UTILITARIAN (E)CYCLING & HEALTH

CEMA MANAGER VELO

27 september 2023

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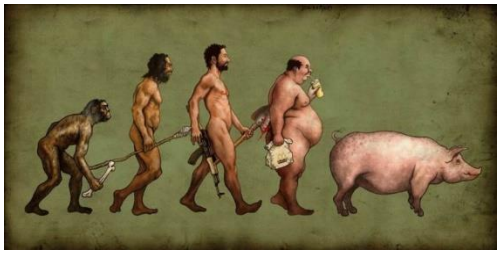
Faculté des sciences de la motricité

Societal Challenges (in large cities)

- Health (care)

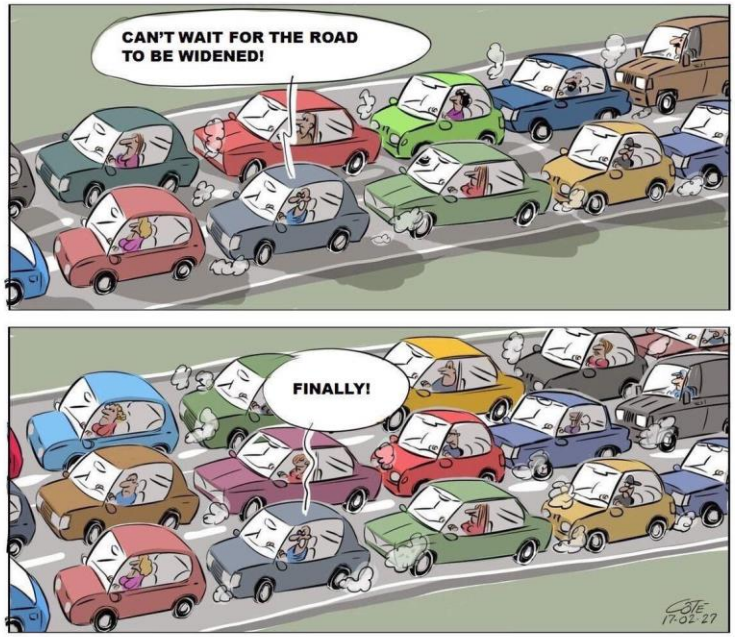


- Mobility – Public space

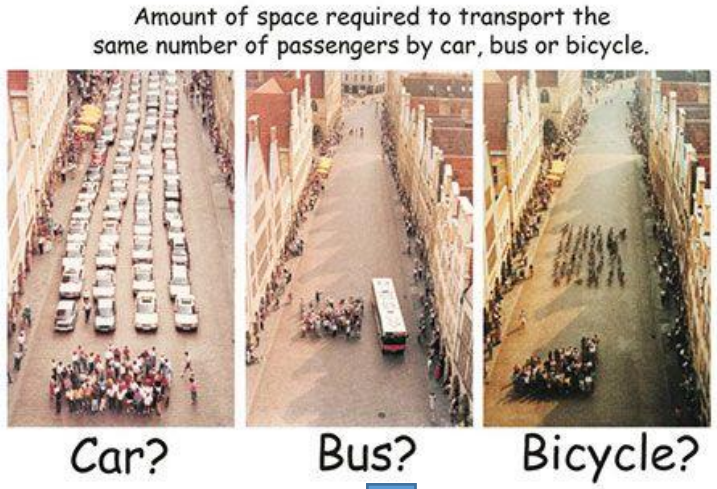
- Air & Noise pollution

- Climate change / fossil fuels

Societal Challenges - Sustainability



(Anupriya et al, 2023)



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

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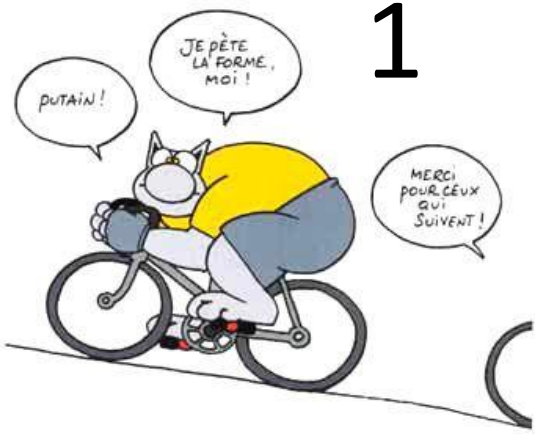
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Is (utilitarian) Cycling good for Health?

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

BMJ Open

The association of cycling with all-cause, cardiovascular and cancer mortality: findings from the population-based EPIC-Norfolk cohort

Conclusions: Cycling, in particular for utility purposes, was associated with greater moderate-to-vigorous and total physical activity. While this study provides tentative evidence that modest levels of cycling may reduce the risk of mortality, further research is required to confirm how much cycling is sufficient to induce health benefits.

Nevertheless, cycling provides an opportunity to incorporate frequent physical activity into activities of daily living, and when done as a means to get from place to place, it may also provide substantial environmental and economic benefits to society.

Sahlqvist S, Goodman A, Simmons RK, *et al. BMJ Open* 2013;**3**:e003797. doi:10.1136/bmjopen-2013-003797

Cycling & Type 2 diabetes

JAMA Internal Medicine | Original Investigation

Association of Cycling With All-Cause and Cardiovascular Disease Mortality Among Persons With Diabetes

The European Prospective Investigation Into Cancer and Nutrition (EPIC) Study

CONCLUSION AND RELEVANCE In this cohort study, cycling was associated with lower all-cause and CVD mortality risk among people with diabetes independent of practicing other types of physical activity. Participants who took up cycling between the baseline and second examination had a considerably lower risk of both all-cause and CVD mortality compared with consistent noncyclists.

JAMA Intern Med. 2021;181(9):1196-1205. doi:10.1001/jamainternmed.2021.3836
Published online July 19, 2021.

Cycling & (Over)Weight

ELSEVIER

Available online at www.sciencedirect.com
ScienceDirect
Preventive Medicine 46 (2008) 29–32

Preventive Medicine
www.elsevier.com/locate/ypmed

Inverse associations between cycling to work, public transport, and overweight and obesity: Findings from a population based study in Australia

Li Ming Wen *, Chris Rissel

Results. Men who cycled to work were significantly less likely to be overweight and obese (39.8%) compared with those driving to work (60.8%), with an adjusted odds ratio of 0.49 (95% CI: 0.31–0.76) and much less likely to be obese (5.4%) with an adjusted odds ratio 0.34 (95% CI: 0.13–0.87). Men who used public transport to work were also significantly less likely to be overweight and obese (44.6%) with an adjusted odds ratio of 0.65 (95% CI: 0.53–0.81). However, these inverse relationships were not found in women.

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

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.

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

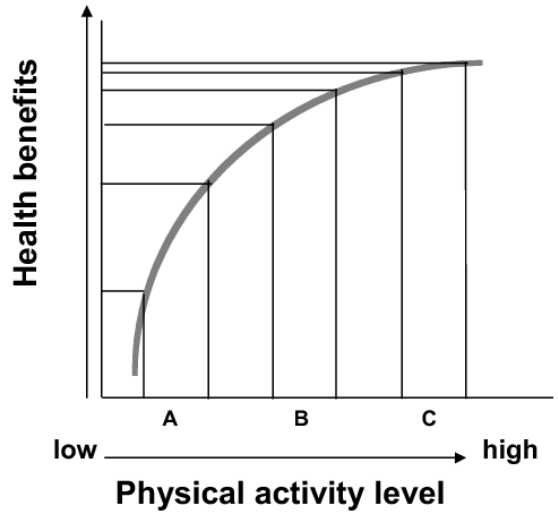
Cycling to work: influence on indexes of health in untrained men and women in Flanders. Coronary heart disease and quality of life

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



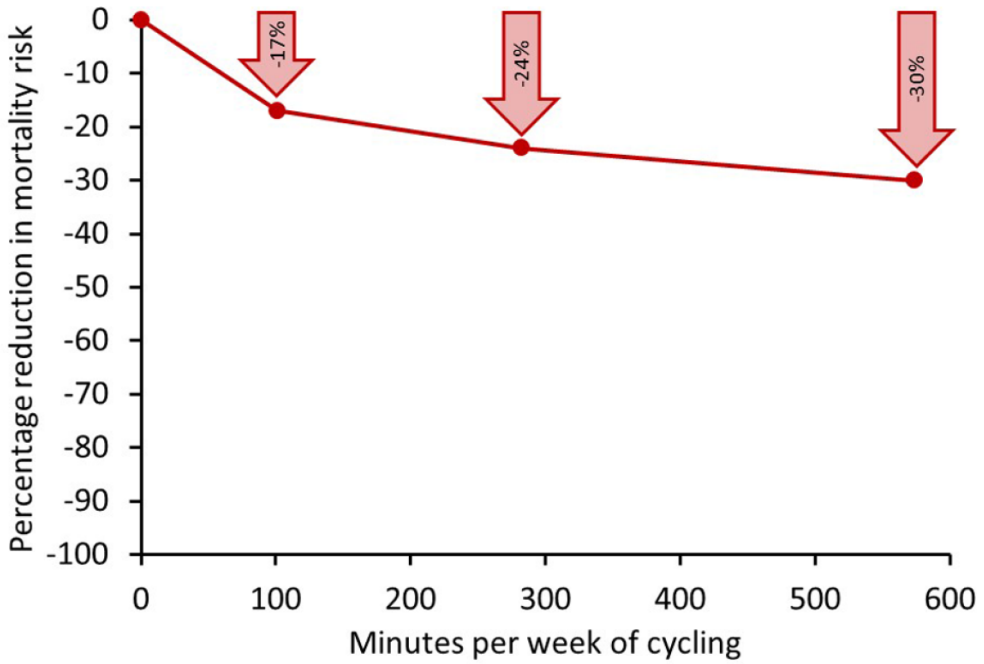
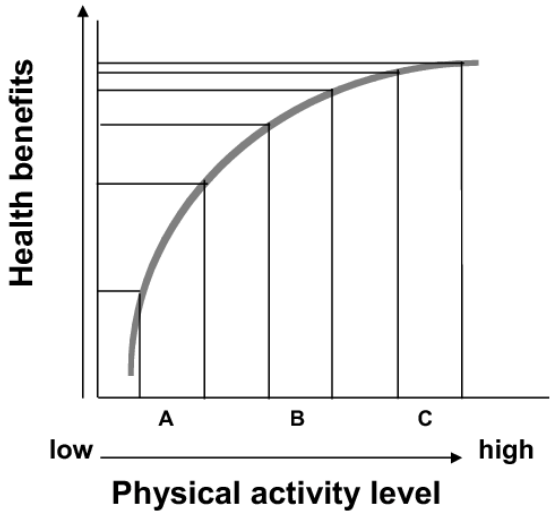


