

**Mobil im Alltag –
Umwelt. Zeit. Geld. Leben.**





Individuell

Zu Fuß

Fahrrad

MIV

Unmittelbar verfügbar

Öffentlicher Verkehr

Bus / Straßenbahn

Bahn

Fahrpläne

Mobilitätskette

Kriterien

Umwelt- / Ressourcenschonend

Komfortabel

Sicher / gesund

Schnell / zeitsparend

Kostengünstig

Umwelt- / Ressourcenbelastung

A photograph of a sunlit forest path. The sun is shining through the trees, creating a bright glow and lens flare. The path is covered in fallen leaves and is flanked by tall, thin trees. The overall scene is lush and green.

Energieverbrauch / Abgase

Lärm

Flächenverbrauch

Luftschadstoffe

Stickoxide (NO_x)

Feinstaub (PM_{2,5})

Kfz-Anteil

31%

19%

davon 2/3 Diesel-Pkw

20.000 Todesfälle / Jahr in Deutschland,
davon etwa 4.600 durch Straßenverkehr

Energieverbrauch / CO₂

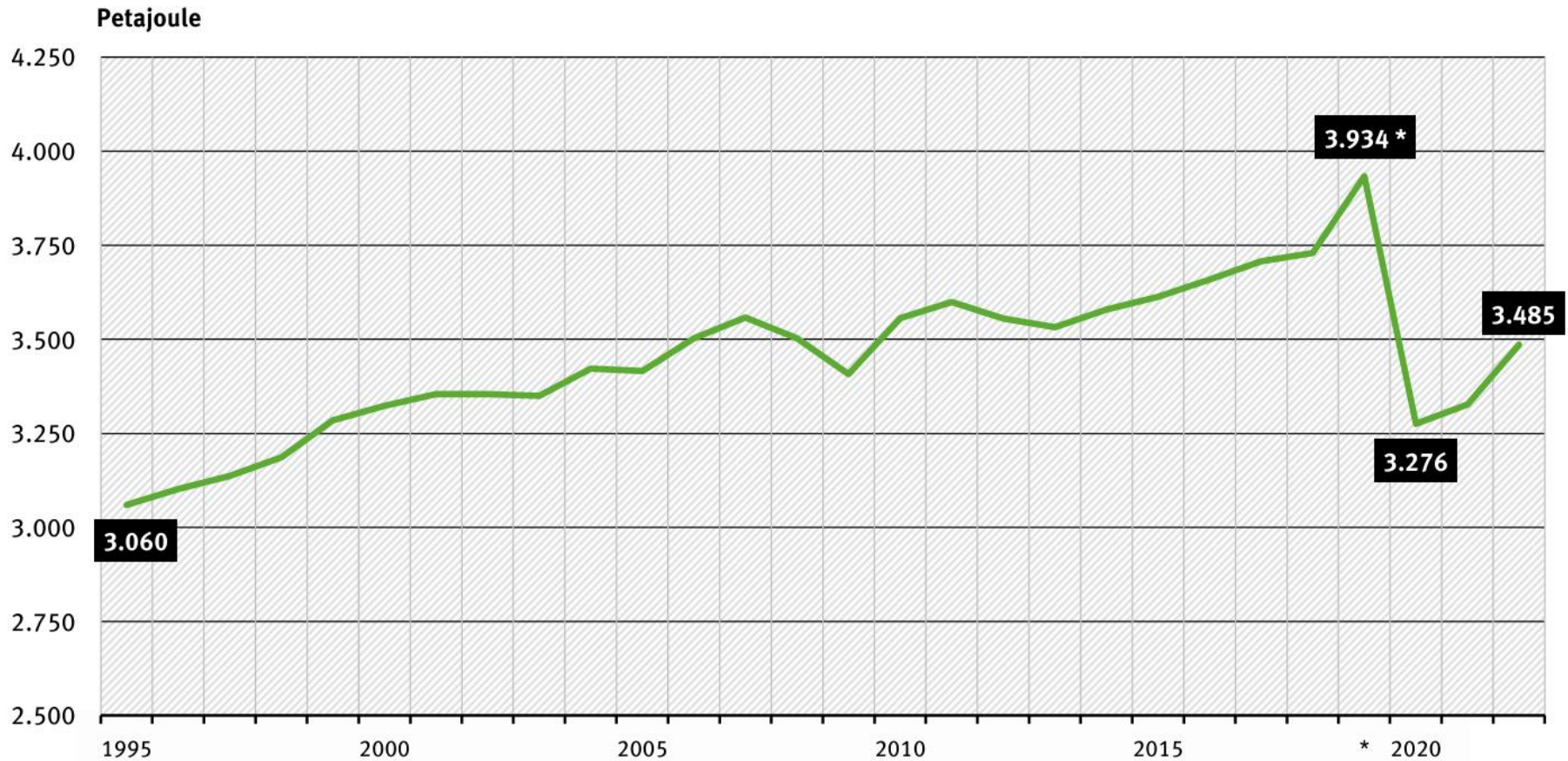
Fahrrad: 1000 kCal/100km 1,2 kWh

Pkw: 5l Super/100km 43,8 kWh

Langfristige Relevanz?

Energieverbrauch Verkehr

Entwicklung des gesamten Primärenergieverbrauchs im Verkehrssektor



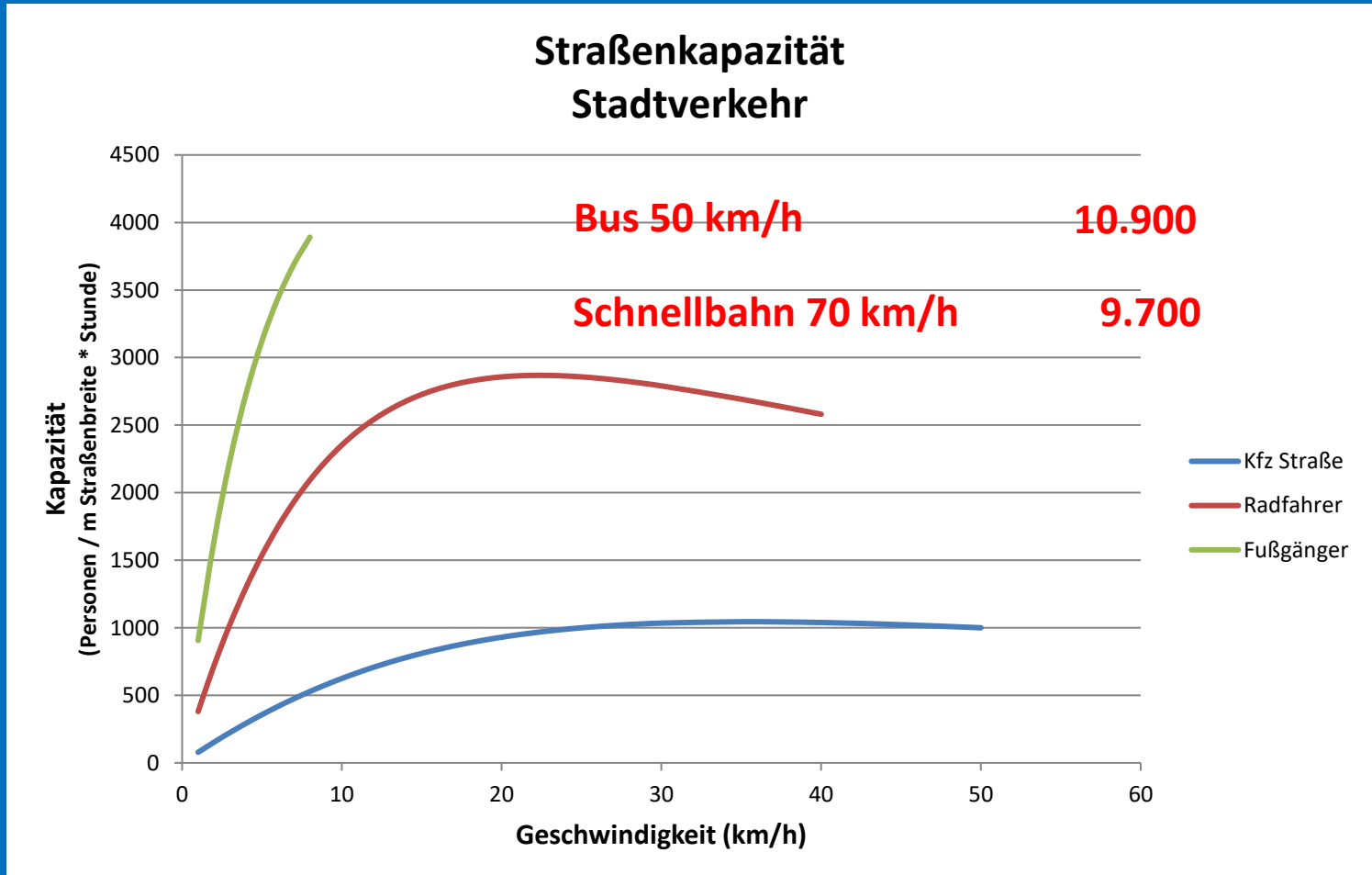
* Methodenwechsel in der Vorkettenmodellierung, Werte ab 2019 sind daher nur eingeschränkt mit den Vorjahren vergleichbar

Quelle: Umweltbundesamt, Daten und Rechenmodell TREMOD, Version 6.51

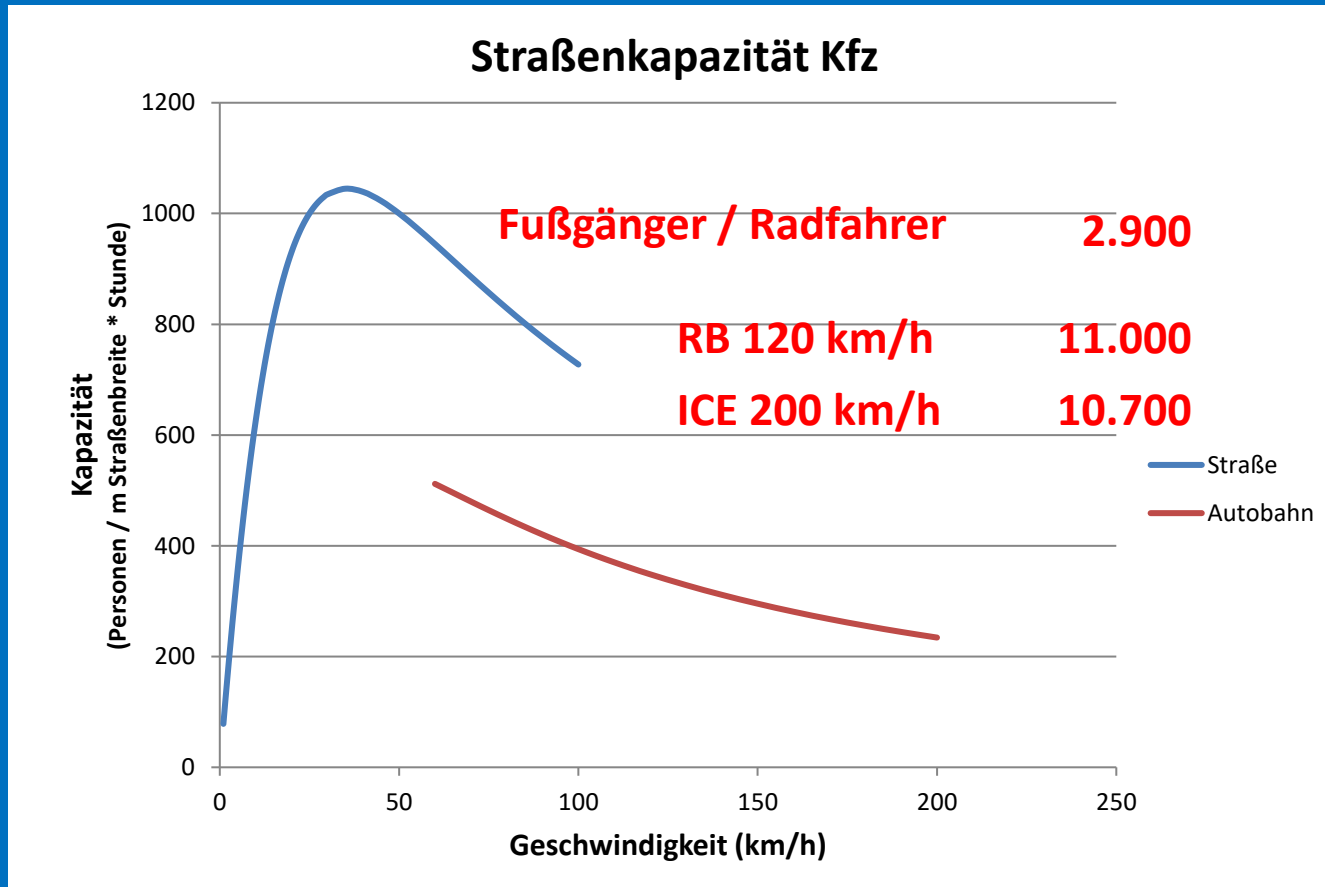
Lärm



Beförderungskapazität (Ortschaften; P/m*h)



Beförderungskapazität (außerorts; P/m*h)



Sicher / gesund

Bewegung ist gesund

	Fußgänger	Radfahrer	MIV	ÖV
Verkehrsleistung %	2,9	3,5	74,8	18,8
Unfalltote 2018	480	445	2121	15
Anteilig %	15,7	14,5	69,3	0,5

Verkehrsleistung: MiD 2017

Unfalltote (nur Personenverkehr): Stat. Bundesamt

...entscheidend ist, was hinten rauskommt.



