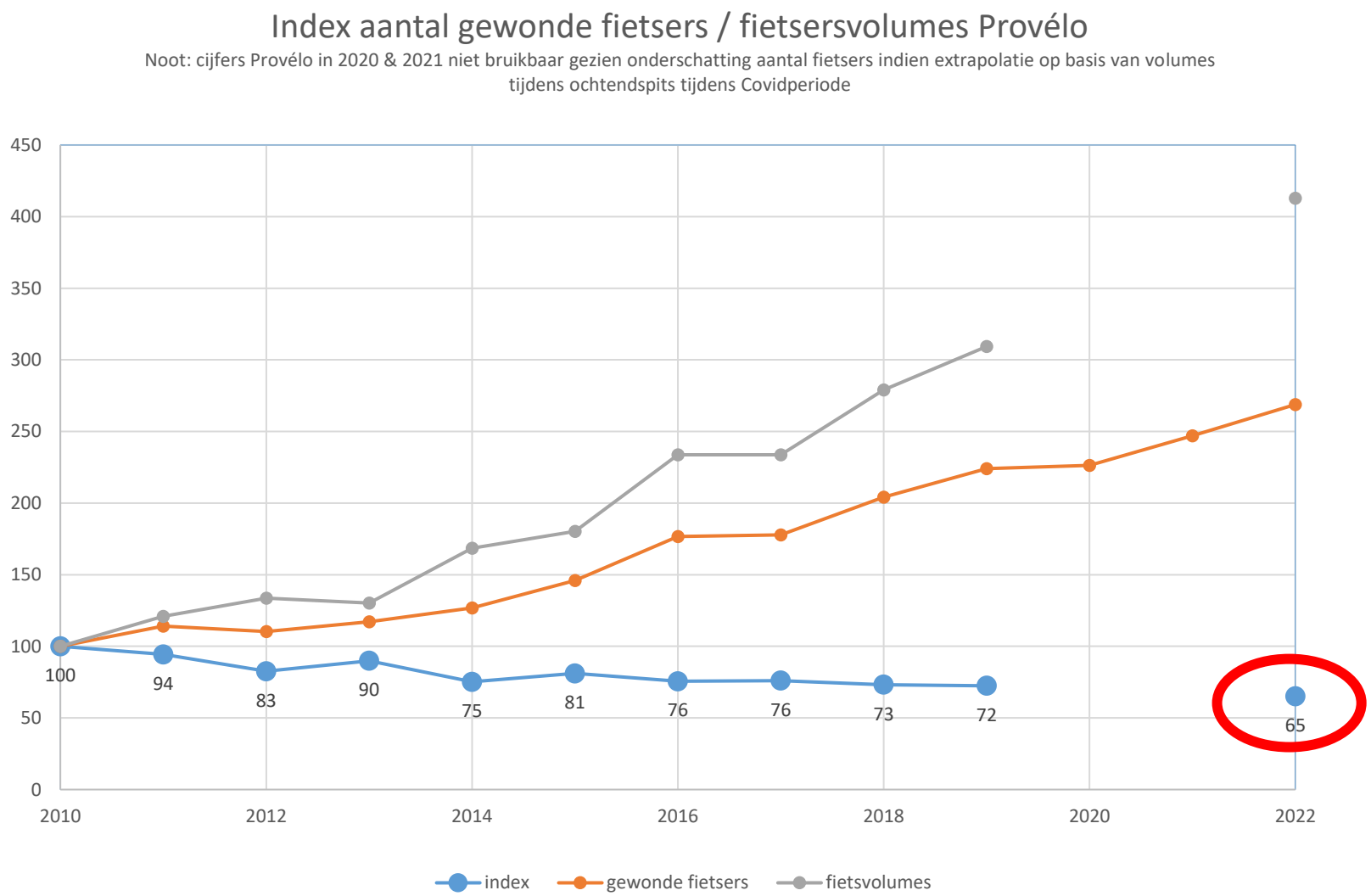
| | Brussels-capital region | Flanders | Wallonia |
|---|---|---|---|
| *Incidence* | | | |
| Number of injuries (*N*) | 28 | 34 | 8 |
| *Exposure* | | | |
| Frequency (# of trips) | 64,982 | 116,262 | 22,920 |
| Time (h) | 20,153 | 45,190 | 8540 |
| Distance (km) | 325,210 | 909,033 | 160,873 |
| *Incidence rate (95% CI)* | | | |
| /1000 trips | 0.431 (0.271–0.590) | 0.292 (0.194–0.391) | 0.349 (0.107–0.591) |
| /1000 h | 1.389 (0.875–1.904) | 0.752 (0.499–1.005) | 0.937 (0.288–1.586) |
| /1000 km | **0.086 (0.054–0.118)** | **0.037 (0.025–0.050)** | 0.050 (0.015–0.084) |

Values in Bold indicate a significant difference ($P < 0.05$).
*Note*: 511 (2.54%) travel diaries could not be attributed to a specific region.



de Geus et al., 2012

# Safety-in-Numbers in Brussels






Source : Pro Vélo, StatBel

# E-bicycle crashes

- No unanimity in the scientific literature:
  - Risk
    - Schepers et al. (2014) did find an elevated risk among EAC users;
    - Schepers et al. (2020b) only found an increased risk for older female EAC users;
    - Fyhri et al. (2019) found an increased risk for female but not for male EAC users;
  - Severity
    - Fyhri et al. (2019) and Schepers et al. (2020b) did not find EAC crashes to result in more severe injuries than crashes involving conventional cycles;
    - Poos et al. (2017) did find more severe injuries among casualties on EAC's receiving treatment at an emergency department after a crash.

# Minor E-bicycle crashes in Belgium & the Netherlands

- 1,919 cyclists (63.2 ± 11.1 years; 50% women)
- 319 (17% of the total sample) cyclists reported a crash in the previous 12 months, of which 36% were EAC crashes
- Results:
  - Cycle type : e-bike > conventional cycle
  - Mental impairments while cycling: more mental impairments → more crashes
  - Cycling more → more crashes
  - Region of residence: BCR > Flanders

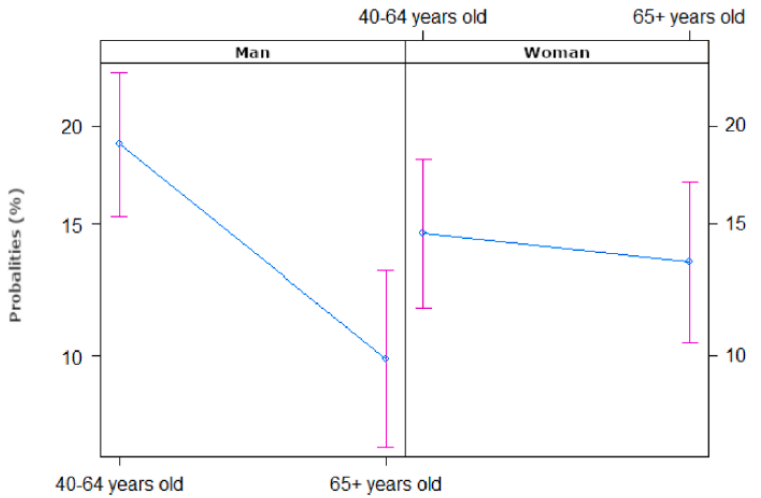



**Fig. 1.** Probabilities of reporting a crash between age categories in men and women.



de Geus et al., 2023

# Individual: Bicycle safety measurements

- Protect yourself and make yourself visible in traffic, especially when the light conditions are poor


# Individual: Bicycle safety measurements

- Port du casque à Bruxelles : en moyenne en 2024, un peu plus de 71% des cyclistes portaient un casque