FIGURE 1
Relative reduction in risk of mortality associated with different weekly volumes of cycling compared with undertaking no regular cycling for a meta-analysis of seven large-scale population studies. Data in individual studies adjusted for a range of confounding factors including age, sex, smoking, other non-cycling physical activity, socio-economic status, and aspects of health status. Points on graph at 100, 280 and 570 min per week represent the mid-points of ranges of 10–210, 210–350, and 350–800 min per week, respectively. Modified from (3).

Kelly et al., 2014

E-cycling & Health benefits

e-cycling ⟷ health benefits ??



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

E-cycling Intensity

- WHO guidelines: health effect → 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

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 Review – Health benefits of (e-)cycling

Review

Health benefits of cycling: a systematic review

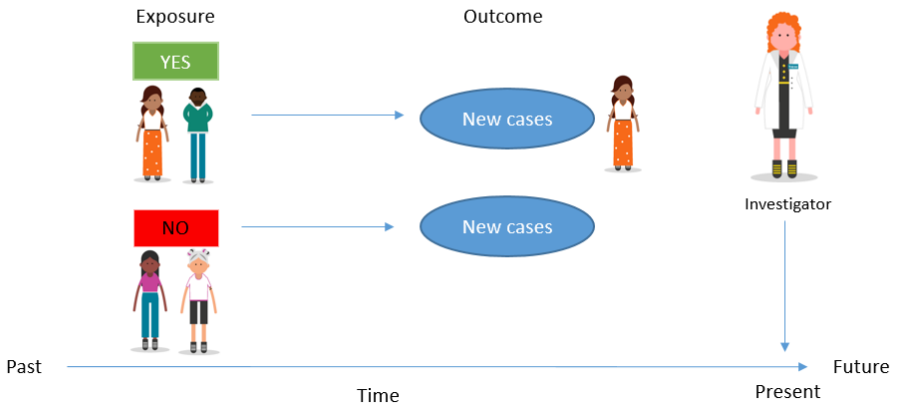
P. Oja[1], S. Titze[2], A. Bauman[3], B. de Geus[4], P. Krenn[2], B. Reger-Nash[5], T. Kohlberger[2]

REVIEW Open Access

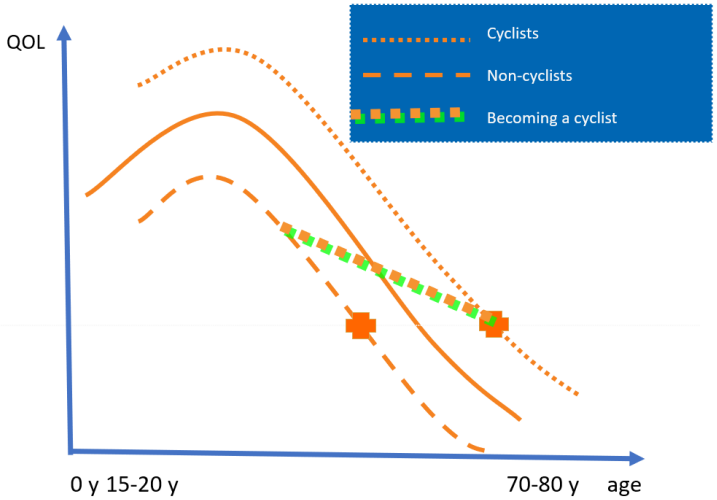
Health benefits of electrically-assisted cycling: a systematic review

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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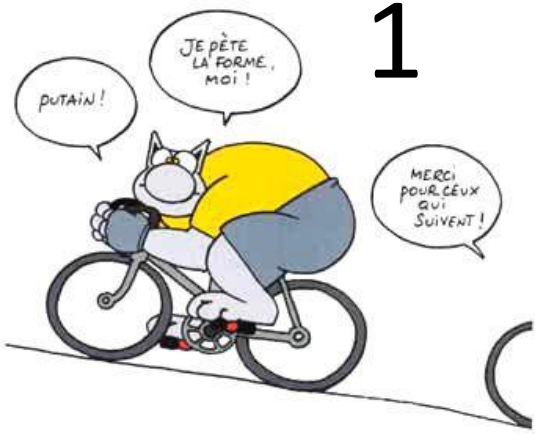
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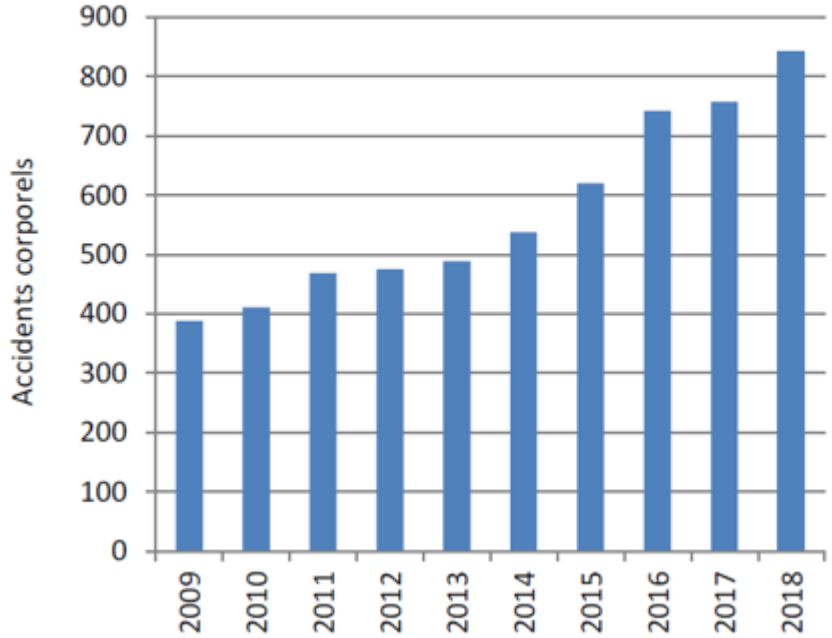
2. (e-)cycle crashes

Absolute number of cycle accidents with corporal damage in BCR

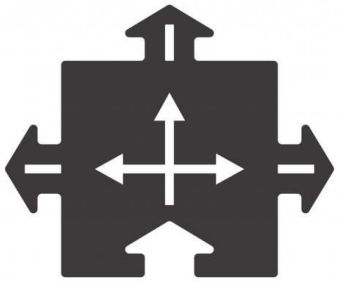
Evolution du nombre absolu d'accidents corporels impliquant un cycliste en Région de Bruxelles-Capitale entre 2009 et 2018