Sterblichkeitsrisiko

50 km wöchentlich: -18%

WHO: HEAT

All-Cause Mortality Associated With Physical Activity During Leisure Time, Work, Sports, and Cycling to Work

Lars Bo Andersen, PhD, DMSc; Peter Schnohr, MD; Marianne Schroll, PhD, DMSc;
Hans Ole Hein, MD

Background: Physical activity is associated with low mortality in men, but little is known about the association in women, different age groups, and everyday activity.

Objective: To evaluate the relationship between levels of physical activity during work, leisure time, cycling to work, and sports participation and all-cause mortality.

Design: Prospective study to assess different types of physical activity associated with risk of mortality during follow-up after the subsequent examination. Mean follow-up from examination was 14.5 years.

Setting: Copenhagen University Hospital, Copenhagen, Denmark.

Participants: Participants were 13375 women and 17265 men, 20 to 93 years of age, who were randomly selected. Physical activity was assessed by self-report, and health status, including blood pressure, total cholesterol level, triglyceride levels, body mass index, smoking, and educational level, was evaluated.

Main Outcome Measure: All-cause mortality.

Results: A total of 2881 women and 5668 men died. Compared with the sedentary, age- and sex-adjusted mortality rates in leisure time physical activity groups 2 to 4 were 0.68 (95% confidence interval, 0.64-0.71), 0.61 (95% confidence interval, 0.57-0.66), and 0.53 (95% confidence interval, 0.41-0.68), respectively, with no difference between sexes and age groups. Within the moderately and highly active persons, sports participants experienced only half the mortality of nonparticipants. Bicycling to work decreased risk of mortality in approximately 40% after multivariate adjustment, including leisure time physical activity.

Conclusions: Leisure time physical activity was inversely associated with all-cause mortality in both men and women in all age groups. Benefit was found from moderate leisure time physical activity, with further benefit from sports activity and bicycling as transportation.

Arch Intern Med. 2000;160:1621-1628

Körperlich schwere Arbeit Körperliche Freizeitaktivität / Sport Fahrrad zur Arbeit

> 30 000 Teilnehmer

Erfasst

Alter

Geschlecht

Bildungsabschluss

Zigarettenkonsum

Chronische Krankheiten

Gemessen

BMI

Blutdruck

Blutfette

15 Jahre

Sterblichkeitsrisiko

BICYCLING TO WORK

Information on bicycling as transportation to work was available for 783 women and 611 men. Among these 6954 subjects, 229 died during follow-up. The same ten-

dencies were found in men and women when mortality rates were compared between those who cycled to work and those who did not, but the estimates were not sig-

nificant in women. The average time spent cycling in those who did cycle to work was 3 hours per week. The analy-

ses are presented for the whole group, with adjustment for sex. Bicycling to work was inversely related to years of education. Among the less educated subjects (<8 years of school), 27.8% used the bicycle to work, in the middle group (8-12 years of school) 24.5% cycled, and in the most educated group (≥ 12 years of school) 20.3% cycled.

After adjustment for age, sex, and educational level, the relative risk in those who cycled was 0.70 (95% CI, 0.55-0.89). After additional adjustment for leisure time physical activity, body mass index, blood lipid levels,

smoking, and blood pressure, the relative risk was 0.72 (95% CI, 0.57-0.91).



Original Contribution

Influence of Exercise, Walking, Cycling, and Overall Nonexercise Physical Activity on Mortality in Chinese Women

Charles E. Matthews¹, Adriana L. Jurj², Xiao-ou Shu¹, Hong-Lan Li³, Gong Yang¹, Qi Li³, Yu-Tang Gao³, and Wei Zheng¹

¹ Department of Medicine, Division of General Internal Medicine and Public Health, Vanderbilt Epidemiology Center, Vanderbilt University Medical School, Nashville, TN.

² Department of Epidemiology and Biostatistics, Norman J. Arnold School of Public Health, University of South Carolina, Columbia, SC.

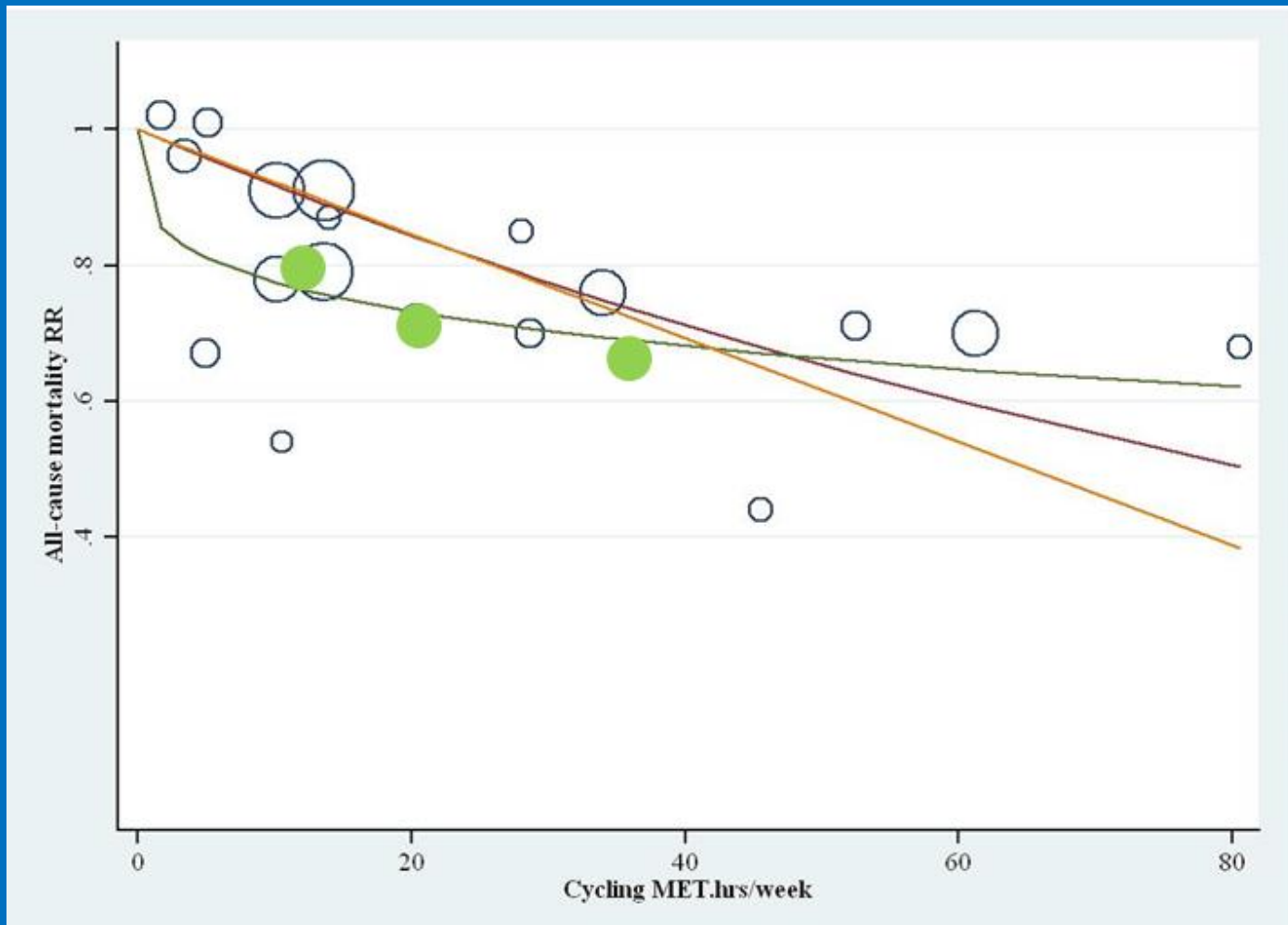
³ Department of Epidemiology, Shanghai Cancer Institute, Shanghai, People's Republic of China.

Received for publication August 1, 2006; accepted for publication November 8, 2006.

Radfahren < 5h/Woche: -21%

Radfahren > 5h/Woche: -34%

WHO: HEAT



Radfahren

 OPEN ACCESS

Association between active commuting and incident cardiovascular disease, cancer, and mortality: prospective cohort study

< 30 Meilen / Woche: Sterblichkeit -32%

Carlos A Celis-Morales,¹ Donald M Lyall,² Paul Welsh,¹ Jana Anderson,¹ Lewis Steel,¹ Yibing Guo,¹ Reno Maldonado,¹ Daniel F Mackay,² Jill P Pell,² Naveed Sattar,¹ Jason M R Gill¹

> 30 Meilen / Woche: Sterblichkeit -40%

¹Institute of Cardiovascular and Medical Sciences, University of Glasgow, Glasgow G12 8TA, UK

²Institute of Health and Wellbeing, University of Glasgow, Glasgow, UK

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Additional material is published online only. To view please visit the journal online.

Cite this as: *BMJ* 2017;357:j1456
<http://dx.doi.org/10.1136/bmj.j1456>

Accepted: 16 March 2017

ABSTRACT

OBJECTIVE

To investigate the association between active commuting and incident cardiovascular disease (CVD), cancer, and all cause mortality.

DESIGN

Prospective population based study.

SETTING

UK Biobank.

PARTICIPANTS

263 540 participants (106 674 (52%) women; mean age 52.6), recruited from 22 sites across the UK. The exposure variable was the mode of transport used (walking, cycling, mixed mode (a combination of public transport)) to commute to and from work on a typical day.

MAIN OUTCOME MEASURES

Incident (fatal and non-fatal) CVD and cancer, and deaths from CVD, cancer, or any causes.

RESULTS

2430 participants died (496 were related to CVD and 1126 to cancer) over a median of 5.0 years (interquartile range 4.3-5.5) follow-up. There were 3748 cancer and 1110 CVD events. In maximally adjusted

cause mortality (cycling hazard ratio 0.59, 95% confidence interval 0.42 to 0.83, P=0.002; mixed mode cycling 0.76, 0.58 to 1.00, P<0.05), cancer incidence (cycling 0.55, 0.44 to 0.69, P<0.001; mixed mode cycling 0.64, 0.45 to 0.91, P=0.01), and cancer mortality (cycling 0.60, 0.40 to 0.90, P=0.01; mixed mode cycling 0.68, 0.57 to 0.81, P<0.001). Commuting by cycling and walking were associated with a lower risk of CVD and cancer (cycling 0.54, 0.33 to 0.88, P=0.01; walking 0.73, 0.54 to 0.99, P=0.04) and CVD mortality (cycling 0.48, 0.25 to 0.92, P=0.03; walking 0.64, 0.45 to 0.91, P=0.01). No statistically significant associations were observed for walking commuting and all cause mortality or cancer outcomes. Mixed mode commuting (including walking) was not noticeably associated with any of the measured outcomes.