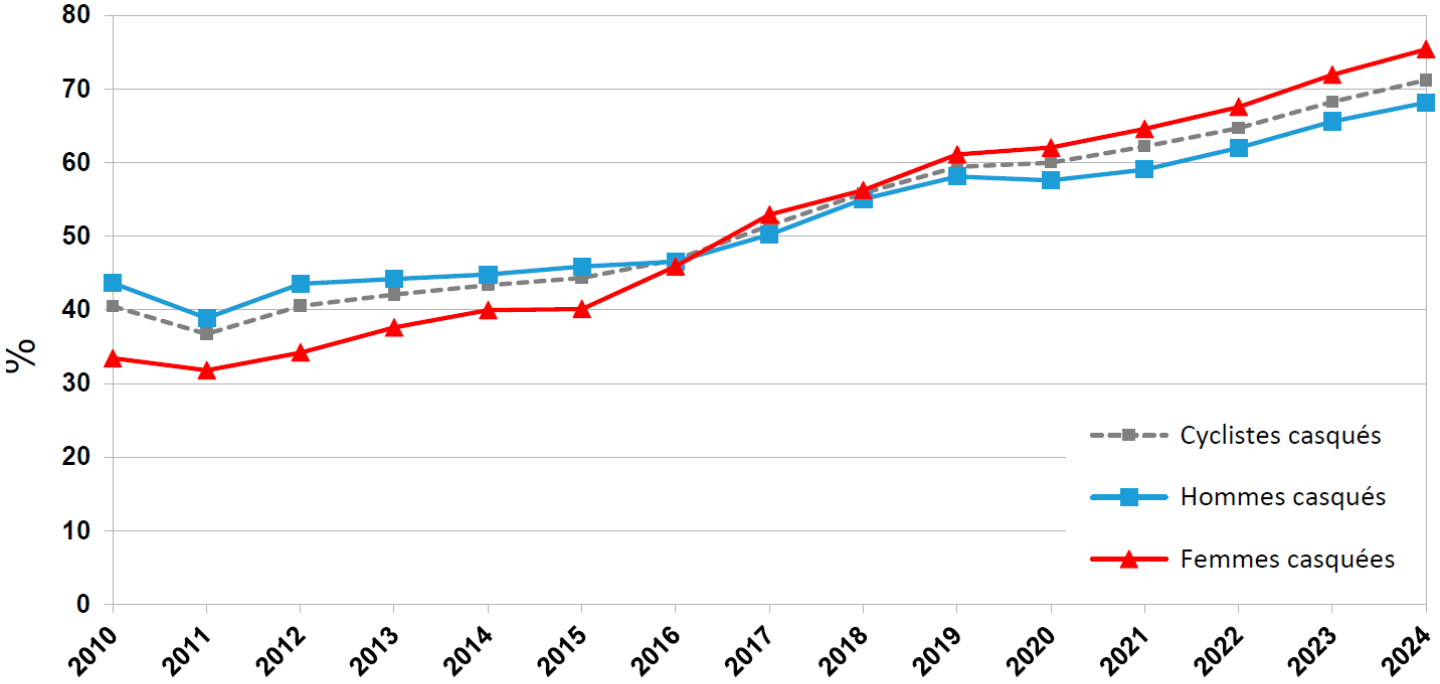



*Figure 8 - Evolution de la part des cyclistes portant un casque parmi les cyclistes observés lors des comptages quantitatifs, depuis 2010. (26 lieux ; comptages de janvier, mai, septembre et novembre) Source : Pro Velo.*



Source : Pro Vélo (Observatoire du vélo, 2025)

# Individual: Bicycle safety measurements

Safety Science 108 (2018) 209–217

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/safety


## The effect of a yellow bicycle jacket on cyclist accidents

Harry Lahrmann[a,*], Tanja Kidholm Osmann Madsen[a], Anne Vingaard Olesen[a], Jens Chr. Overgaard Madsen[b], Tove Hels[c]

A B S T R A C T

This study is the first randomised controlled trial (RCT) of the safety effect of high-visibility bicycle clothing. The hypothesis was that the number of cyclist accidents can be reduced by increasing the visibility of the cyclists. The study design was an RCT with 6793 volunteer cyclists – 3402 test cyclists (with a yellow jacket) and 3391 control cyclists (without the jacket). The safety effect of the jacket was analysed by comparing the number of self-reported accidents for the two groups. The accident rate (AR) (accidents per person month) for personal injury accidents (PIAs) for the test group was 47% lower than that of the control group. For accidents involving cyclists and motor vehicles, it was 55% lower. The study was non-blinded, and the number of reported single accidents was significantly lower in the test group than in the control group. This is likely a result of a response bias, since the bicycle jacket was not expected to affect the number of single accidents. To compensate for this bias, a separate analysis was carried out. This analysis reduced the effect of the jacket from 47% to 38%.

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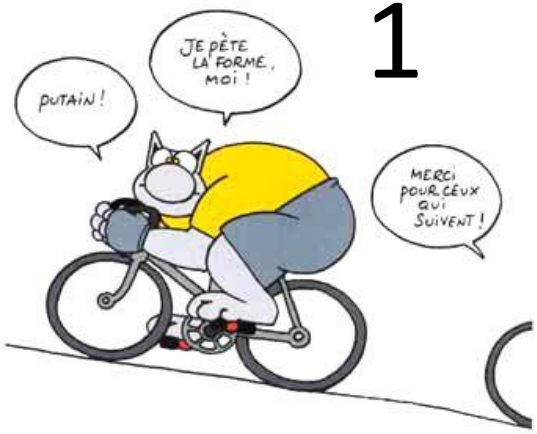
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# 3. Air Pollution & (e)cycling

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# Micro-environment traffic air pollution – Short-term

ELSEVIER

The Science of the Total Environment 279 (2001) 131–136

the Science of the Total Environment

www.elsevier.com/locate/scitotenv

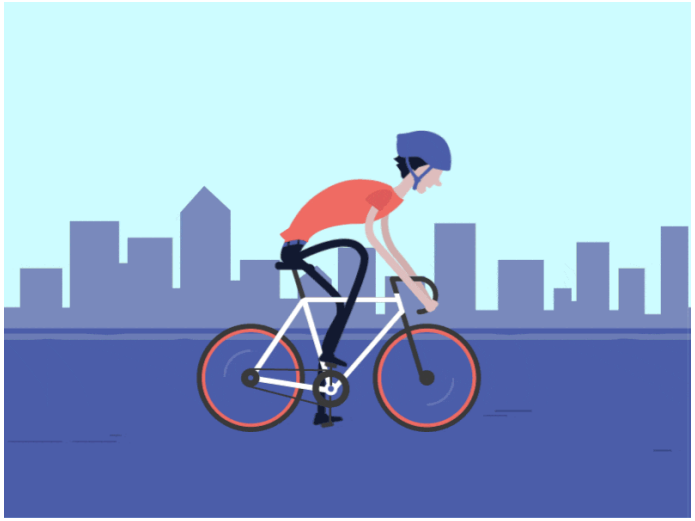
## Differences in cyclists and car drivers exposure to air pollution from traffic in the city of Copenhagen

Jette Rank[a,*], Jens Folke[b], Per Homann Jespersen[a]

### 5. Conclusion

On the basis of this study, we can conclude that cyclists in the city of Copenhagen are exposed to lower concentrations of traffic related pollutants than car drivers. Furthermore, we conclude that car drivers experience 3–4 times higher BTEX concentrations and approximately two times higher exposure of particles than bikers. The study also indicates that the air children breathe may be better on the back of a bicycle than inside a car.