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

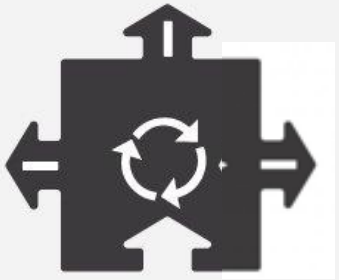


Bicycle crashes - Exposure

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

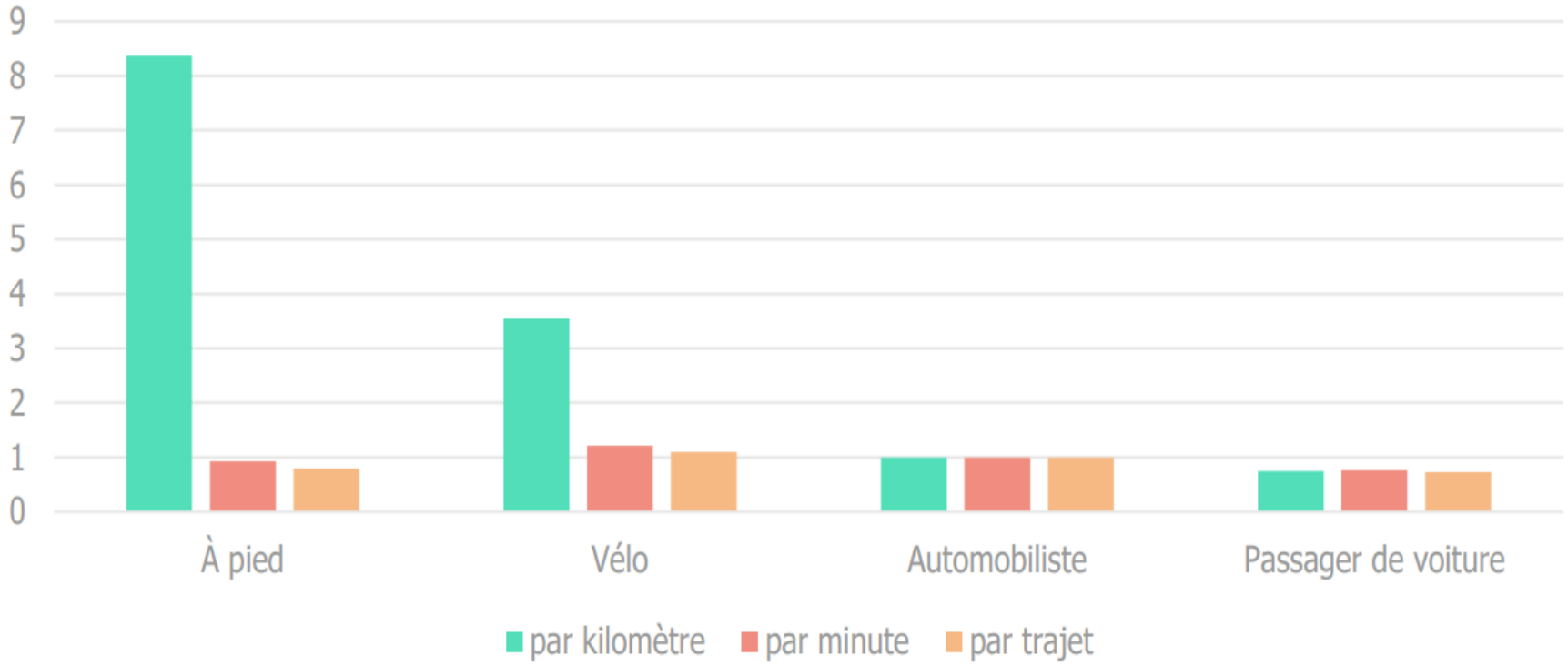


Incidence: 10 crashes / year
Exposure: 1,000 trips / year
Incidence rate: 0.01 crashes / year



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

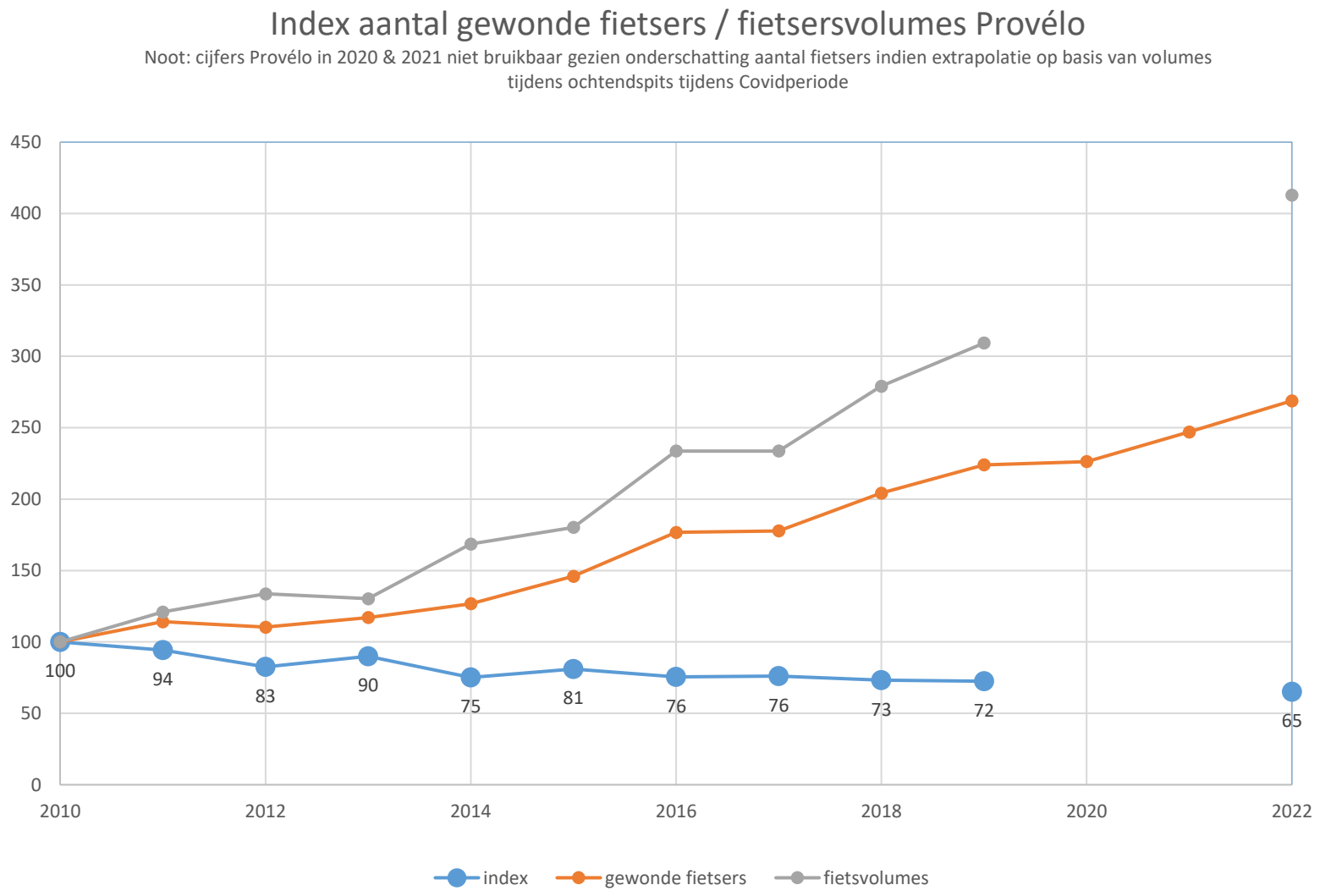
Table 1
Incidence, exposure and incidence rate per region.

	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,

Single-bicycle crashes in Europe

REVIEW

- International literature review identified figures (largely from Western countries) on SBC victims who were fatally injured, hospitalised or treated in an emergency department.
- Resultats:
- 17% (5-30%) of fatal crashes are the result of a SBCs
- 60% - 95% of cyclists in hospitals come from SBCs

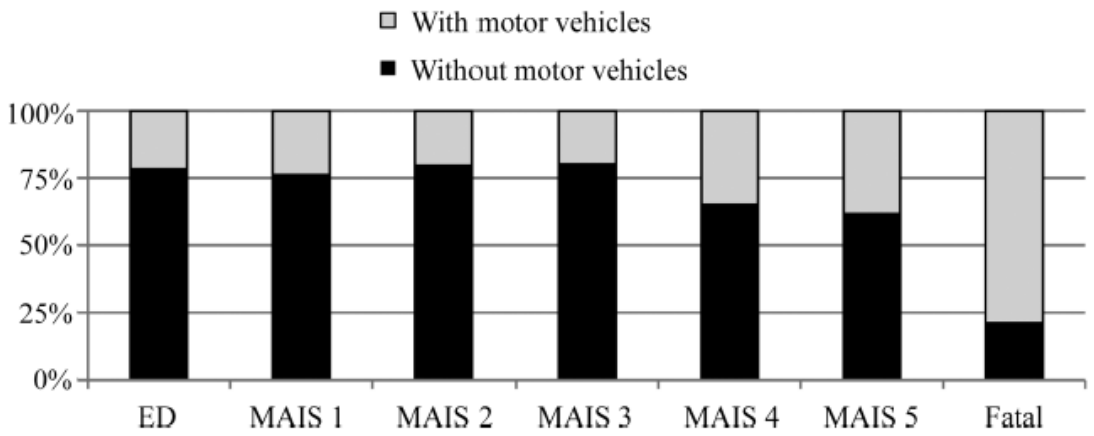


Figure 1 Distribution of injuries incurred by cyclists in crashes with and without motor vehicles in the Netherlands (ED, emergency department).[22–24]

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Single-bicycle crashes in Europe

REVIEW

- RESULTS:
- The proportion of cycling fatalities and hospitalisations due to SBC does not appear to be related to bicycle mode share, but an increasing bicycle mode share is associated with a reduction in the proportion of all traffic accidents due to single-vehicle crashes.

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
  - Cycling more
  - Region of residence (BCR > Flanders)

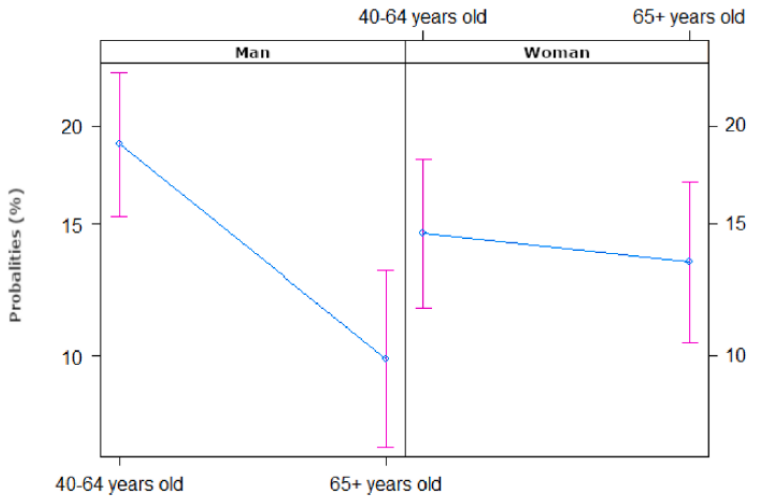

Fig. 1. Probabilities of reporting a crash between age categories in men and women.