CONCLUSIONS

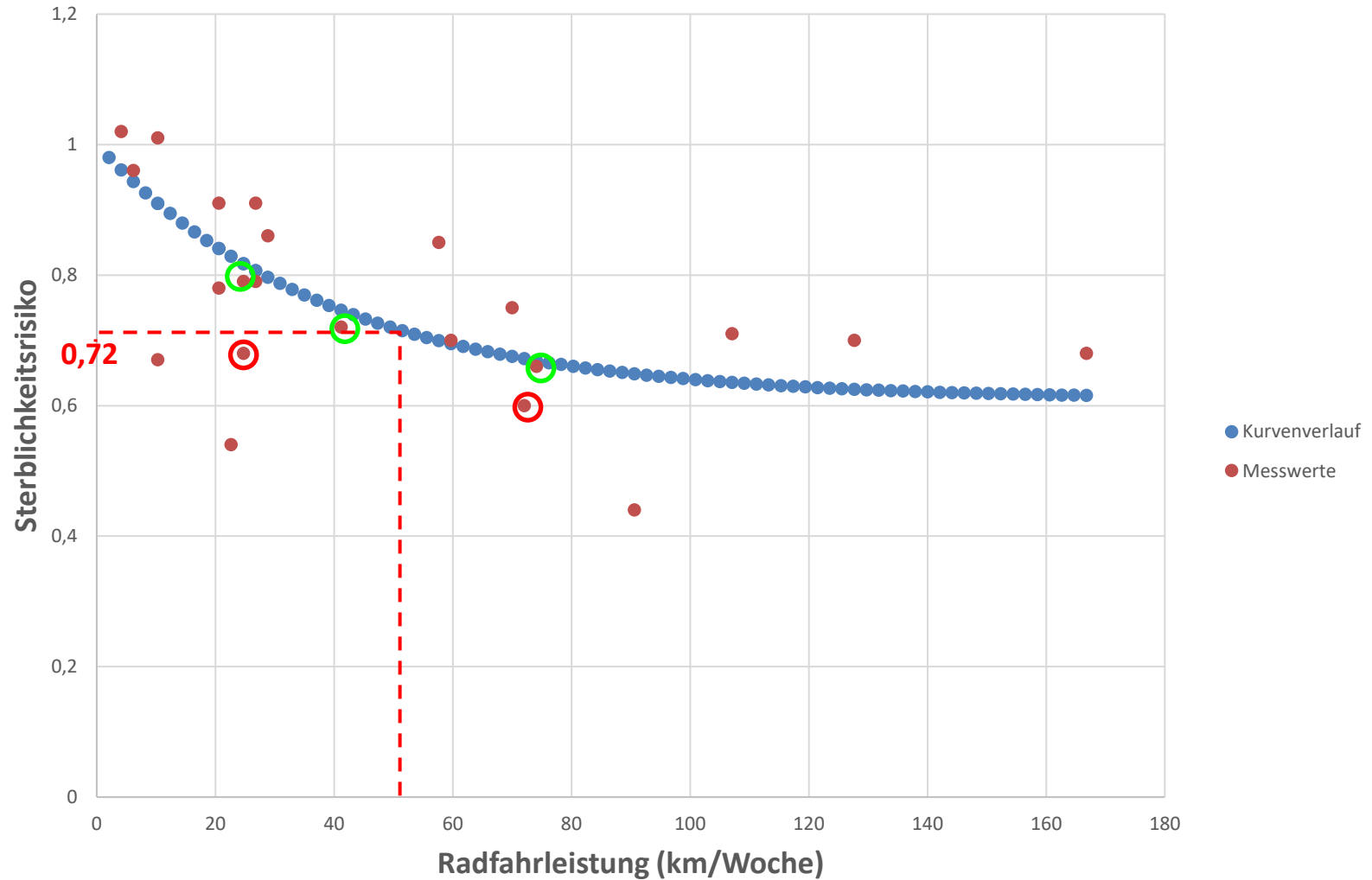
Cycle commuting was associated with a lower risk of CVD, cancer, and all cause mortality. Walking commuting was associated with a lower risk of CVD independent of major measured confounding factors. Initiatives to encourage and support active commuting could reduce risk of death and the burden of important chronic conditions.

Öffentlicher Verkehr

Kombination Rad: Sterblichkeit -24%

Kombination zu Fuß: Sterblichkeit unverändert

Sterblichkeitsminderung durch Radfahren



...etwas konkreter bitte!

Deutschland 2017:

Insgesamt 932.272 Todesfälle

- davon 82% Radlose: 764.463 Todesfälle

- davon 28% vorzeitige Todesfälle:

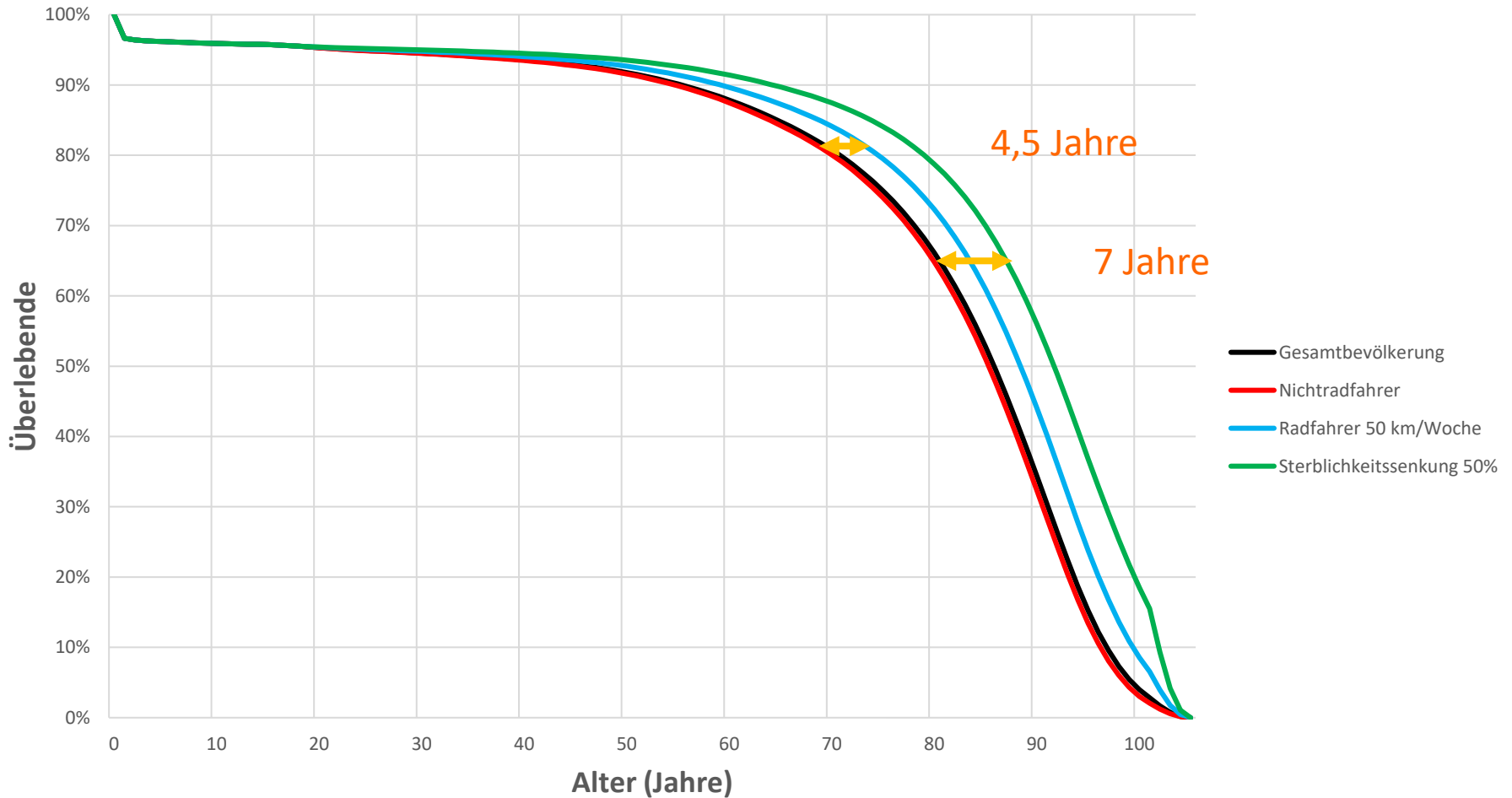
218.000 Menschen

Todesursachen in Deutschland

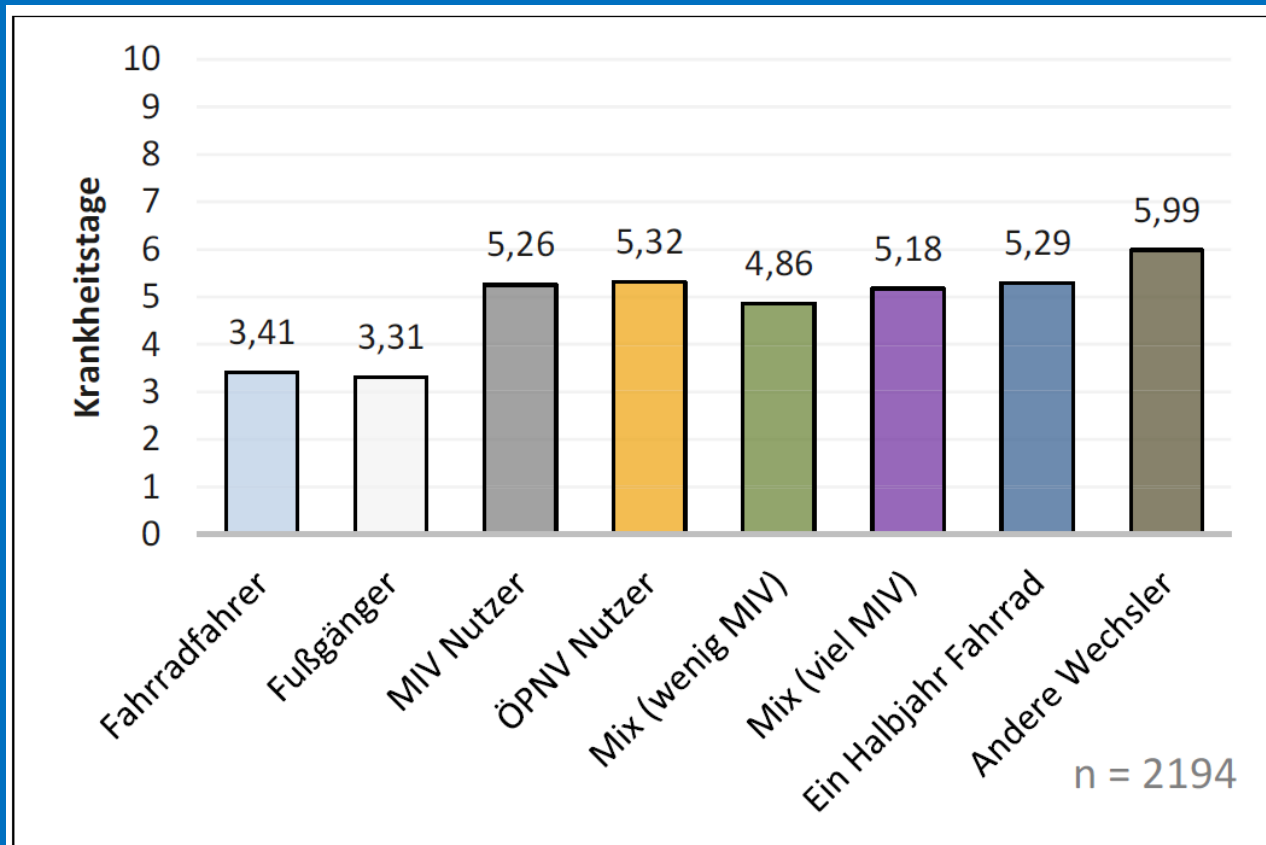
Kreislaufsystem	35,3%
Bösartige Neubildungen	25,5%
Radlosigkeit	23,0%
Atmungssystem	7,1%
Verkehrsunfälle	0,3%

...etwas individueller bitte

Überlebensvorteil bei Sterblichkeitssenkung um 28% bzw. 50%



...und die Gesundheit?



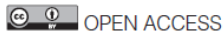
**Nach Korrektur um andere Einflussfaktoren:
29% Rückgang durch Radfahren zur Arbeit (68 km/Woche)**

Auswirkung körperlicher Aktivität auf Sterblichkeits- und Krankheitsrisiko

Sterblichkeitsrisiko	-17-23%
Koronare Herzkrankheit	-30%
Diabetes	-27%
Brust- und Darmkrebs	-21-25%
Durchschnitt Krankheitsrisiko	-27%

Nach WHO: Global Status Report on Noncommunicable Diseases_2010

Radfahren



OPEN ACCESS

Association between active commuting and incident cardiovascular disease, cancer, and mortality: prospective cohort study

Sterblichkeit -41%

Carlos A Celis-Morales,¹ Donald M Lyall,² Paul Welsh,¹ Jana Anderson,² Lewis Steell,¹ Yibing Guo,¹ Reno Maldonado,¹ Daniel F Mackay,² Jill P Pell,² Naveed Sattar,¹ Jason M R Gill¹

Herz- / Kreislaufkrankungen -46%

Krebserkrankungen: -45%

¹Institute of Cardiovascular and Medical Sciences, University of Glasgow, Glasgow G12 8TA, UK

²Institute of Health and Wellbeing, University of Glasgow, Glasgow, UK

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CONCLUSIONS

Cycle commuting was associated with a lower risk of CVD, cancer, and all cause mortality. Walking commuting was associated with a lower risk of CVD independent of major measured confounding factors. Initiatives to encourage and support active commuting could reduce risk of death and the burden of important chronic conditions.

...und die Fitness?