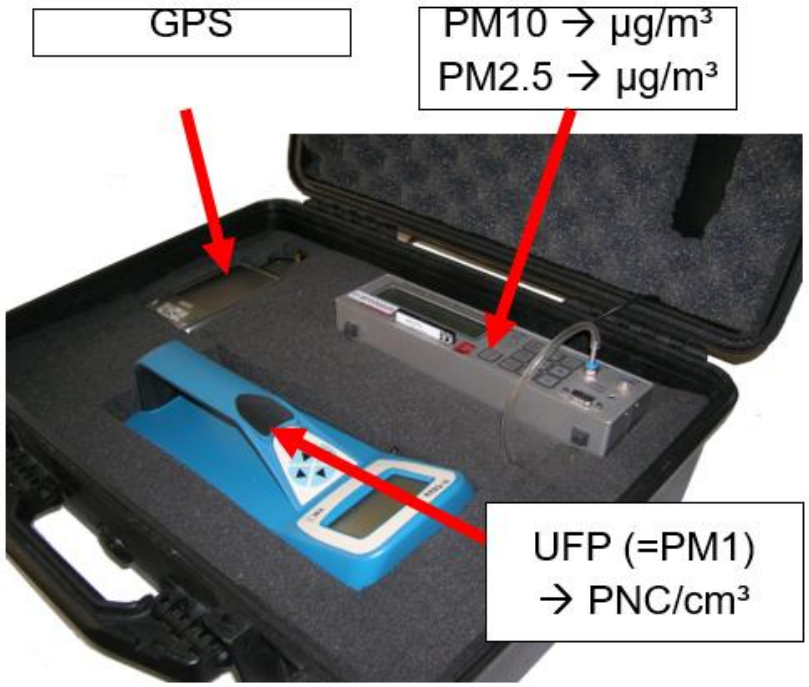
# What is forgotten?




➔ Exposure = human ventilation x air quality x distance traveled

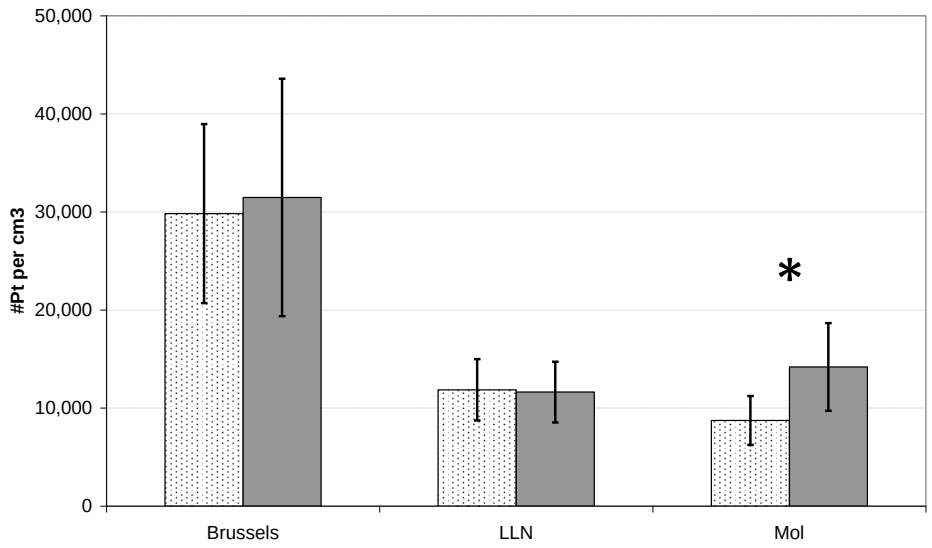
# Materials & Methodes

➔ Exposure = ventilation per distance x concentration x distance




# Results – Air pollution

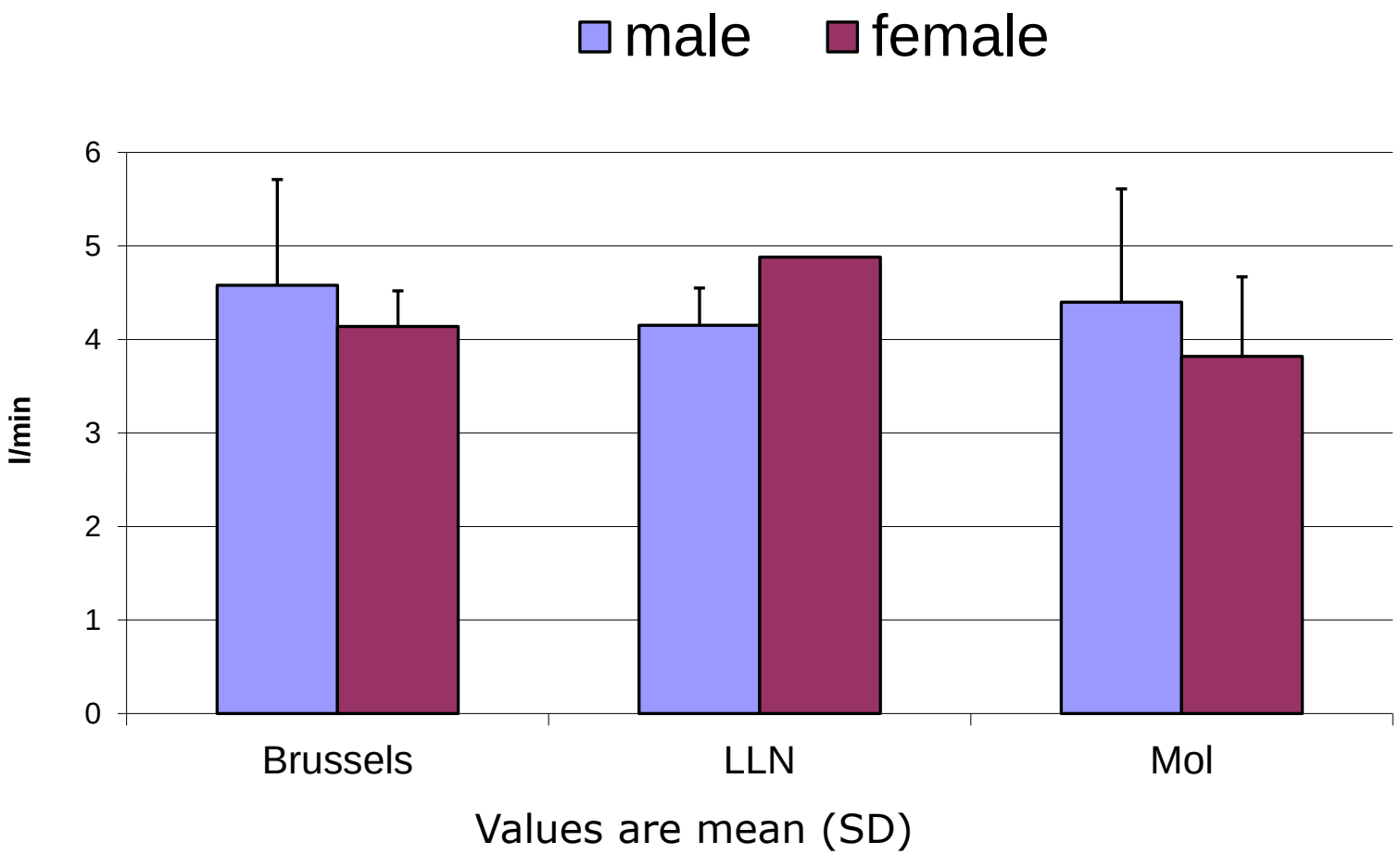
## UFP (PNC/cm³)