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

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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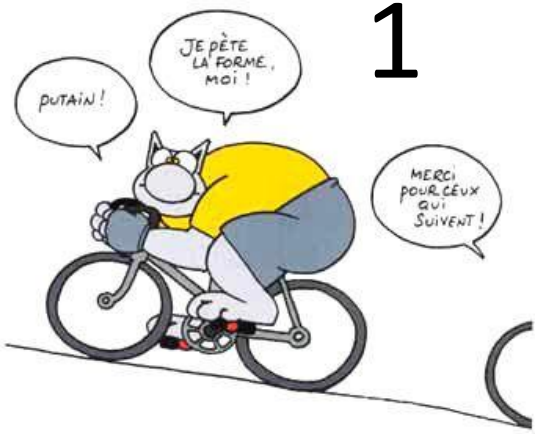
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3. Air Pollution & (e)cycling

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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

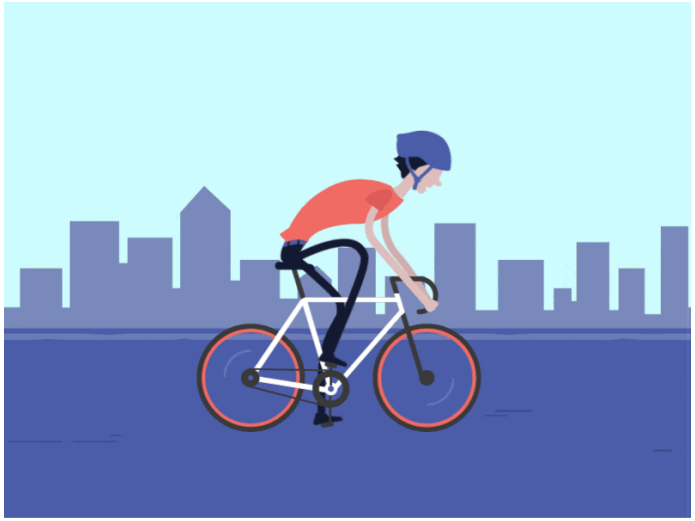
Differences in cyclists and car drivers exposure to air pollution from traffic in the city of Copenhagen

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.

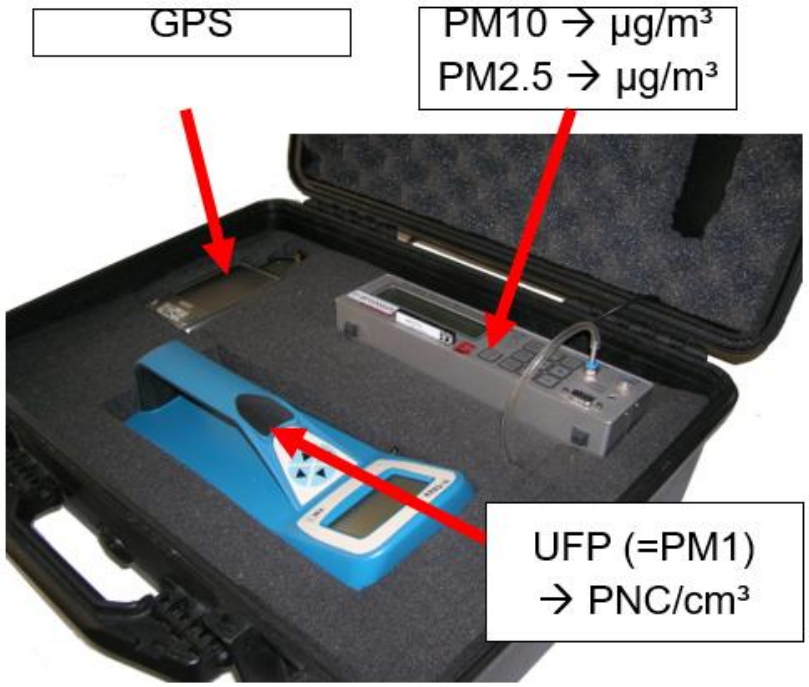
What is forgotten?



➔ Exposure = ventilation x concentration x distance

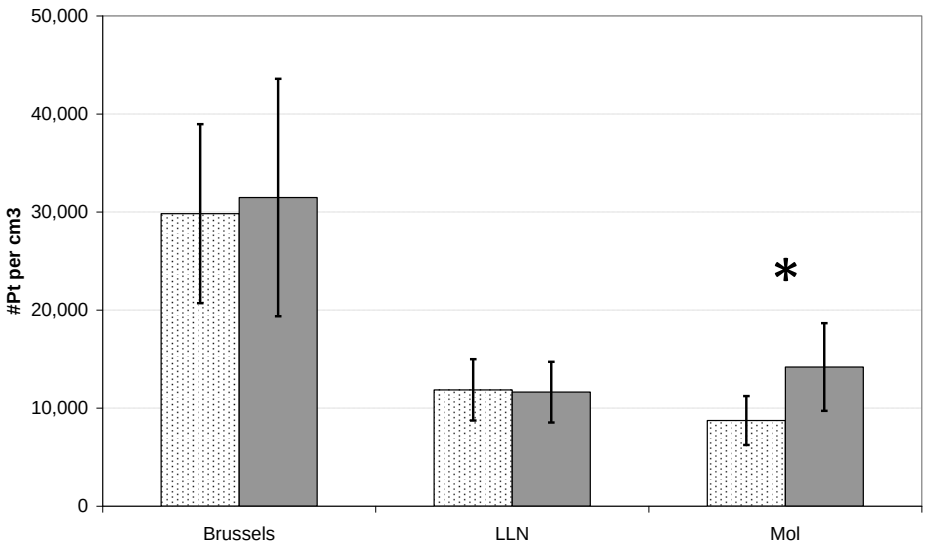
Materials & Methodes

➔ Exposure = ventilation per distance x concentration x distance



Results – Air pollution

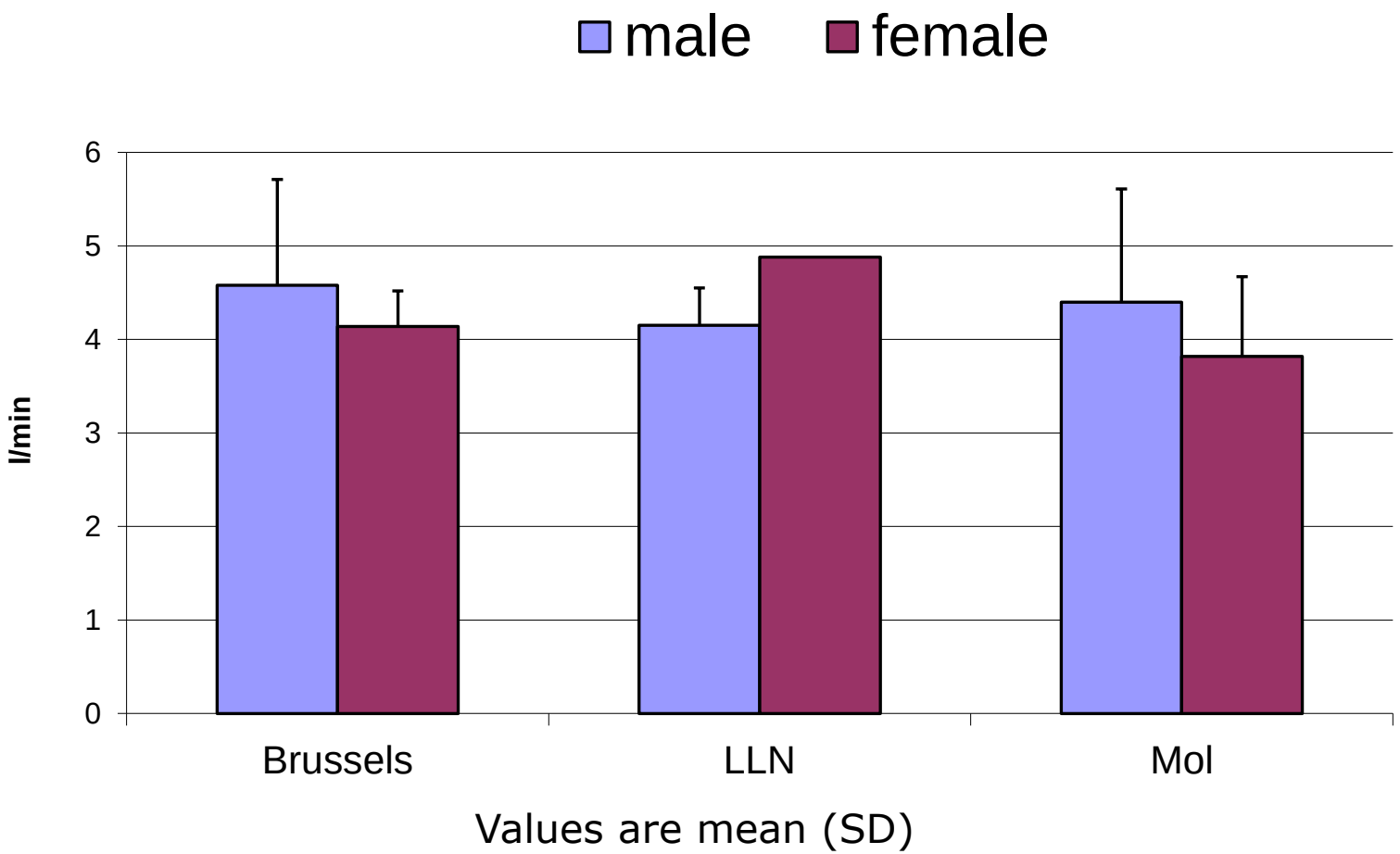
UFP (PNC/cm³)