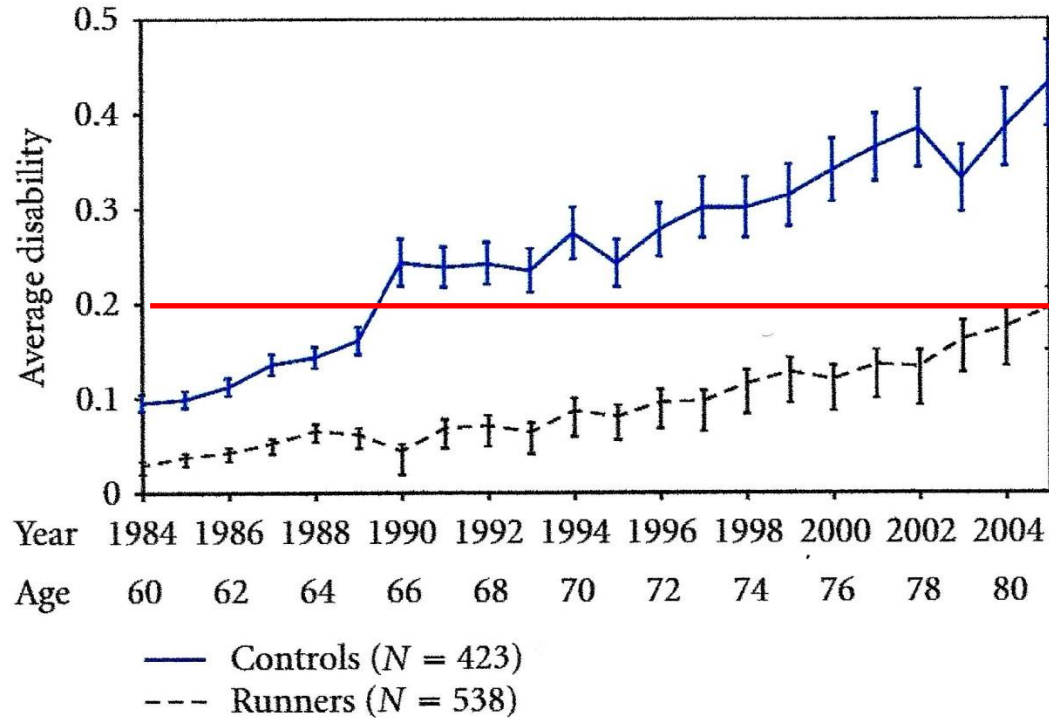


FIGURE 1: Average disability scores by age and calendar year, Runner's and community controls 1984–2005.

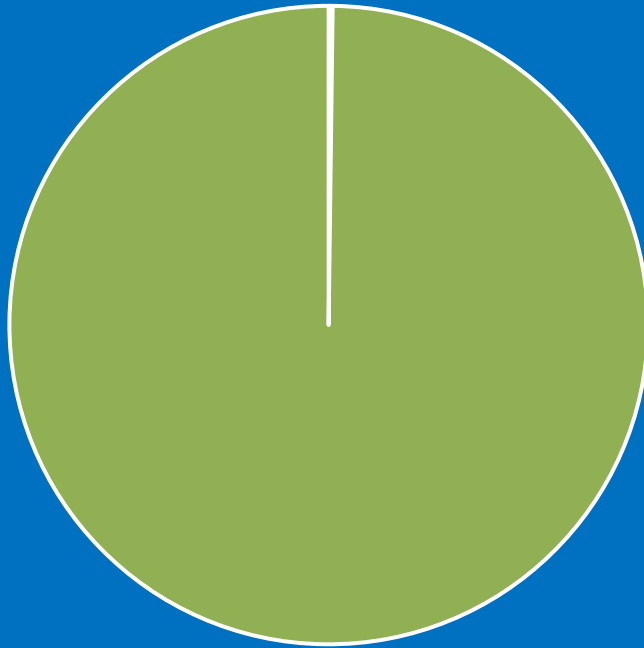
Regelmäßiges Radfahren



- Deutlich geringeres Krankheitsrisiko
- Erheblich verbesserte Lebensqualität im letzten Lebensdrittel
- Mindestens 4 Jahre höhere Lebenserwartung

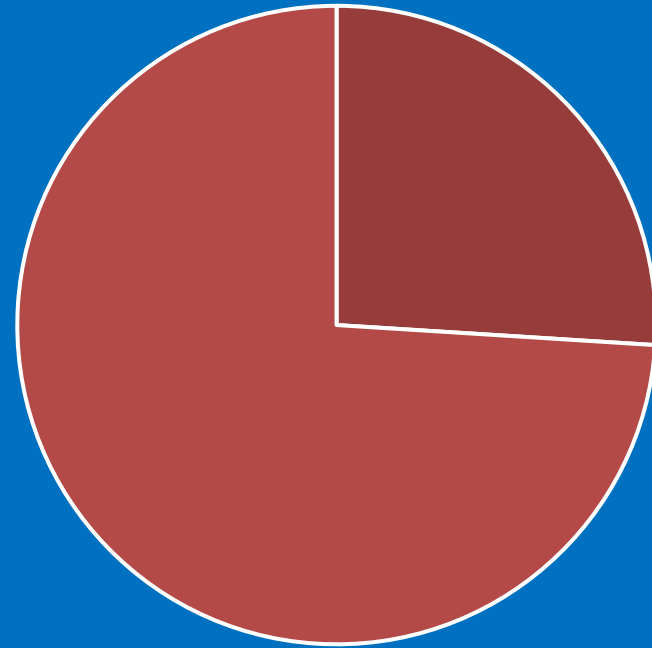
Was kommt hinten raus?

1.000 Radfahrende*



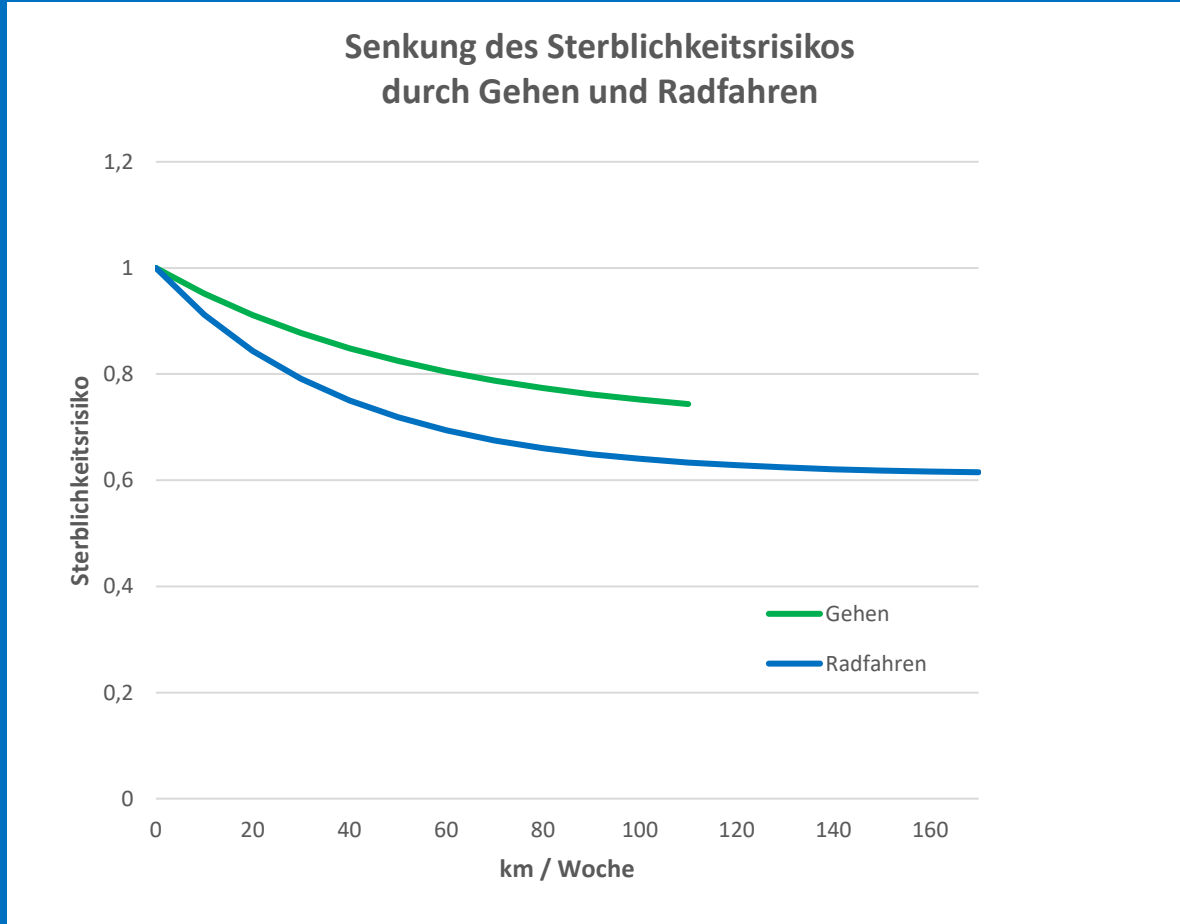
2 tödliche Unfälle

1.000 Radlose



260 vorzeitige Todesfälle

Gehen und Radfahren



Gehen



- **Geringerer Effekt**
- **Etwa 5-fach höherer Zeitaufwand für vergleichbaren Nutzen**

Zeitaufwand



Zeitaufwand Individualverkehr

Fahrrad: drei- bis viermal so schnell wie Fußgänger

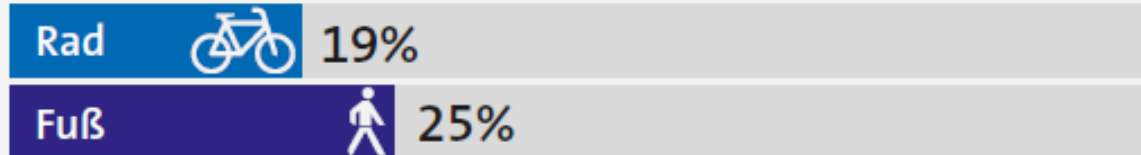
MIV: doppelt so schnell wie Fahrrad
+ Stau + Parkplatzsuche