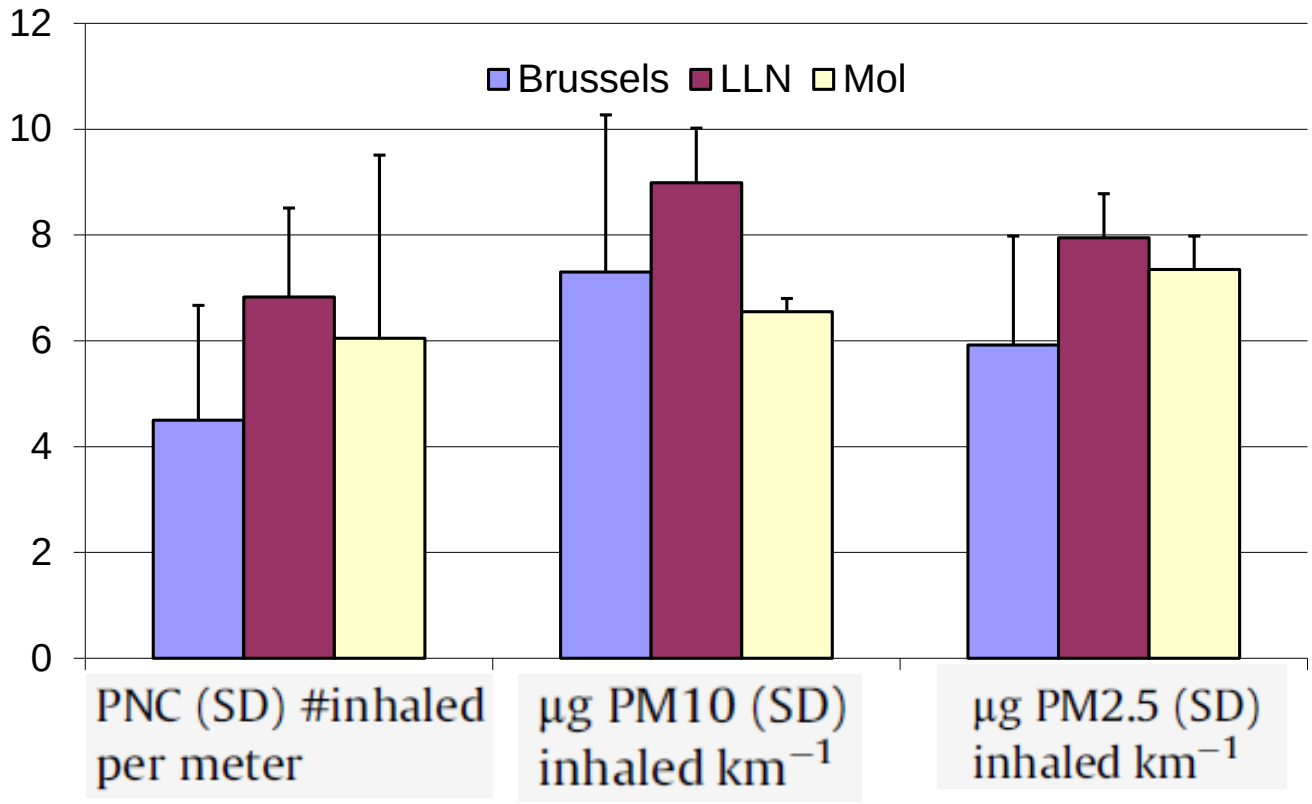

Values are mean (SD)

* Sign diff car vs bicycle

# Results: Minute Ventilation (VE): Bike/car ratio



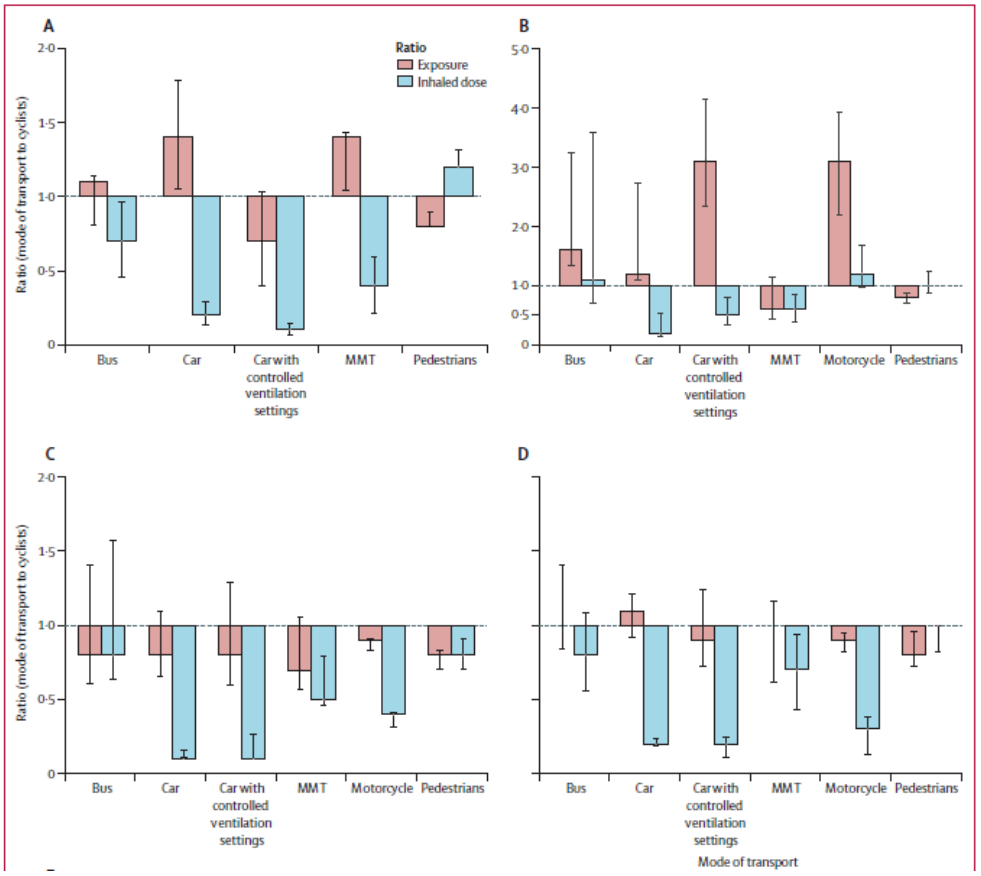
# Results: inhaled quantities: bike/car ratio



# Review Inhaled dose of Air Pollution

## Levels of ambient air pollution according to mode of transport: a systematic review

*Magda Cepeda, Josje Schoufour, Rosanne Freak-Poli, Chantal M Koolhaas, Klodian Dhana, Wichor M Bramer, Oscar H Franco*



# Inhaled dose: conventional *vs* e-cycle

*Results:* Mean respiratory ventilation was predicted based on sex (-7.78 L/min for women), cycle type (-17.61 L/min for EAC), height gain (+0.07 L/min) and speed (+1.30 L/min). Inhaled dose of pollutants both for BC dose/km and BC dose/min was primarily predicted by cycle type (-31.62% and -34.68% for EAC compared to CC, respectively). Results were similar for the other pollutants.



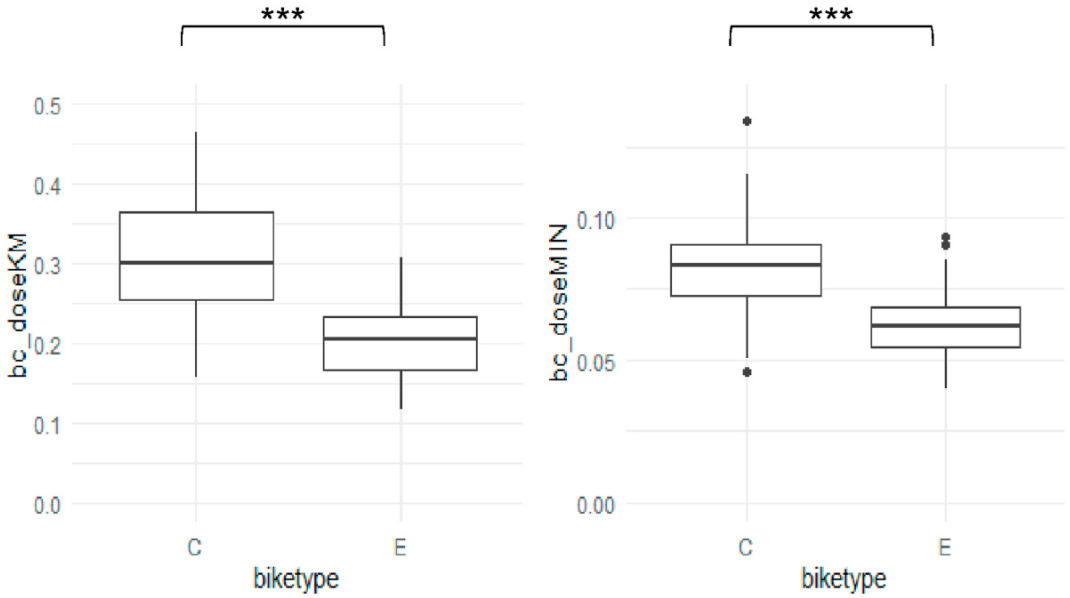
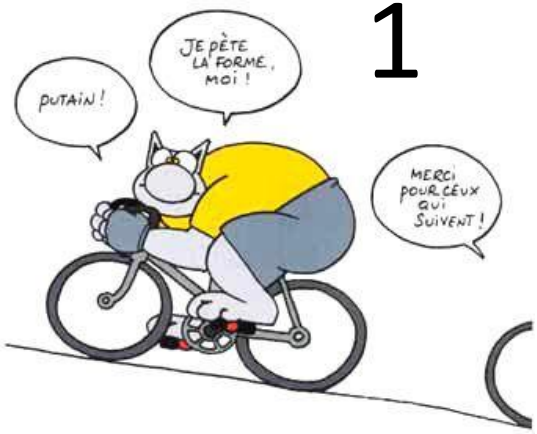