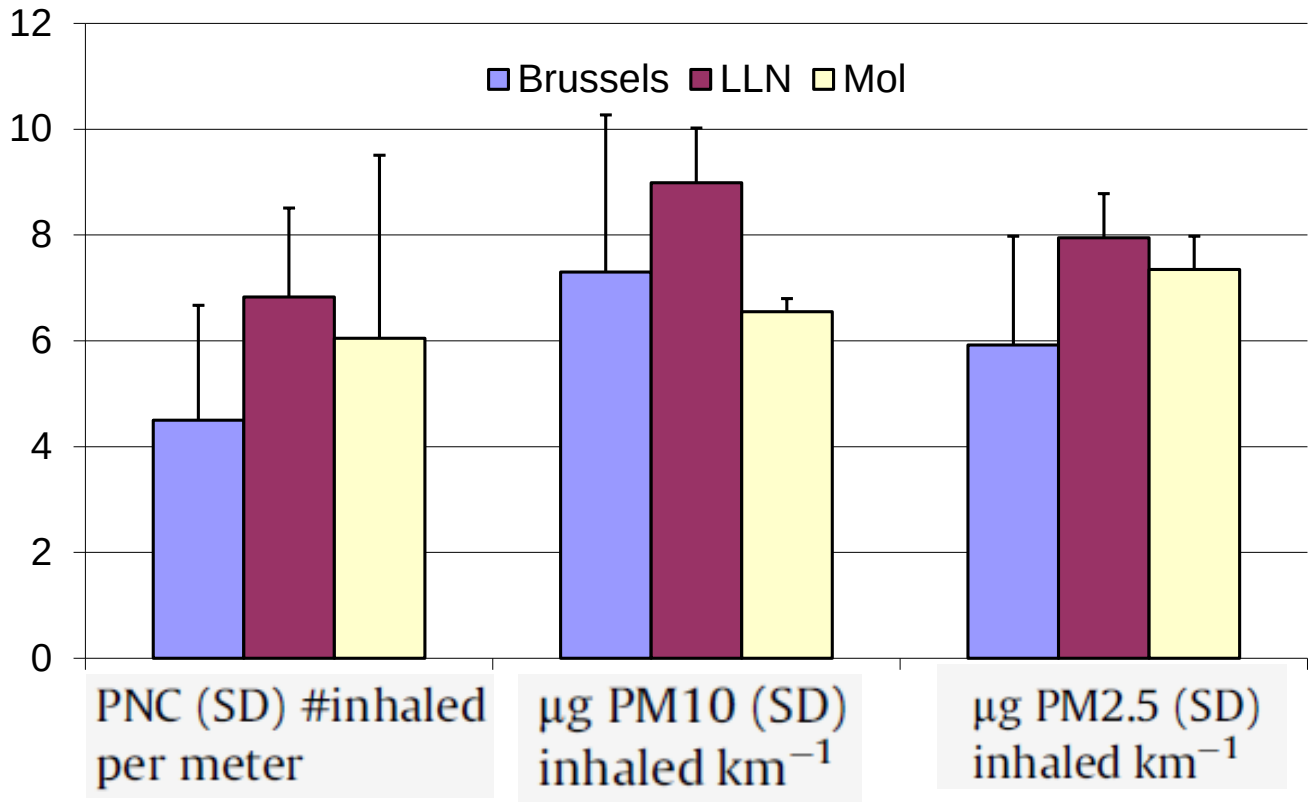
Values are mean (SD)

* Sign diff car vs bicycle

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



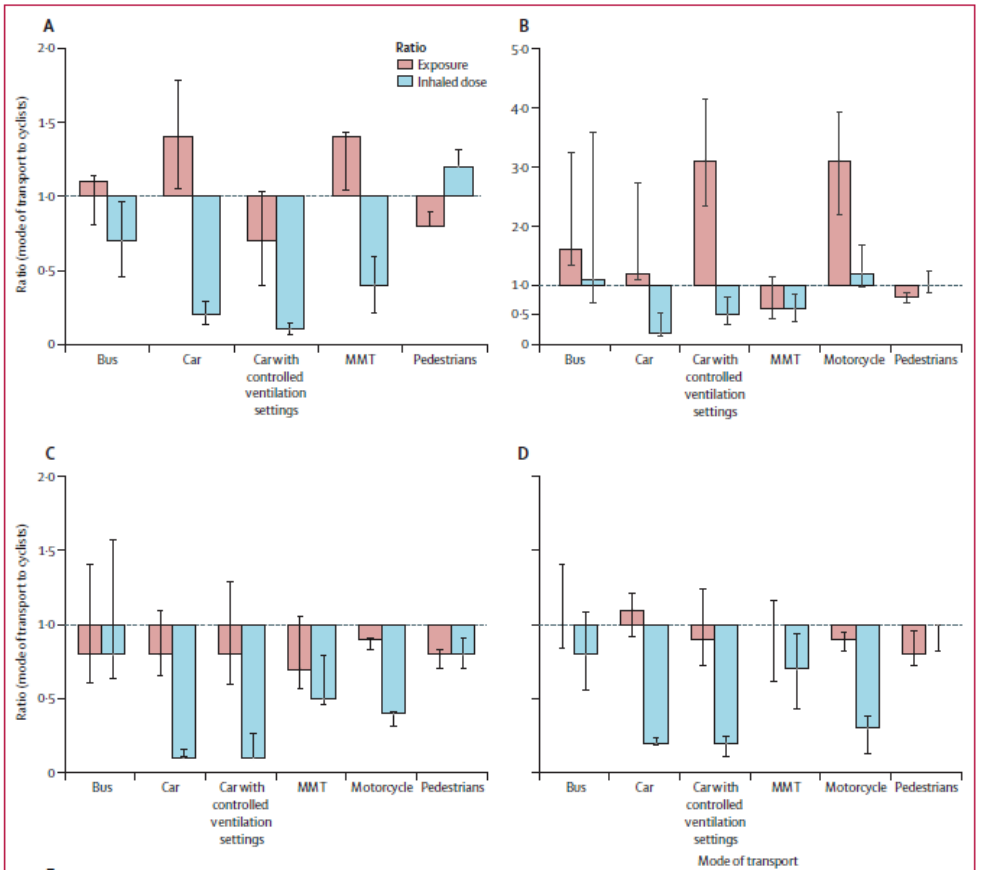
Results: inhaled quantities: bike/car ratio



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.

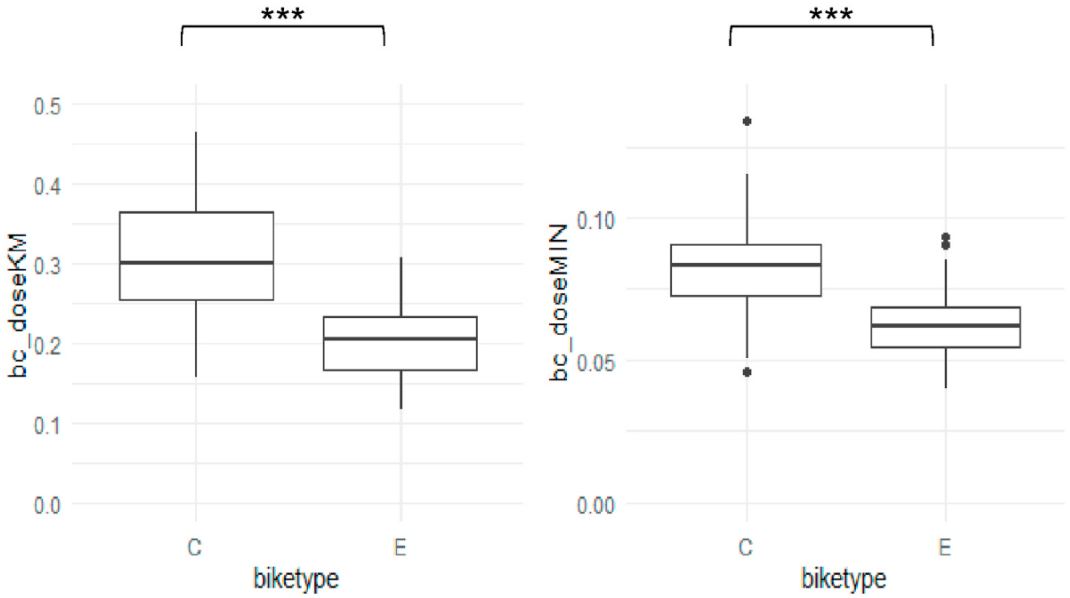


Fig. 2. Black carbon dose/km and dose/min by cycle type.
Represented are the median and the IQR (box), Q1 - 1.5* IQR and Q3 + 1.5*IQR (whiskers), and outliers (dots)Statistical significance: $p<0.001$
***Abbreviations: bc_doseKM = inhaled dose black carbon µg per km; bc_doseMIN = inhaled dose black carbon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

Lathouwers et al., 2021

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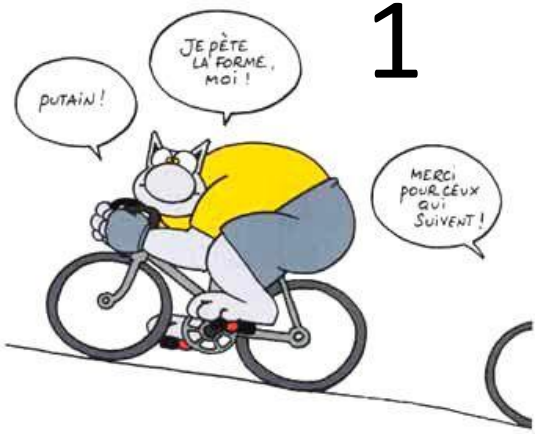

PUTAIN !
JE PÈTE LA FORME, MOI !
MERCI POUR CEUX QUI SUIVENT !