Wege nach Entfernungsklassen in Deutschland

unter 1 km



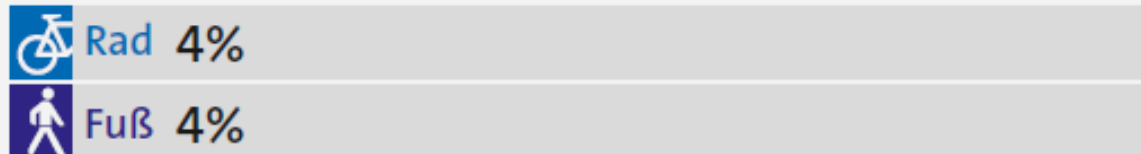
1 bis unter 2 km



2 bis unter 5 km



5 bis unter 20 km



Zeitgutschrift



**Radfahren
50 km / Woche**

4 Jahre

24 Stunden täglich?







Zeitgutschrift



4 Jahre

**12 disponible
Stunden täglich**

12 x 365 x 4

Ertrag: 17520 disponible Stunden :60

Ertrag: 292 disponible Stunden / Jahr

Zeitgutschrift



4 Jahre

292 disponible
Stunden jährlich

:52

Zusätzlicher Aufwand: 1,8 Stunden / Woche

Ertrag: 5,6 disponible Stunden / Woche

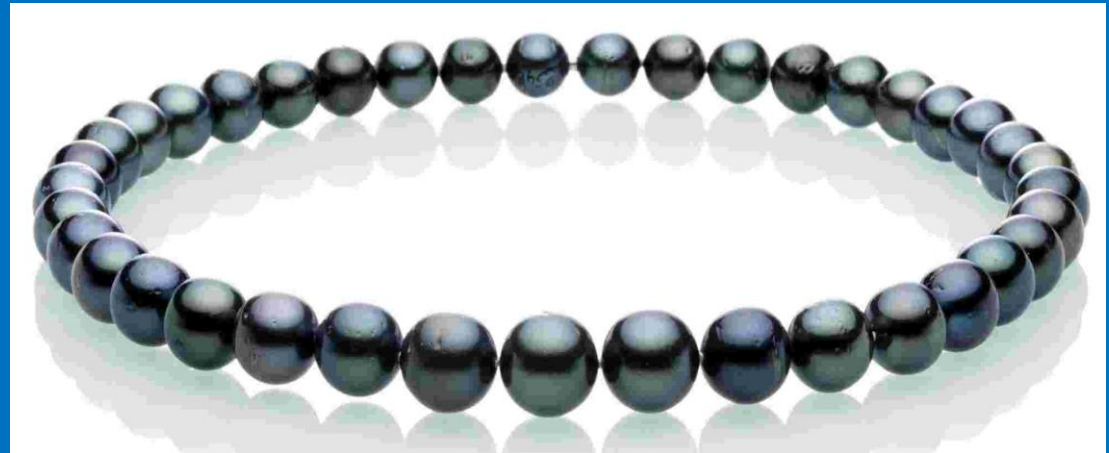
Mobilitätskette ÖPNV

Fußweg

Wartezeit

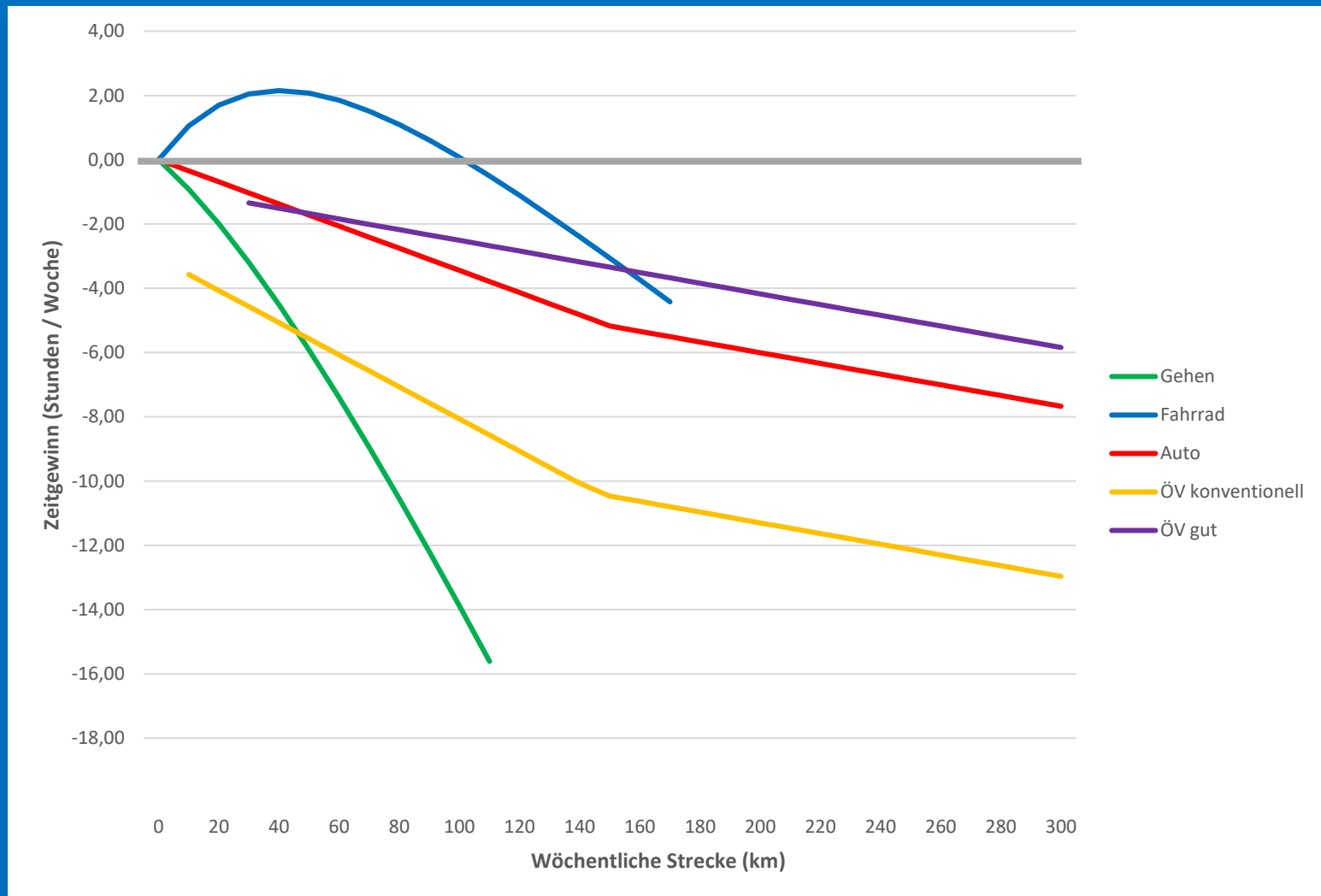
Fahrt

Fußweg



Wartezeit =
Halber Taktabstand

Zeitgewinn durch Alltagswege



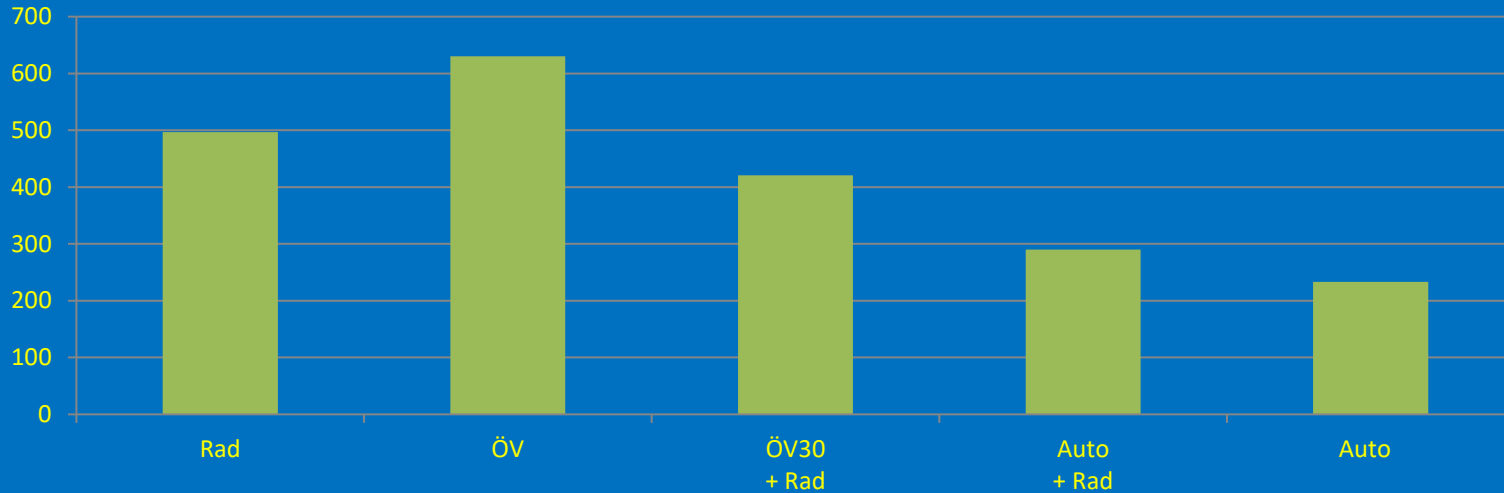
Individuelle Zeit-Kosten-Rechnung

Lübeck-Ratzeburg, 25 Straßen-km

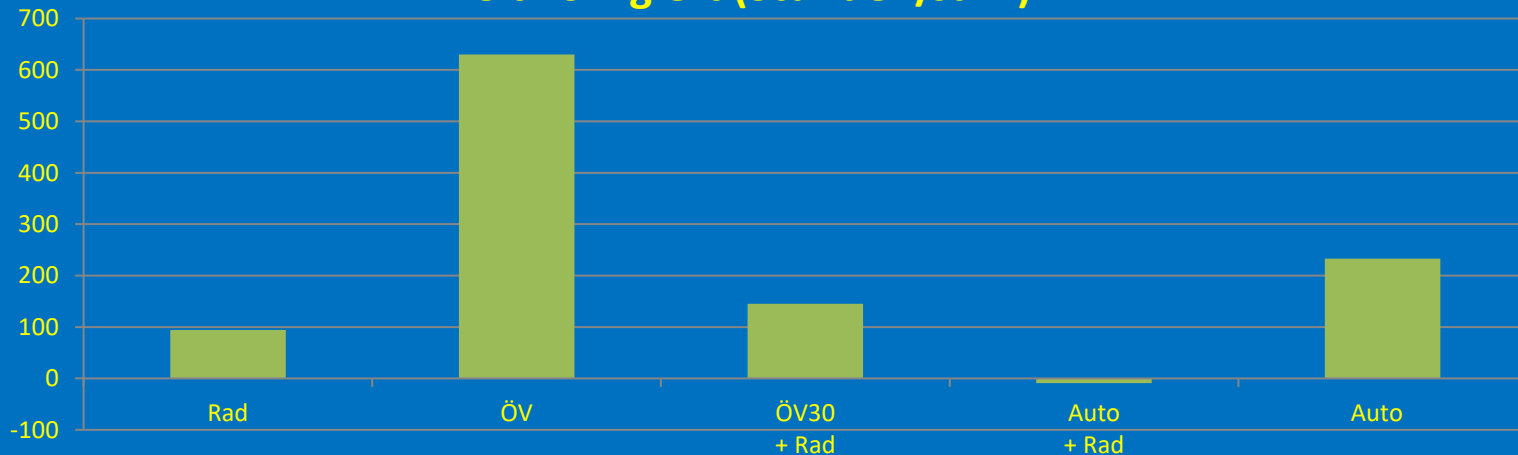
MIV	40 min
Fahrrad	85 min
ÖPNV	108 min
ÖPNV + Rad	88 min
ÖPNV 30 + Rad	72 min

Individuelle Zeitrechnung

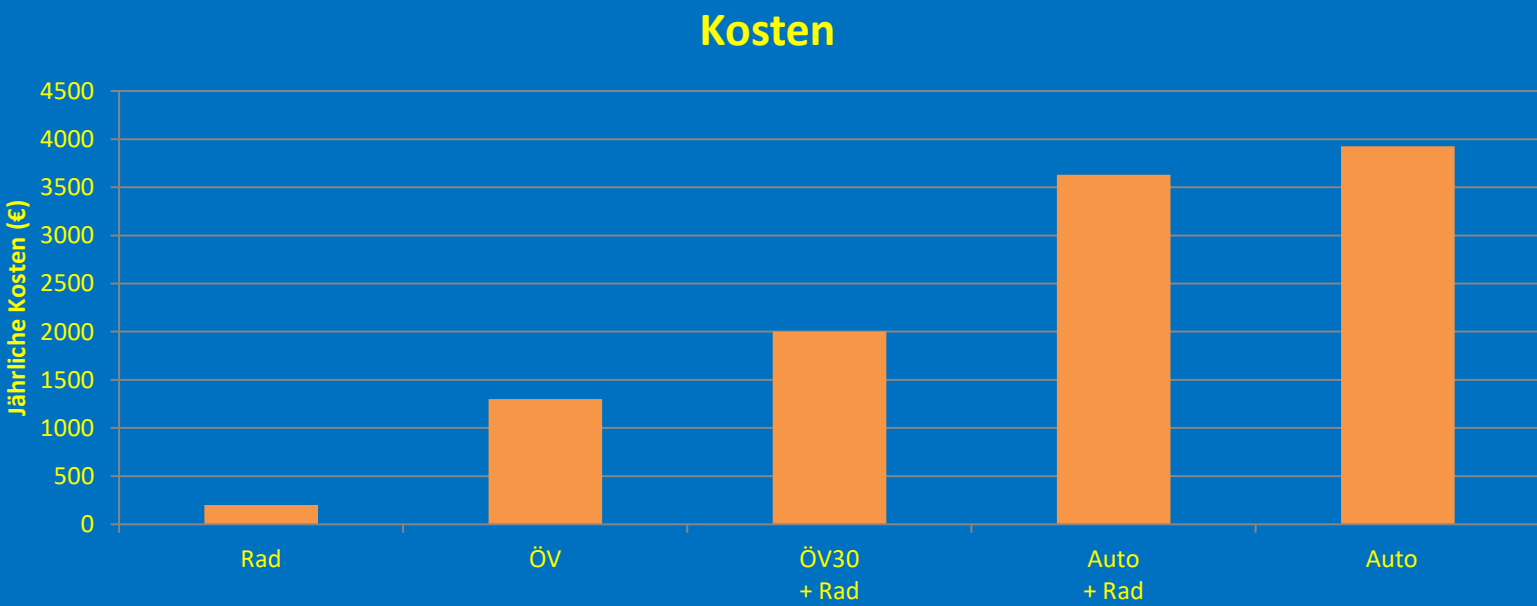
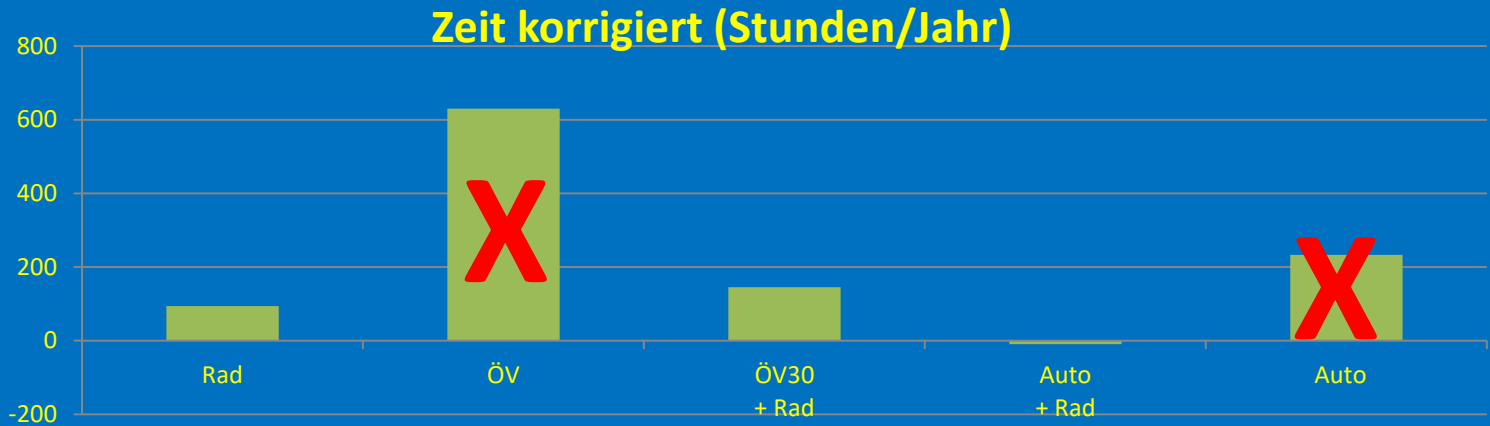
Zeit unkorrigiert (Stunden/Jahr)