**Fig. 2.** Black carbon dose/km and dose/min by cycle type.
Represented are the median and the IQR (box), Q1 - 1.5* IQR and Q3 + 1.5*IQR (whiskers), and outliers (dots)Statistical significance: $p<0.001$
***Abbreviations: bc_doseKM = inhaled dose black carbon µg per km; bc_doseMIN = inhaled dose black carbon µg per min; C: conventional cycle, E: EAC.



Lathouwers et al., 2021

1


PUTAIN !
JE PÈTE LA FORME, MOI !
MERCI POUR CEUX QUI SUIVENT !

2

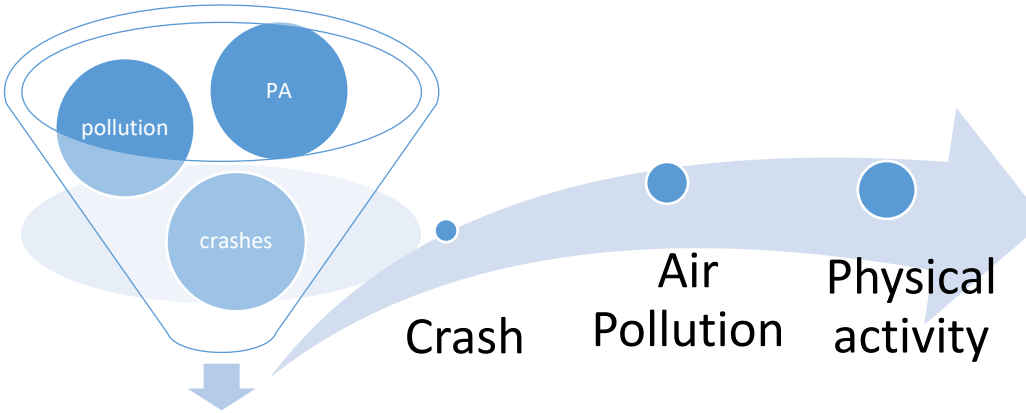

HEALTH

4

# 4. Cost-benefit analysis / Health Impact Assessment

UCLouvain
Faculté des sciences de la motricité

# Predictive models – population level




Car driver → conventional cyclist

Anno: 2025

Anno: 2065

# Net health benefit: 7 months

→500,000 car drivers make a transition from car to bicycle for short trips (7.5-15 km) on a daily basis in the Netherlands

| Stressor | Relative risk | Gain in life years[a] | Gain in life days/ months per person[a] |
|---|---|---|---|
| Air pollution | 1.001 to 1.053 | –1,106 to –55,163 (–28,135) | –0.8 to –40 days (–21 days) |
| Traffic accidents | 0.996 to 1.010[b] 0.993 to 1.020[b] | –6,422 to –12,856 (–9,639) | –5 to –9 days (–7 days) |
| Physical activity | 0.500 to 0.900 | 564,764 to 111,027 (337,896) | 14 to 3 months (8 months) |

CONCLUSIONS: On average, the estimated health benefits of cycling were substantially larger than the risks relative to car driving for individuals shifting their mode of transport.



de Hartog et al. (2010)

# Economic cost: health


Total benefits, external costs and cost:benefit analysis over 20 years for Antwerp–Mechelen bicycle highway (scenario 1[a])

| Impact factor | euro |
|---|---|
| Physical activity (reduced mortality) | $1.2 \times 10^7$ |
| Physical activity (reduced morbidity) | $2.3 \times 10^6$ |
| Reduced air pollution society (mortality) | $7.4 \times 10^4$ |
| Air pollution active mobility | $-8.9 \times 10^5$ |
| Crash risk | $-1.4 \times 10^6$ |
| **Total** | $\mathbf{+1.2 \times 10^7}$ |
| Infrastructure construction costs | $-6.0 \times 10^6$ |
| **Benefit:cost ratio** | **2.0** |



Buekers et al. (2018)

# HIA of active transportation (walking & conv. cycling): A systematic review

Preventive Medicine 76 (2015) 103–114

Contents lists available at ScienceDirect

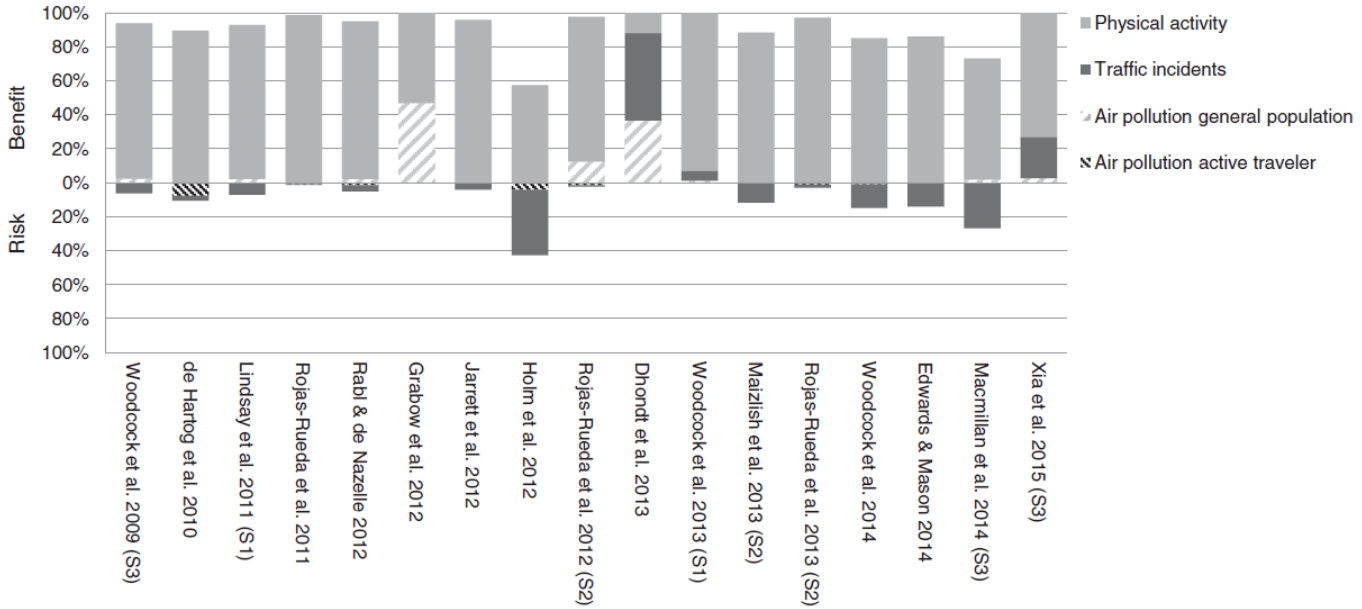
Preventive Medicine

journal homepage: www.elsevier.com/locate/ypmed

Review

Health impact assessment of active transportation: A systematic review

Natalie Mueller [a,b,c,*], David Rojas-Rueda [a,b,c], Tom Cole-Hunter [a,b,c], Audrey de Nazelle [d], Evi Dons [e,f], Regine Gerike [g], Thomas Götschi [h], Luc Int Panis [e,i], Sonja Kahlmeier [h], Mark Nieuwenhuijsen [a,b,c]