2

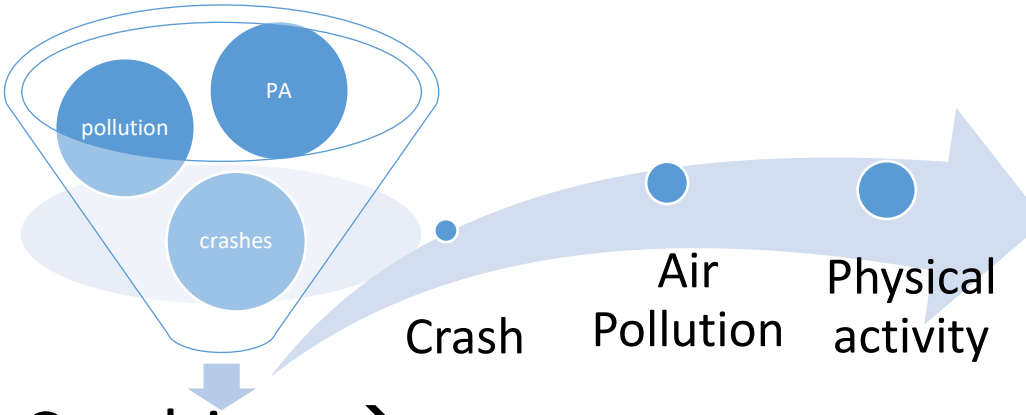

HEALTH

4

4. Cost-benefit analysis / Health Impact Assessment

UCLouvain
Faculté des sciences de la motricité

Predictive models – population level



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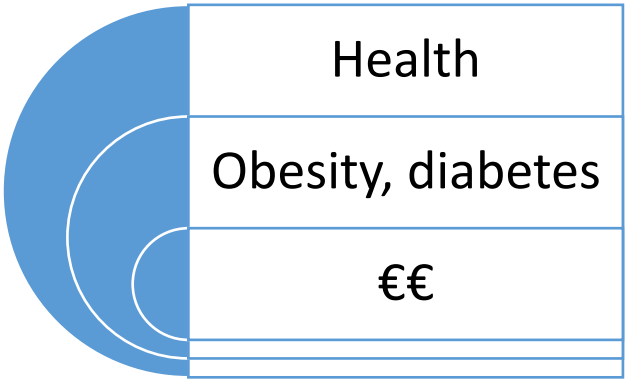


Car driver → conventional cyclist

Anno: 2022

Anno: 2062

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)	1.2×10^7
Physical activity (reduced morbidity)	2.3×10^6
Reduced air pollution society (mortality)	7.4×10^4
Air pollution active mobility	-8.9×10^5
Crash risk	-1.4×10^6
Total	$\mathbf{+1.2 \times 10^7}$
Infrastructure construction costs	-6.0×10^6
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

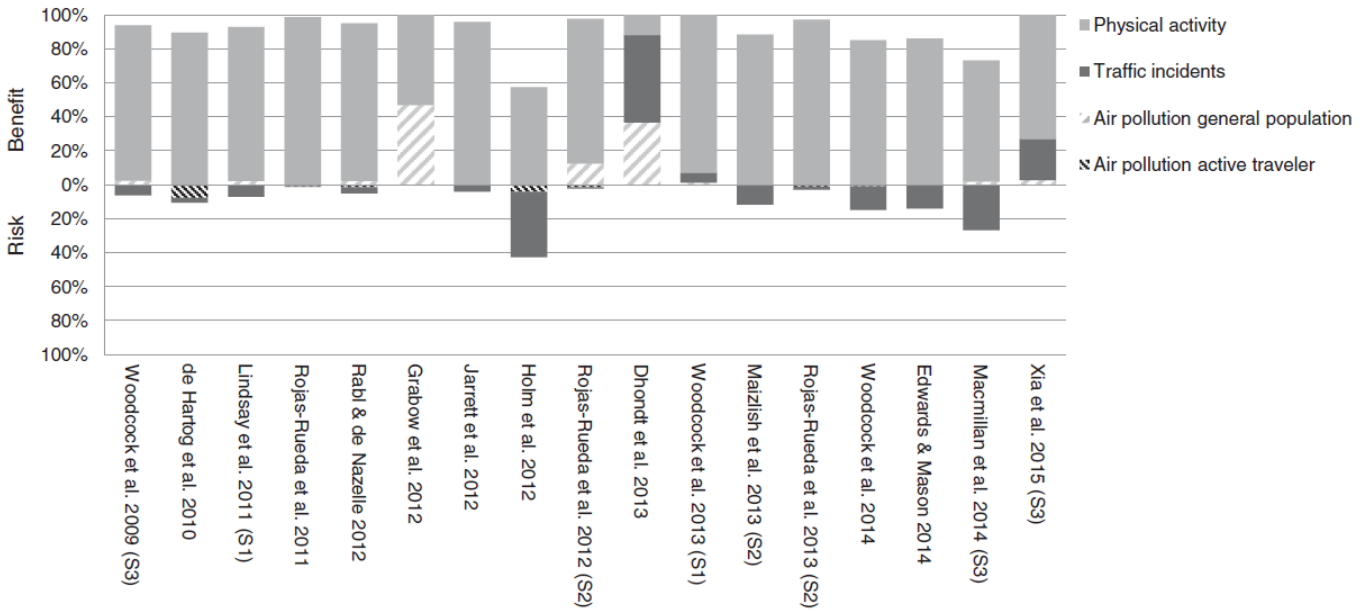
Preventive Medicine

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

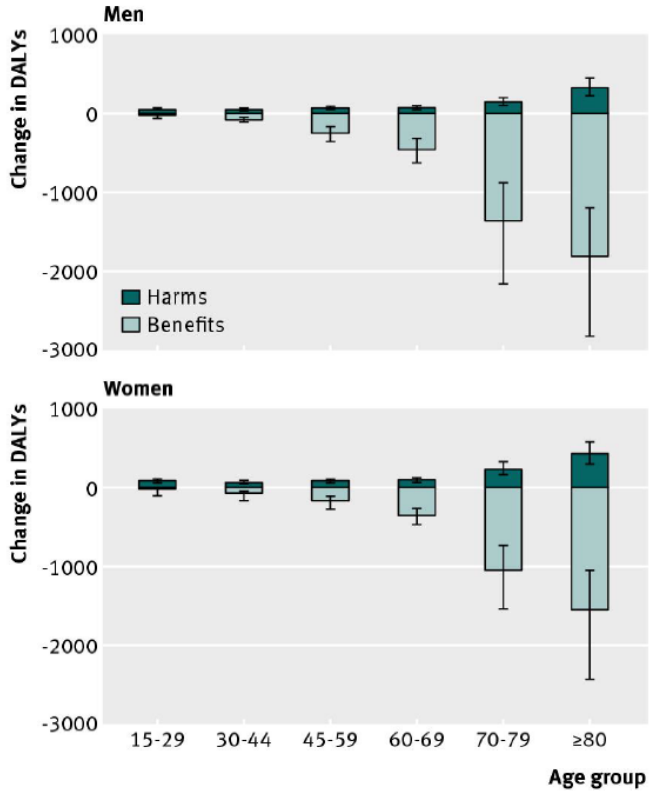


Fig 2 Trade-off of benefits to harms for cycling in central London: effects by age and sex, per million population (although few older people used cycle hire). Benefits come through impacts on diseases related to physical activity, harms come from exposure to road traffic injuries (see table 28 in appendix 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)

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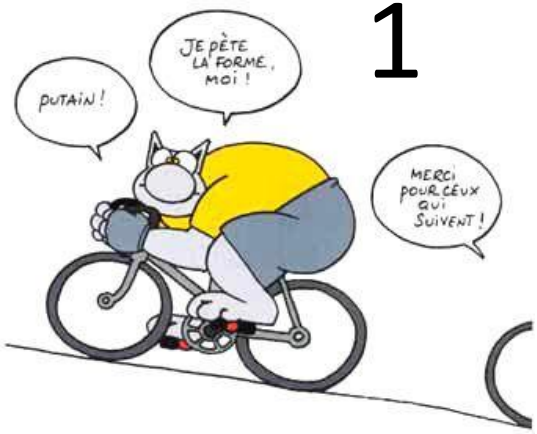