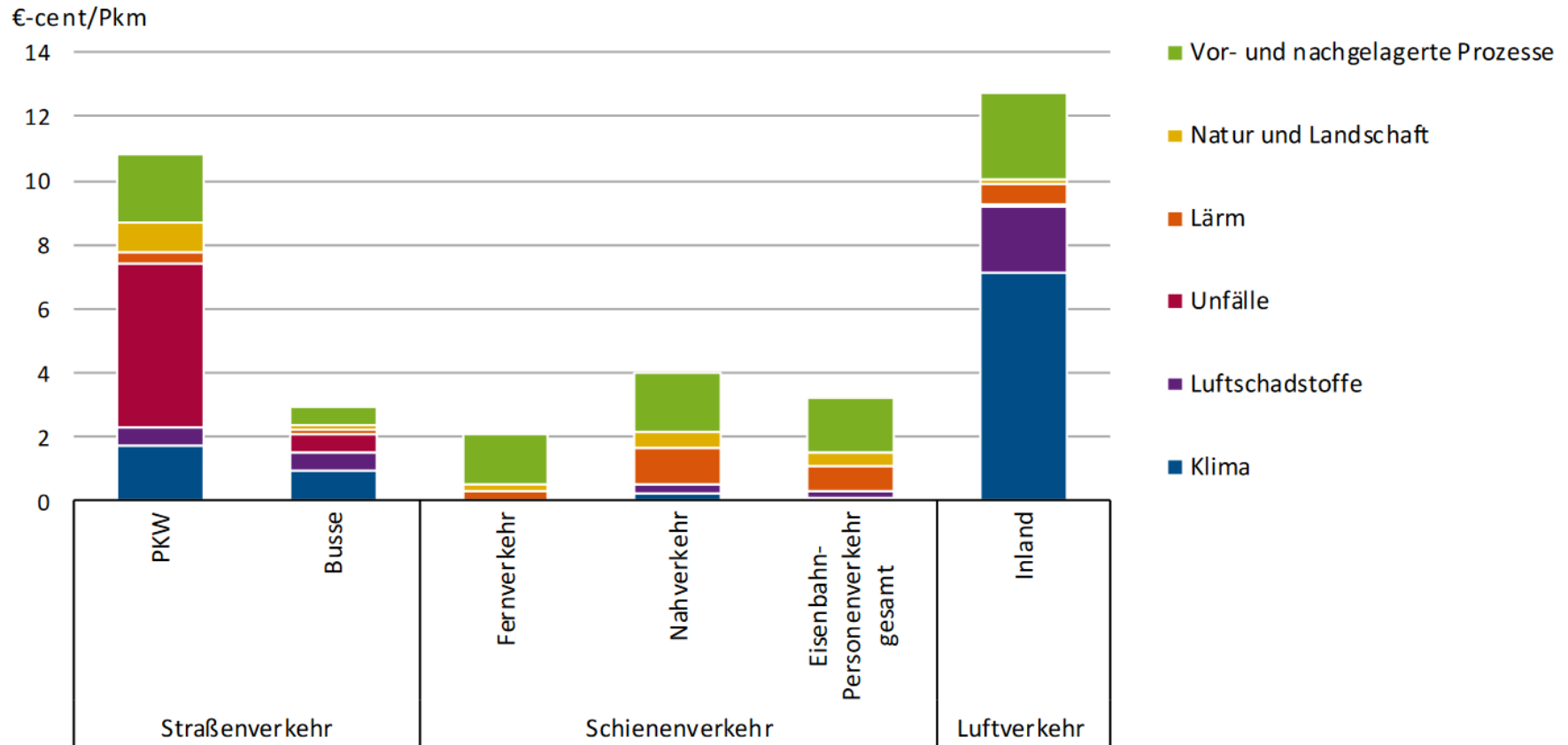
Zeit korrigiert (Stunden/Jahr)



Individuelle Zeit-Kosten-Rechnung



Externe Kosten

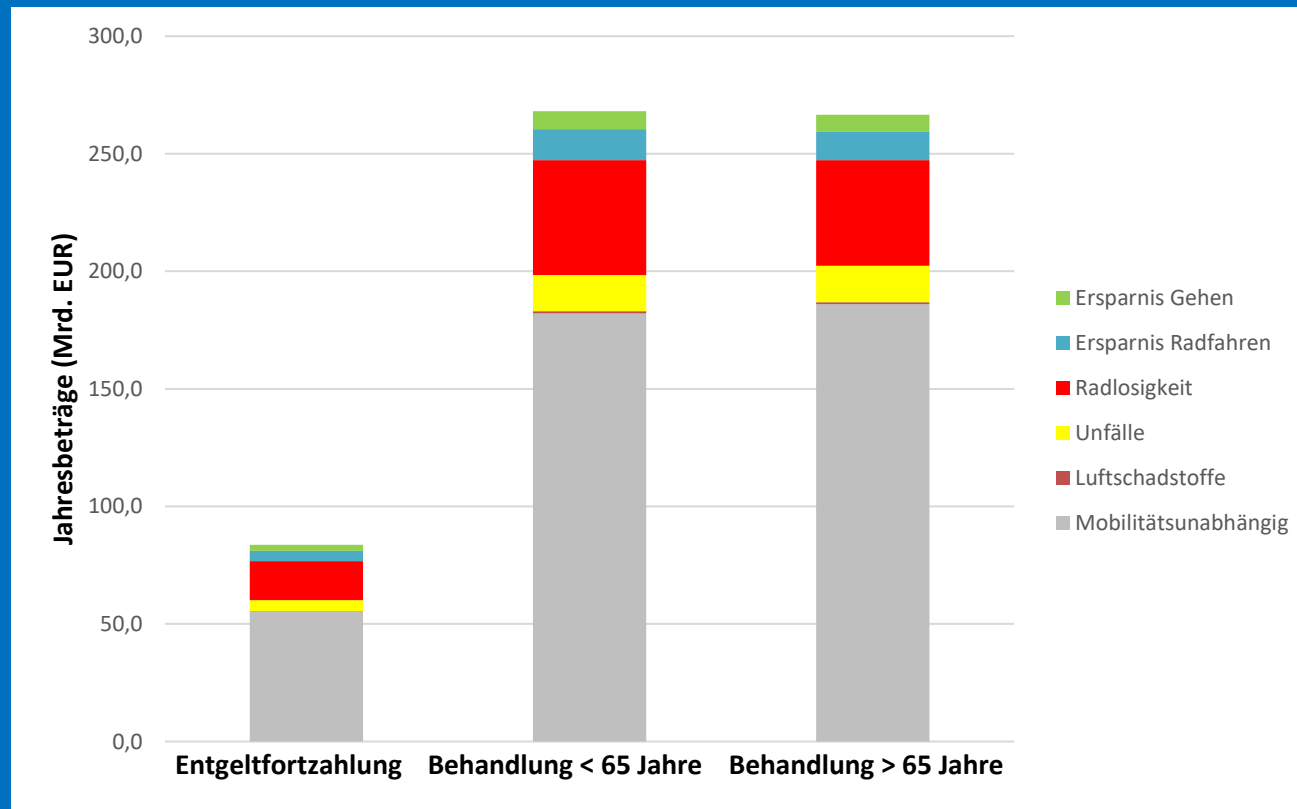


Pkw: 10,8 ct/Pkm
95 Milliarden EUR jährlich

Krankheits- und Pflegekosten

2023 insgesamt 494,6 Mrd. €

Entgeltfortzahlung 76,7 Mrd. €



je Radloser (67,9 Mio)

1.630 €

Gesellschaftliche Gesamtkosten Mobilität

Externe Kosten MIV

95 Mrd. EUR / Jahr

Externe Kosten ÖV + Zuschüsse

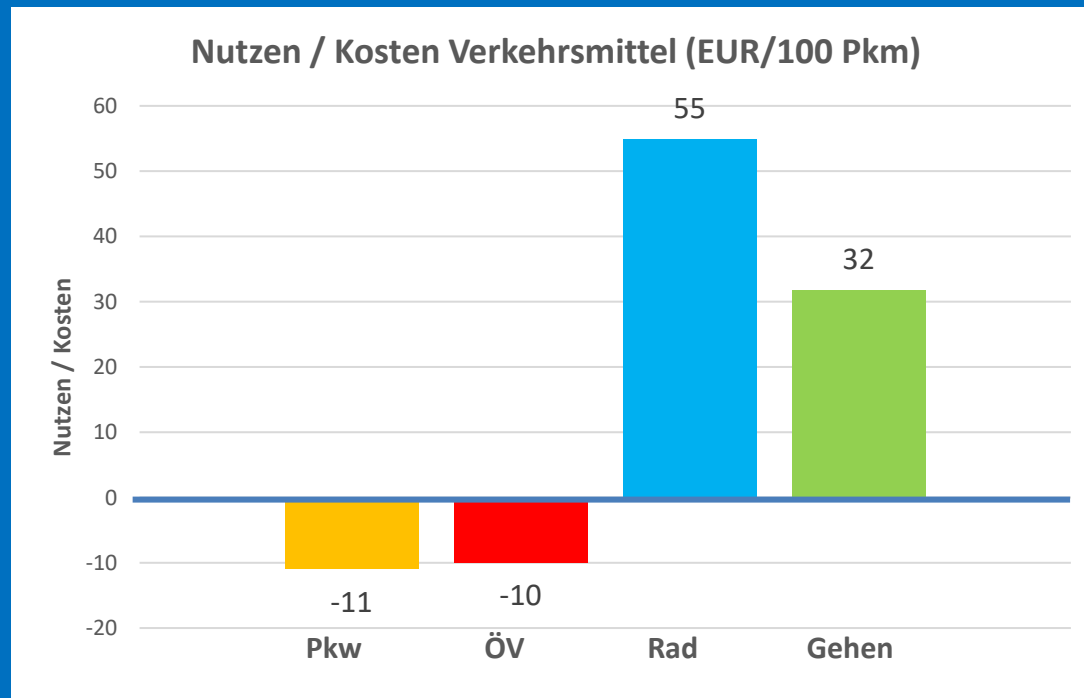
22 Mrd. EUR / Jahr

Behandlungs- und Pflegekosten Radlosigkeit

110 Mrd. EUR / Jahr

Summe

227 Mrd. EUR / Jahr





Pause

Umwelt / Ressourcen

	Energie Abgase	Lärm	Flächenbedarf
Fuß Fahrrad	Green	Green	Yellow
Pkw	Red	Orange	Red
Bahn	Yellow	Orange	Green

Sicherheit / Gesundheit

Fuß	Längeres und besseres Leben
Fahrrad	Deutliche Zunahme von Gesundheit < Lebenserwartung < Lebensqualität
Pkw	
ÖV	Sehr geringes Unfallrisiko