Mueller et al. (2015)

# HIA & London conv. cycle sharing system

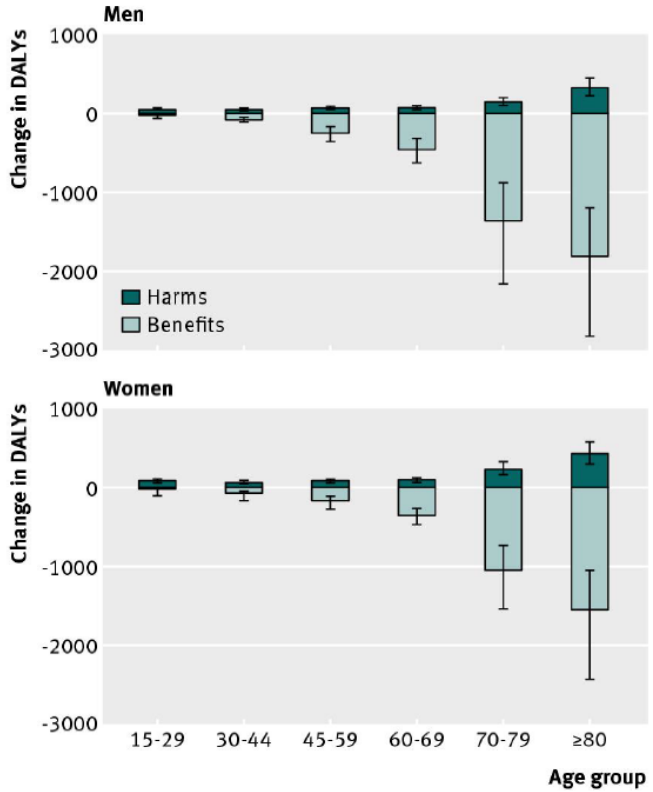
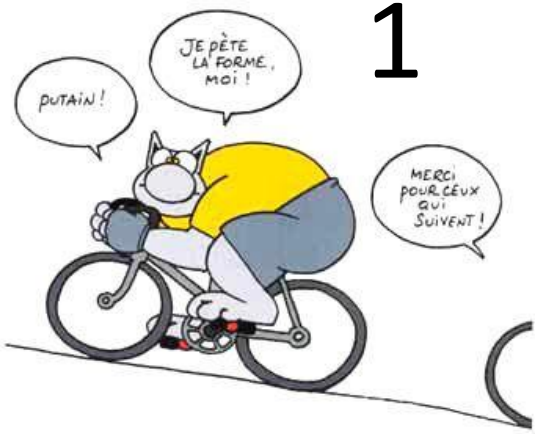



**Fig 2** Trade-off of benefits to harms for cycling in central London: effects by age and sex, per million population (although few older people used cycle hire). Benefits come through impacts on diseases related to physical activity, harms come from exposure to road traffic injuries (see table 28 in appendix 4). Results use background injury rates and so should be interpreted as the trade-off for cycling in general in the cycle hire zone and not for specifically using cycle hire bicycles (which may carry lower risks of injury)



Woodcock et al. (2014)

1

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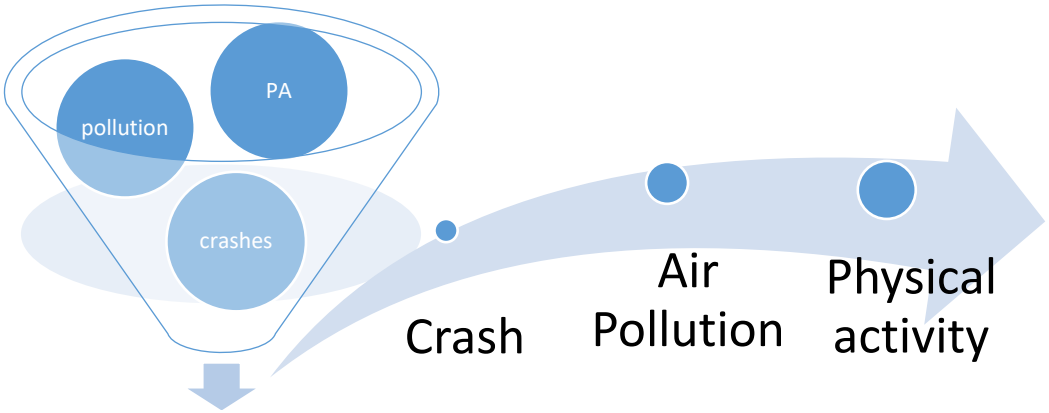
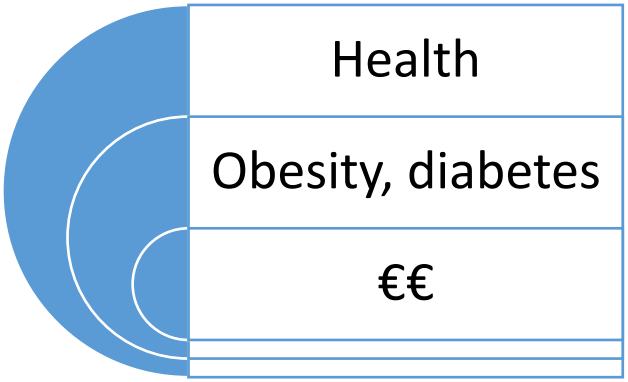
# Predictive models – population level




Car driver → **electric** cyclist

Anno: 2025

Anno: 2065

# Cost-benefit – Conventional vs EAC

Case Studies on Transport Policy 9 (2021) 608–615

Contents lists available at ScienceDirect

Case Studies on Transport Policy

journal homepage: www.elsevier.com/locate/cstp


Cost-benefit of bicycle infrastructure with e-bikes and cycle superhighways

Jeppe Rich [a,*], Anders Fjendbo Jensen [a], Ninette Pilegaard [a], Martin Hallberg [b]

It is found that larger shares of e-bikes implies lower benefits as these bikes provide lower health benefits and larger accident costs. These costs exceeds the higher surplus from travel time savings.

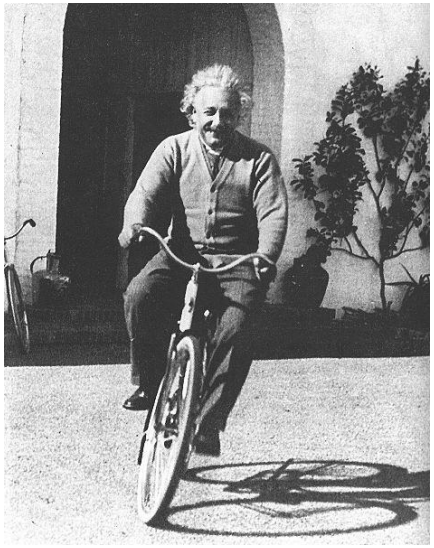
# Future recherche : participez !


https://surveys.uclouvain.be/index.php/714681?lang=fr


https://surveys.uclouvain.be/index.php/477793?lang=fr


https://s.sonar.mensura.be/surveys/?e=393791&s=0&c=0&v=false&h=975D5FD5213CB72&d=l&l=en

# THANK YOU FOR YOUR ATTENTION

prof dr Bas de Geus
Université catholique de Louvain
Institut de recherche : IACCHOS
Place Pierre de Coubertin, 1 bte L8.10.01
1348 Louvain-la-Neuve
[T] +32 (0)10 47 44 24
[E] bas.de.geus@uclouvain.be