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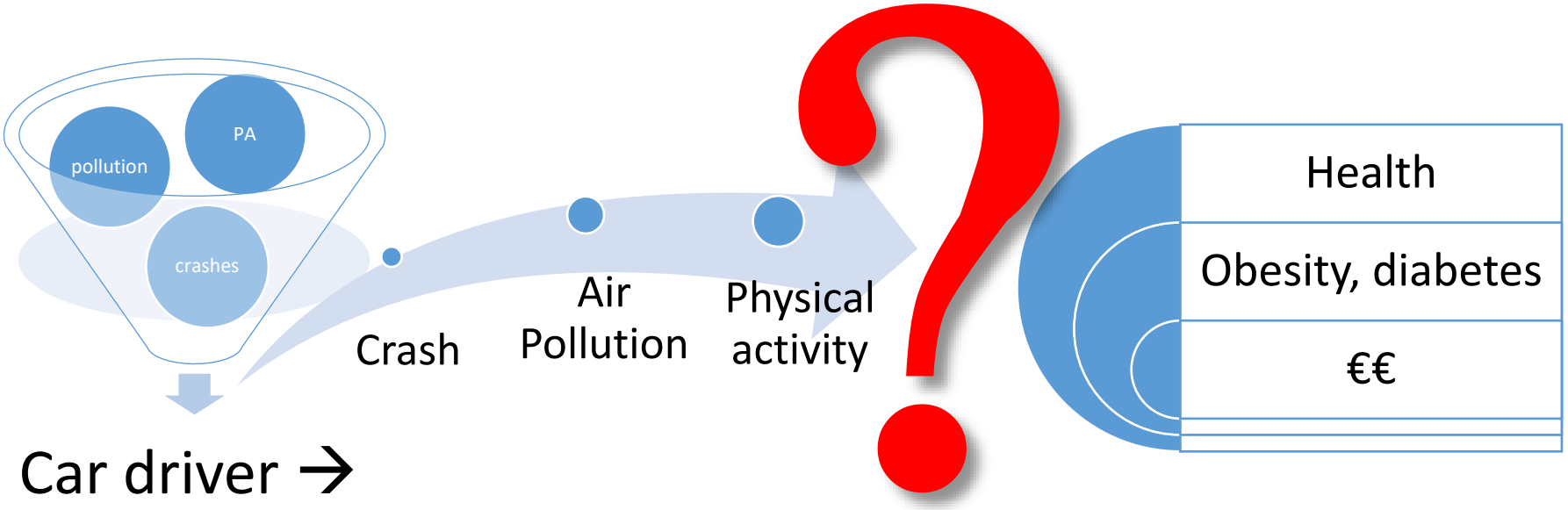
Predictive models – population level

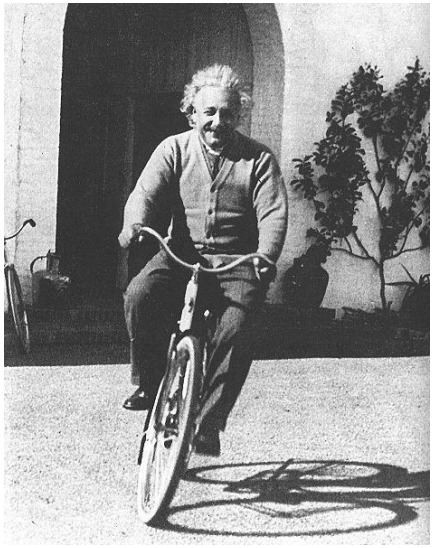


Car driver → **electric** cyclist

Anno: 2022

Anno: 2062

THANK YOU FOR YOUR ATTENTION



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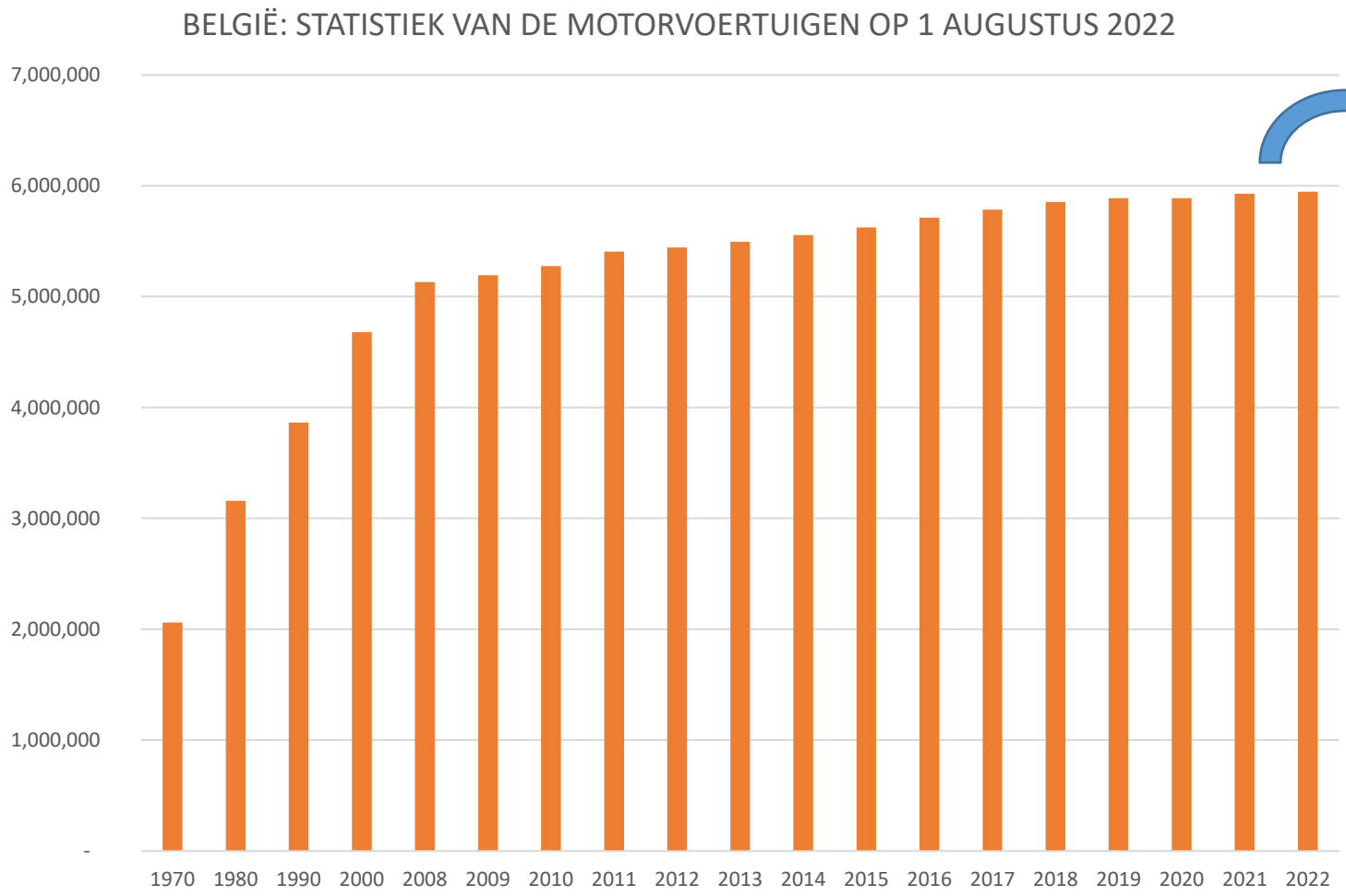
[E] bas.de.geus@uclouvain.be

Vehicle fleet



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

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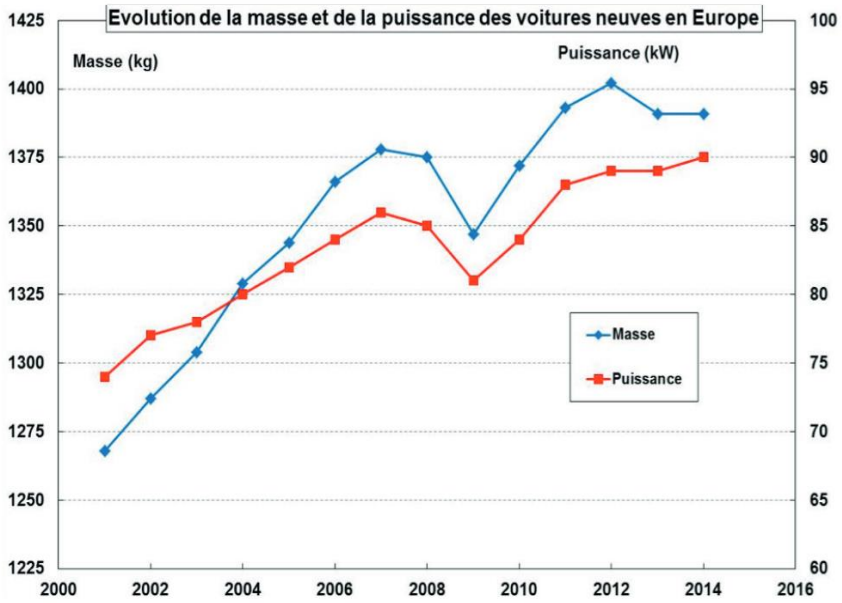
Source: StatBel