Zeit / Individuelle Kosten

Fahrrad (allein / kombiniert)	
Pkw	
öV	

Gesellschaftliche Kosten

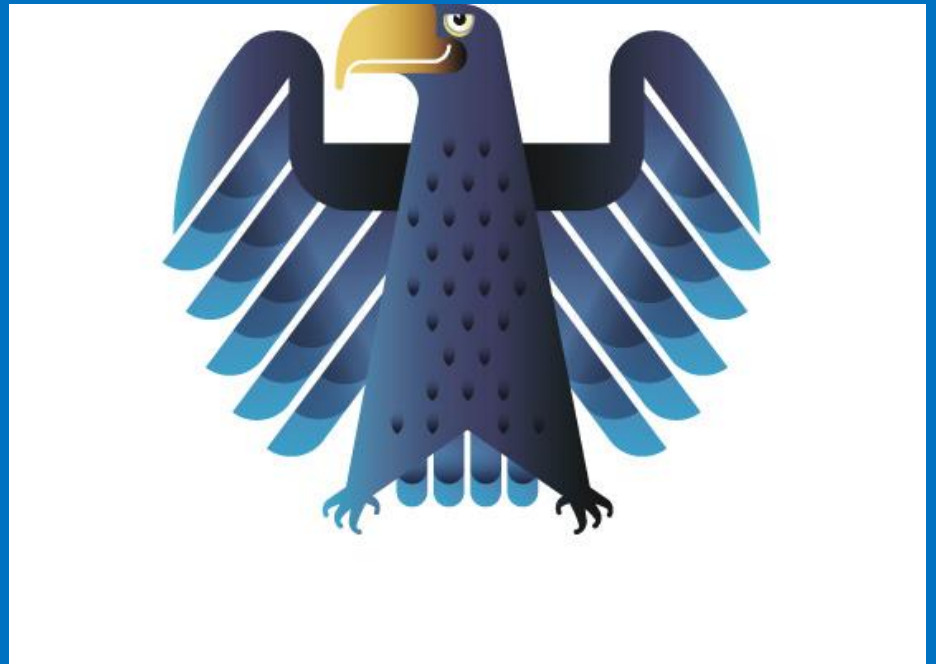
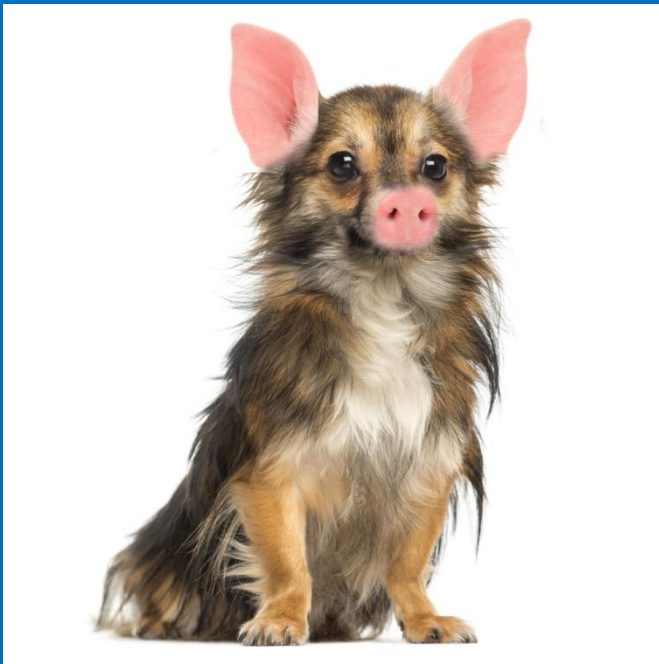
**Fahrrad
(allein / kombiniert)**

**Weniger Krankheitskosten
Längeres und besseres
Leben**

Ohne Fahrrad

**Wirtschaftliches und
humanitäres Desaster**

Wer hat Schuld?



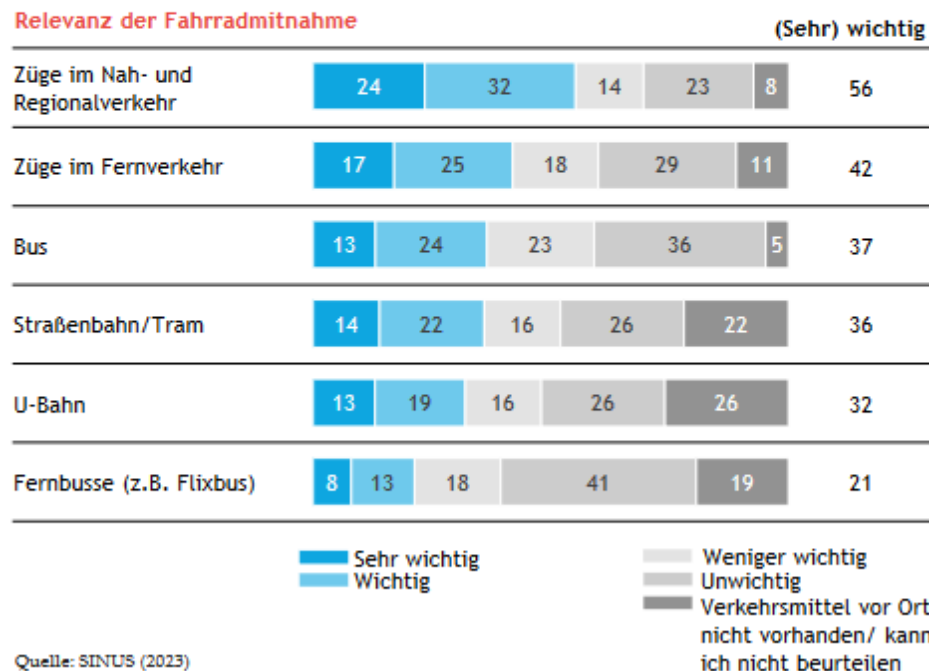
Weshalb benutzen Sie das Fahrrad nicht als Verkehrsmittel?

Weg ist zu weit	54%
Dauert zu lange	43%
Wind / Wetter	27%
Zu anstrengend	24%

Zu weit? Zu lange?

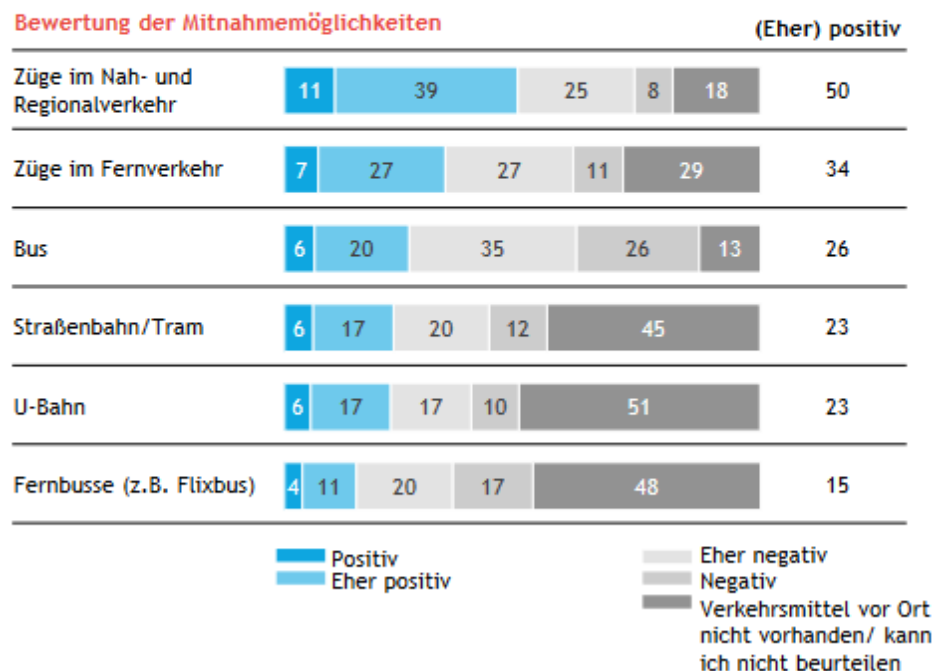
Fahrradmitnahme in öffentlichen Verkehrsmitteln

F37: Für wie wichtig halten Sie es, Ihr Fahrrad in folgenden Verkehrsmitteln mitnehmen zu können?



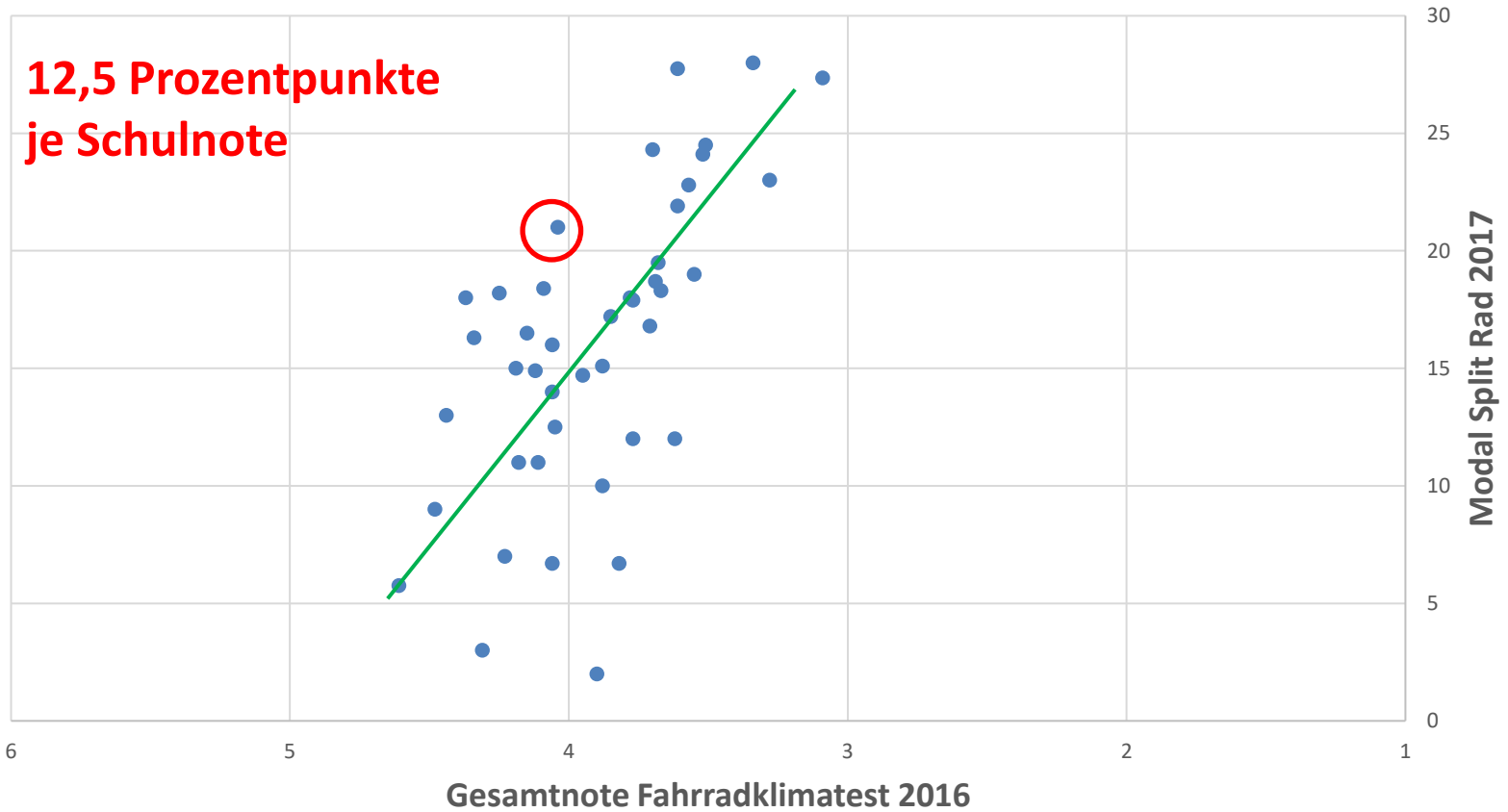
Quelle: SINUS (2023)
 N=3.253 Fälle, Radfahrende im Alter zwischen 14 und 69 Jahren
 Angaben in %

F64: Wie schätzen Sie die Mitnahmemöglichkeit von Fahrrädern bei den folgenden Optionen an Ihrem Wohnort ein?