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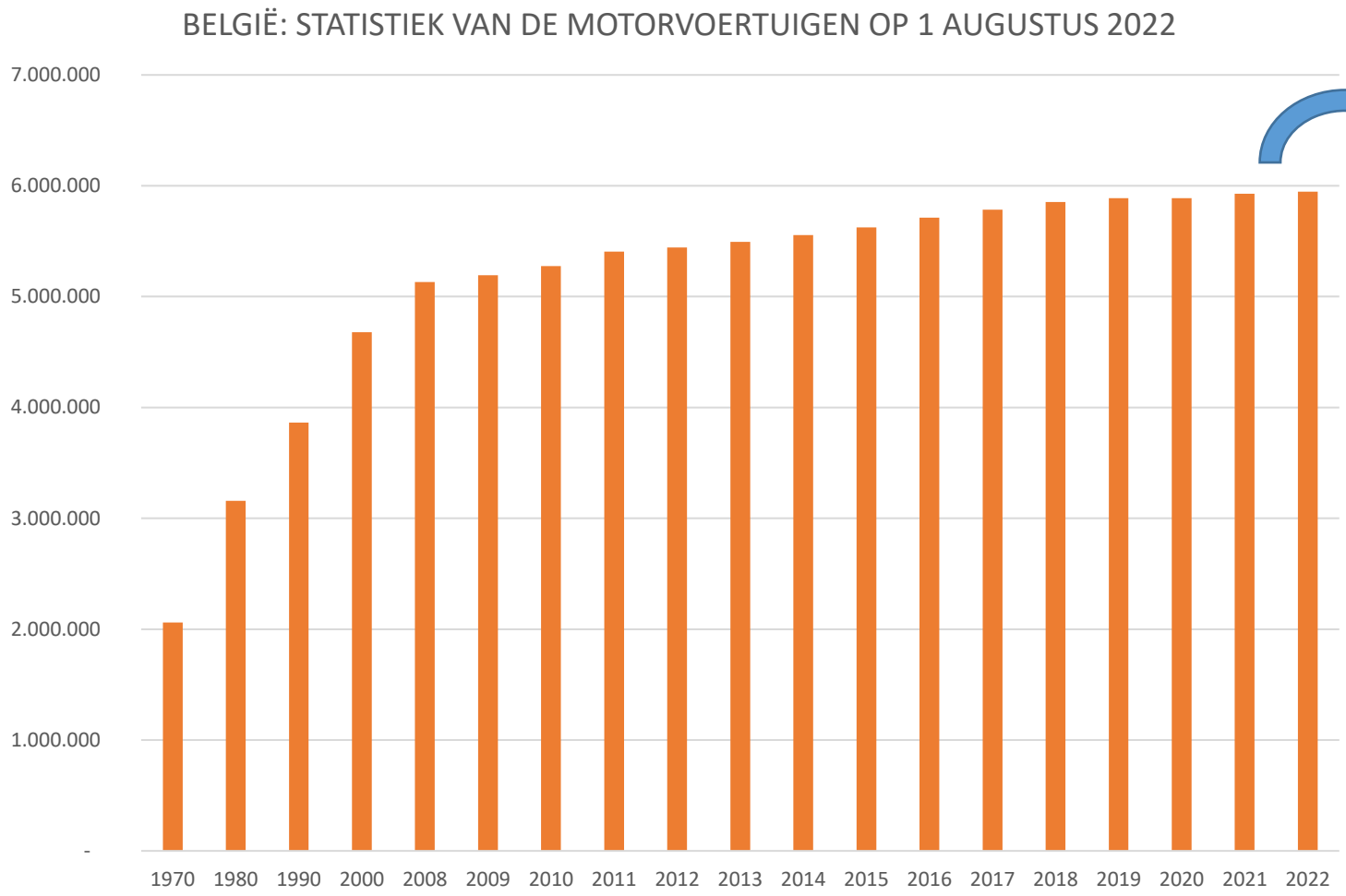
# Vehicle fleet




Cars in BCR:
2020: 492,459
2022: 488,717

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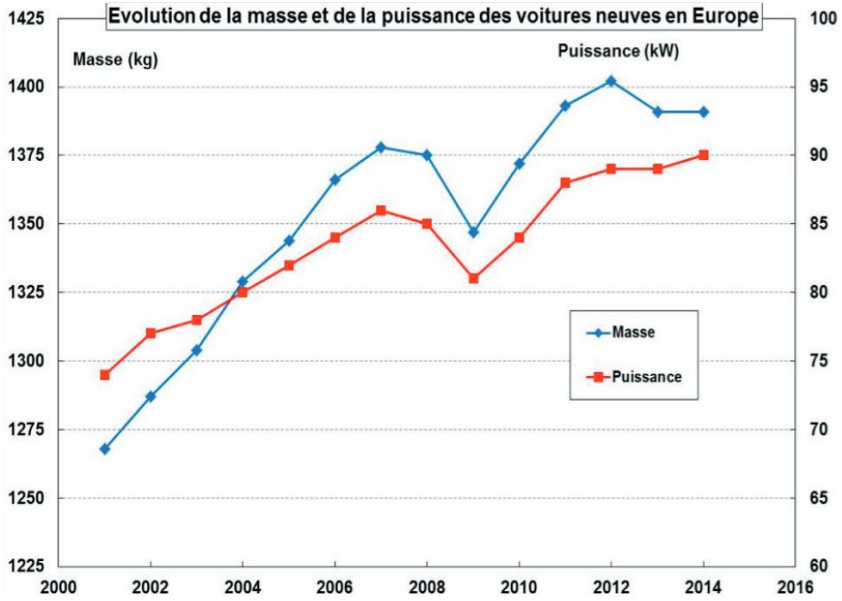
Source: StatBel