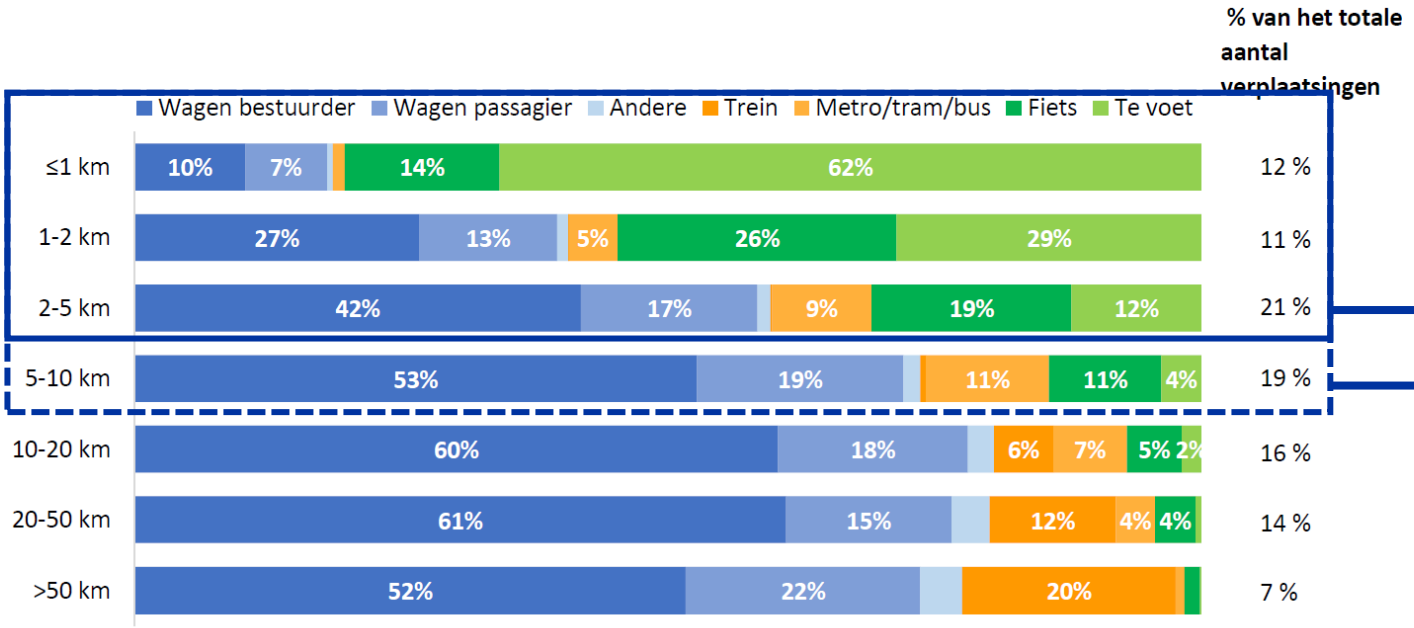
Vehicle fleet



Societal Challenges – Sustainabe cities

Societal Challenges – Sustainable cities

Trips that could be replaced by cycling?



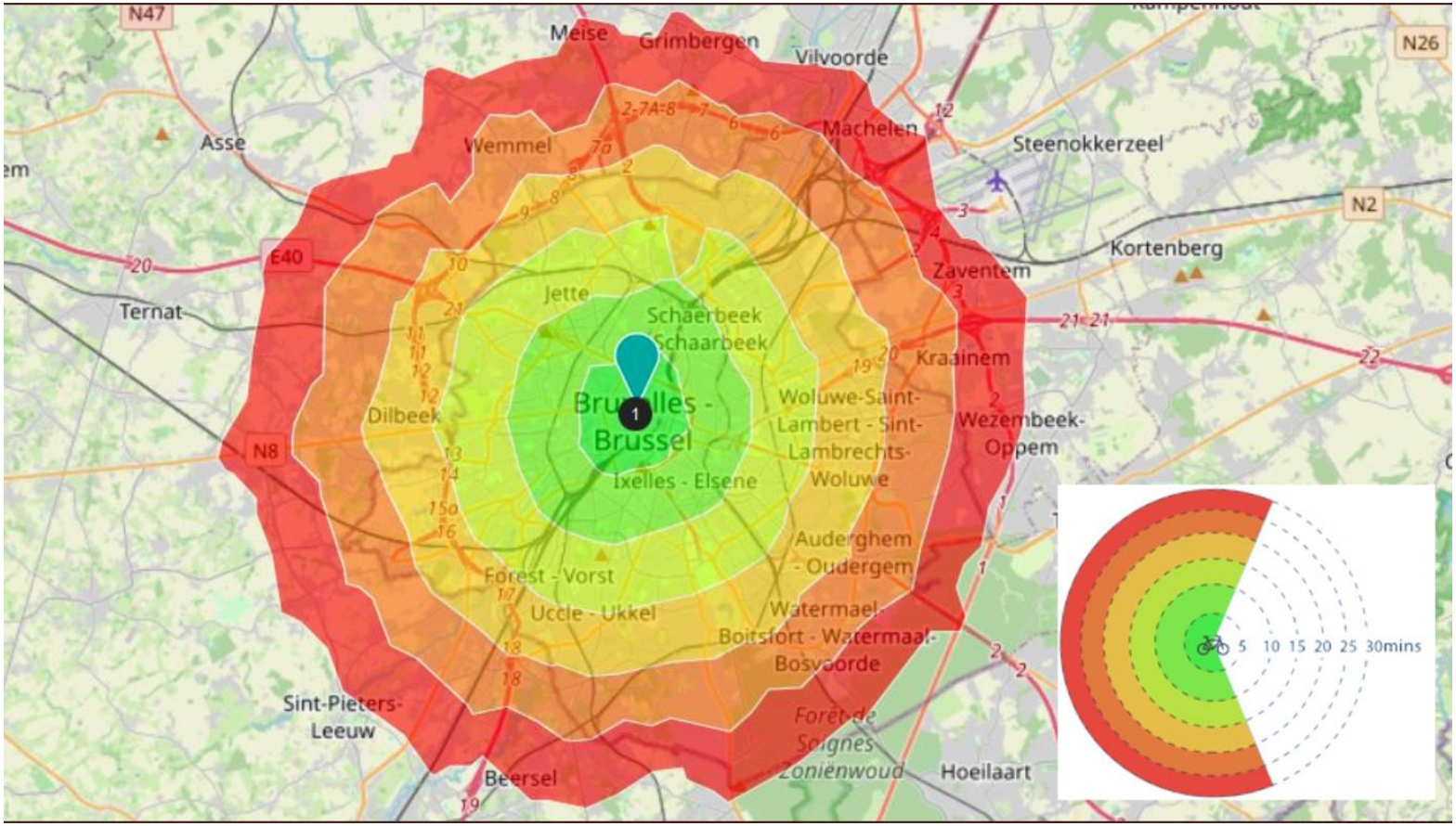
Grafiek 25 - Modale aandelen naargelang de afstand van de trajecten (in aantal verplaatsingen) (Basis: 25.168 trajecten)

Cycling @ 15 km/h
conventional bike

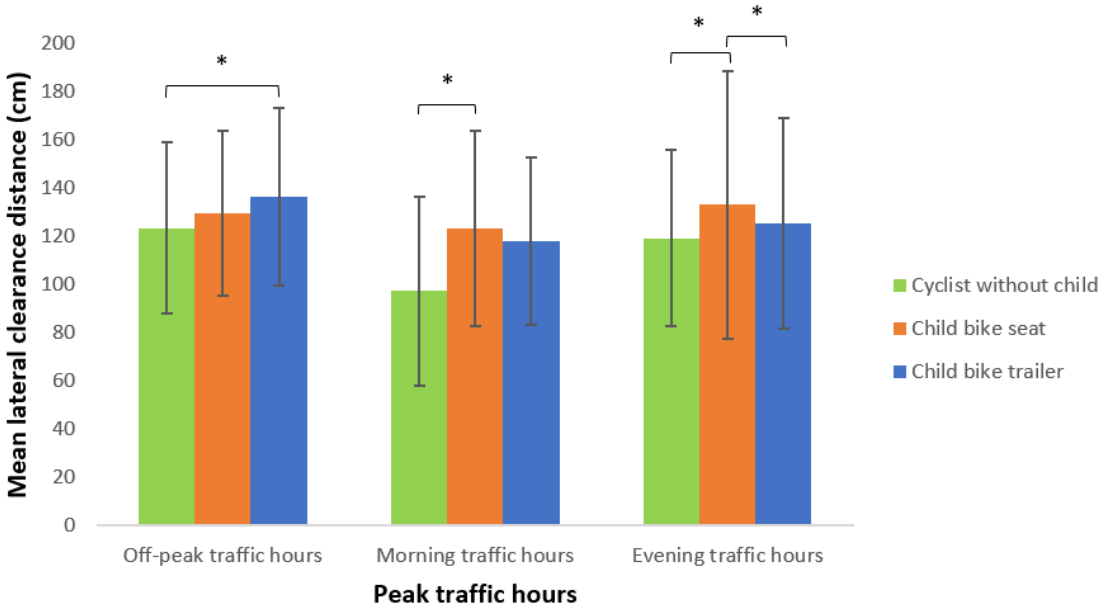
5 km → 20 min

10 km → 40 min

How far can I reach by cycle ?



Lateral clearing distance



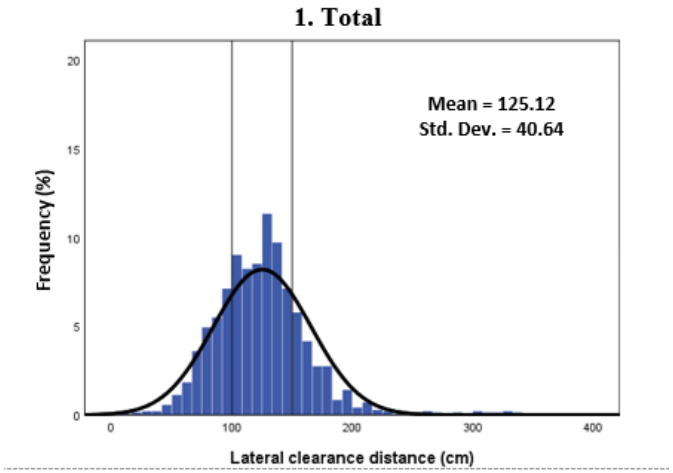


Fig. 9 Mean lateral clearance distance (cm) as a function of the combination of peak traffic hours and cycling condition. Bars indicate standard deviations of the mean. * = *significant ($p \leq 0.05$)*

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