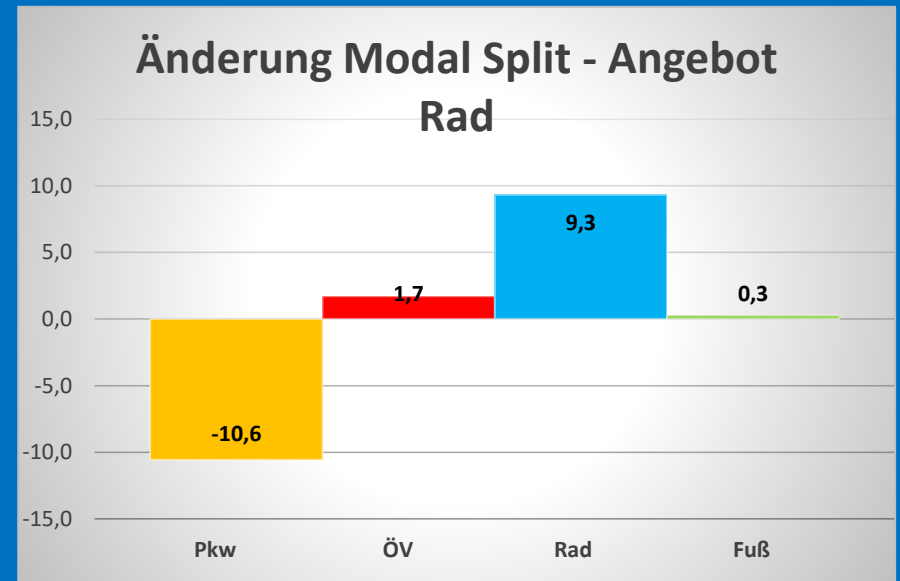
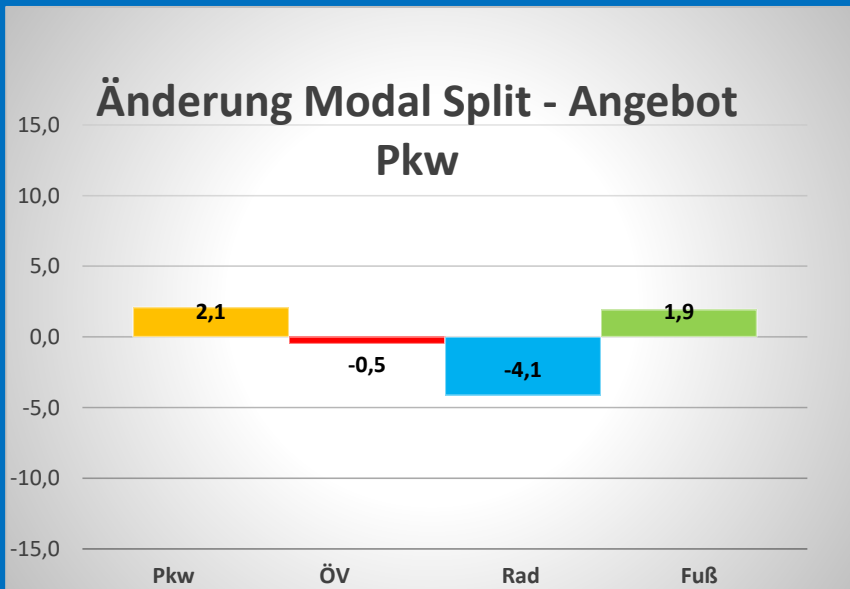
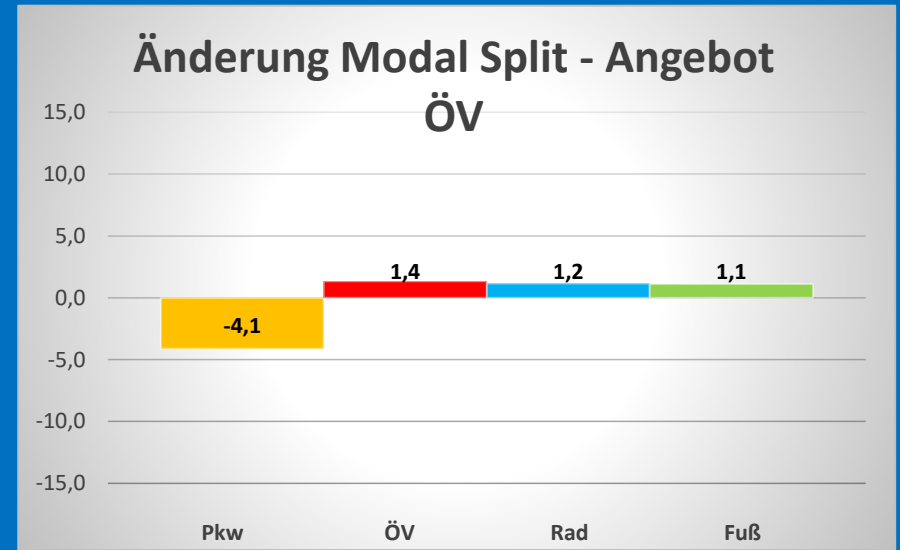
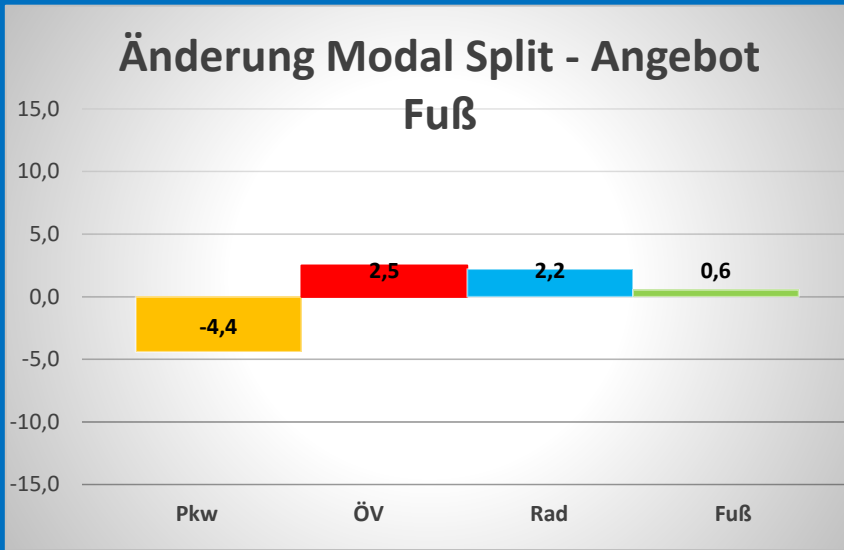


Infrastruktur und Fahrradnutzung

Fahrradnutzung nach Angebotsqualität



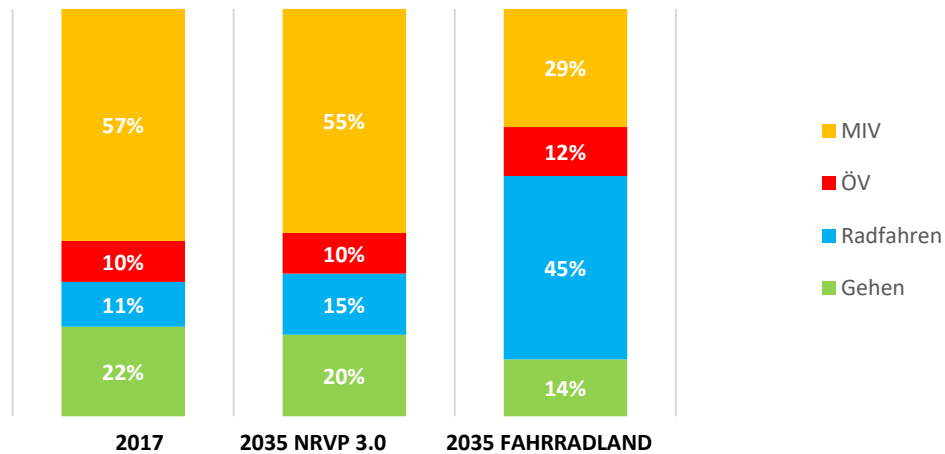
Angebot – Nutzung aller Verkehrsmittel



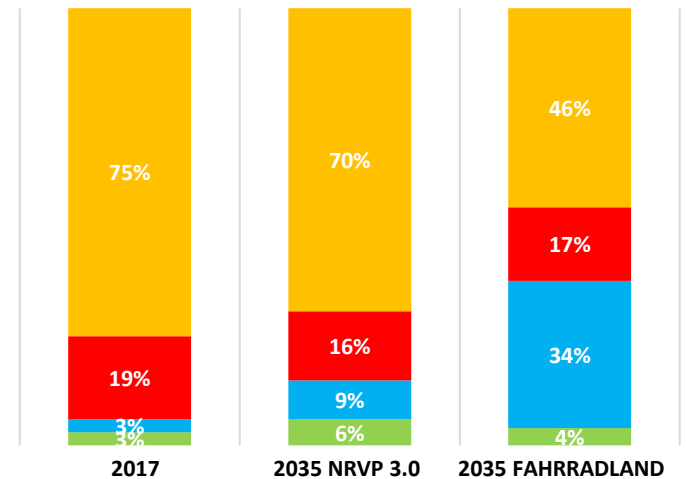
Potenziale

(Wege bis 30 km Länge)

MODAL SPLIT - WEGE



MODAL SPLIT - VERKEHRSLEISTUNG



Kostensparnis Gesundheitswesen

	Radlos	2017	Fahrradland Deutschland	Vision Zero
Modal Split Radverkehr	0	11,2%	45,0%	
Anteil tägliche Radfahrer	0	18,0%	72,3%	
Vorzeitige Todesfälle	261.000	218.000	86.000	215.000
gewonnene Lebensjahre (jährlich)	0	621.000	2.495.000	99.000
Kostensparnis Rad Krankheit / Pflege Mrd €	0	29,8	97,4	
Kostensparnis Gehen Krankheit / Pflege Mrd €	17,2	17,2	10,9	

Jährliche Investitionen in den Radverkehr ca. 1 Mrd. €
(Bund + Länder + Kommunen, Plan 2024)

Hansestadt Lübeck

ADFC-Fahrradklimatest 2016	Note 4,04
Modal Split Fahrrad	21%
Täglich Radfahrende	34%

Konsequenzen

510 vorzeitige Todesfälle / Jahr

240 Mio. Euro zusätzliche Krankheits- / Pflegekosten

Hansestadt Lübeck

	Radlos	2017	VEP?
Modal Split Radverkehr %	0	21	42
Täglich Radfahrende %	0	34	68
Verhinderte Todesfälle (jährlich)	0	260	520
Kostensparnis Krankheit / Pflege Mio. € (jährlich)	0	120	240

A photograph of a person riding a bicycle on a path through a snowy landscape. The path is a narrow strip of dark ground, and the surrounding area is covered in deep snow. The person is wearing a red jacket and is riding away from the camera. The background shows a large, dark, irregular shape, possibly a cave entrance or a large rock formation, partially covered in snow. The overall scene is a winter or high-altitude environment.

Neugierig?
bewegungskonzepte.raabe@web.de

Danke für Ihre Aufmerksamkeit

Anhang

Flächenverbrauch

**„Den drohenden Verkehrskollaps
können wir nicht mit Autos
verhindern.“**

Manfred Schoch

Flächenverbrauch je Passagier

Trassenbreite

Fahrzeuglänge (+ Gleisabschnitt)

Sicherheitsabstand

MIV: 15 m bei 50 km/h; 50 m bei 100 km/h

Fahrgeschwindigkeit

Personen je Fahrzeug

Flächenverbrauch je Passagier

Verkehrsmittel	Personen/Fzg	Länge	Spurbreite	Notbremsung	Bremsung
		(m)	(m)	(m/s ²)	(m/s ²)
Fuß	1	1	1	9,6	
Rad	1	2	1,25	9,6	
MI	1,3	5	3,25	9,6	
MI Autobahn	1,3	5	6	9,6	
Bus	50	16	3,25	3	
Schnellbahn	300	150	4		1
RB / ICE	800	250 / 400	4,5		0,8

Komfortabel



Wünsche an die Politik

Mehr Radwege	56%
Trennung Radfahrende von Pkw	50%
Mehr Schutz- und Radfahrstreifen	41%
Sichere Abstellplätze	41%

Infrastruktur und Fahrradnutzung

ADFC-Klimatest 2016

Infas, TU Dresden 2017

	Durchschnittsnote Klimatest
11 Städte 3,09-3,67	3,49
21 Städte 3,68-4,12	3,90
11 Städte 4,15-4,61	4,32

Infrastruktur und Fahrradnutzung

ADFC-Klimatest 2016

Infas, TU Dresden 2017

	Durchschnittsnote Klimatest	Modal Split
11 Städte 3,09-3,67	3,49	22,6%
21 Städte 3,68-4,12	3,90	14,6%
11 Städte 4,15-4,61	4,32	12,1%

Wieviel Investition wäre sinnvoll?

DALY Disability adjusted life year

WHO: 49.770 EUR (D 2019)

D 2017: 764.463 Todesfälle von Radlosen

Verlust jeweils 4 Jahre: 3,06 Mio Jahre

Verlust jeweils 4,7 DALY: 3,59 Mio DALY

Jährlicher theoretischer Nutzen:

179 Mrd €

WHO; Destatis; Fries