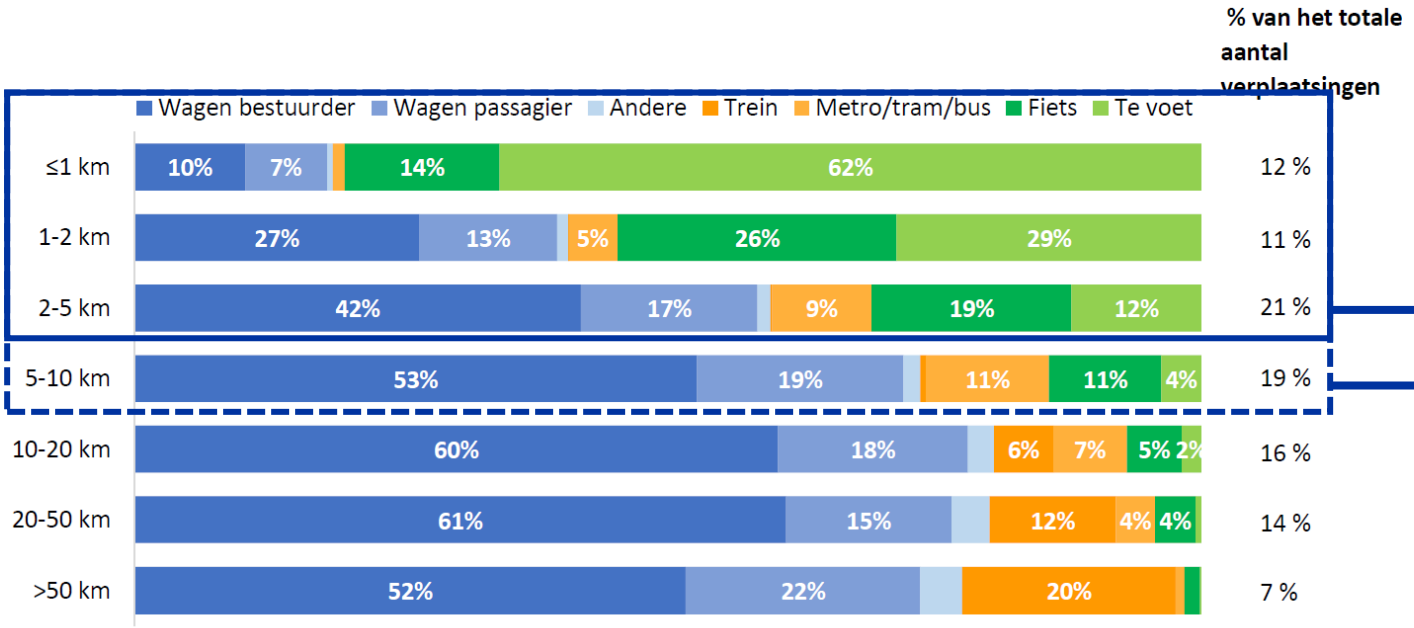
# Vehicle fleet




# Societal Challenges – Sustainabe cities

# Societal Challenges – Sustainable cities

# Trips that could be replaced by cycling?



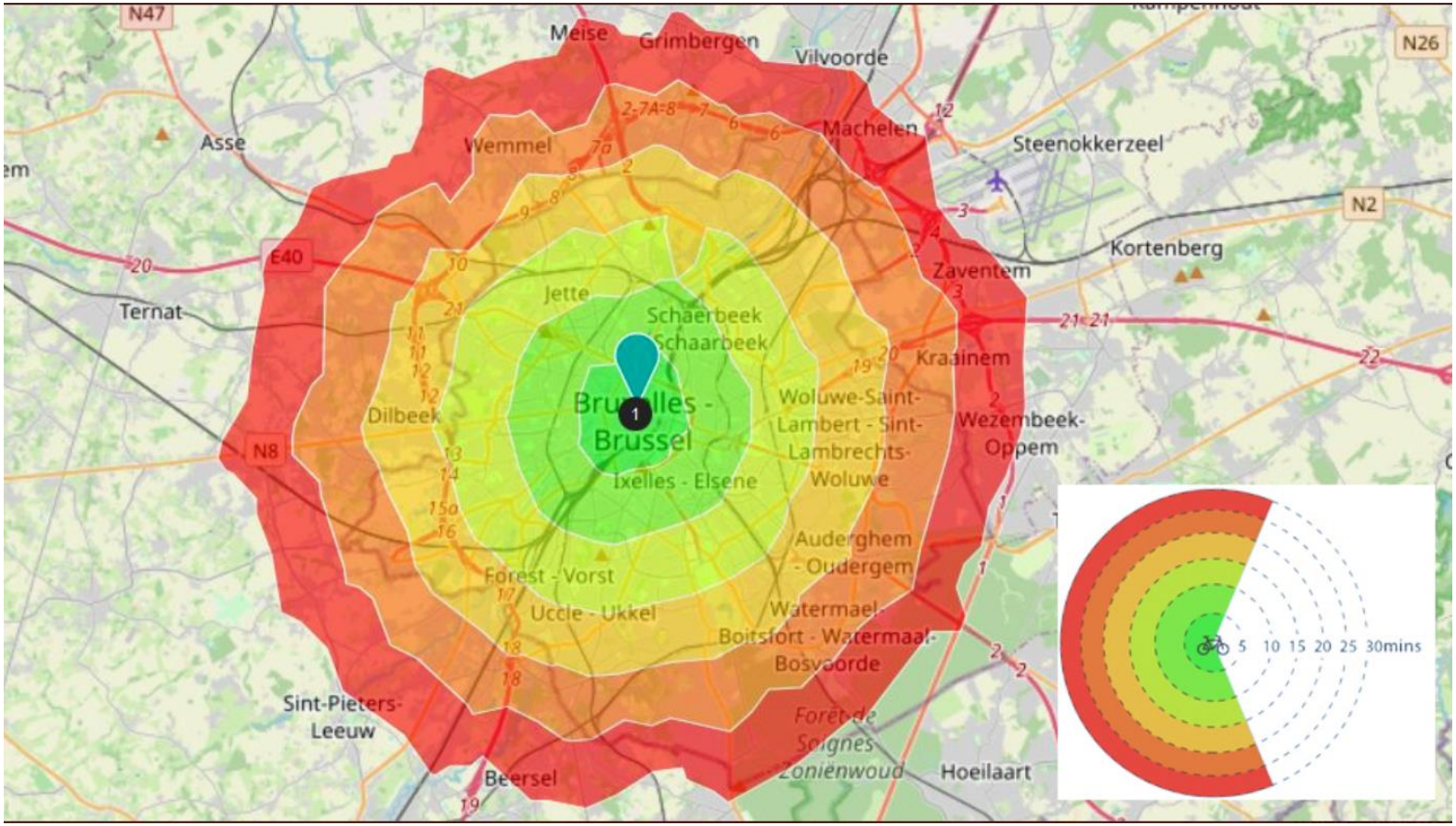

**Grafiek 25 - Modale aandelen naargelang de afstand van de trajecten (in aantal verplaatsingen)** (Basis: 25.168 trajecten)

Cycling @ 15 km/h
conventional bike

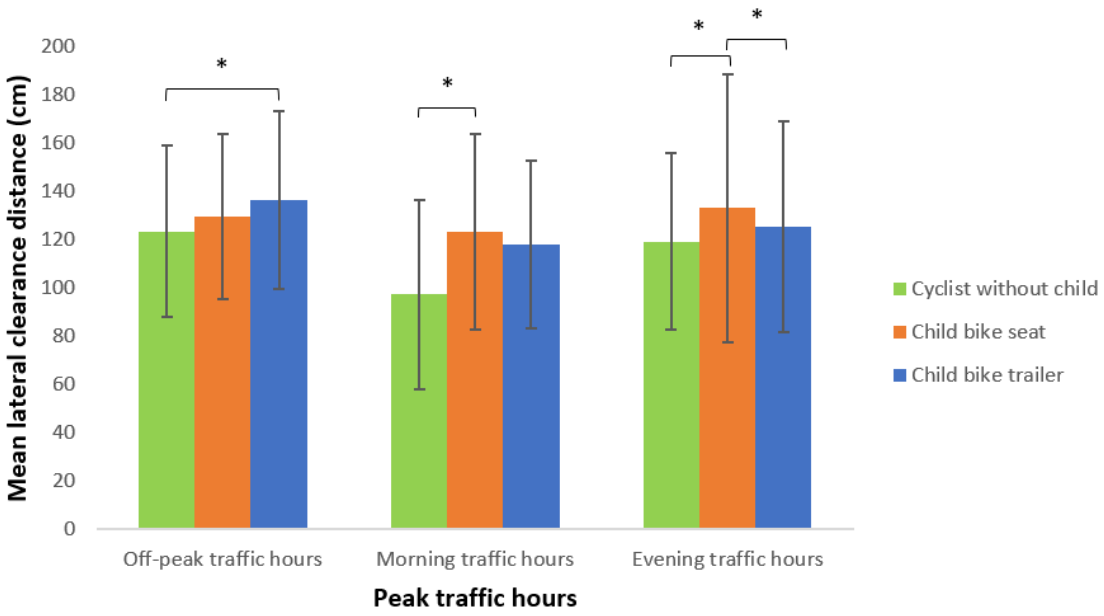
5 km → 20 min

10 km → 40 min

# How far can I reach by cycle ?



# Lateral clearing distance



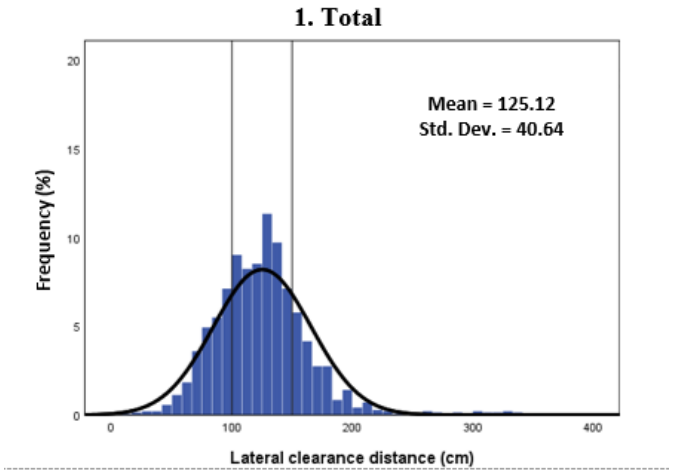




**Fig. 9** Mean lateral clearance distance (cm) as a function of the combination of peak traffic hours and cycling condition. Bars indicate standard deviations of the mean. * = *significant ($p \leq 0.05$)*

**Fig. 1** Child bike seat

**Fig. 2** Child bike trailer


**Fig. 3** The different cycling infrastructure types on the road used for the cycling trips



Ampe et al., 2020