VRIJE UNIVERSITEIT BRUSSEL

BICYCLE CRASHES IN ADULTS 45+ CONVENTIONAL & EAB

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CYCLING AND SOCIETY, BRISTOL 6-7/09/2018

MFYS HUMAN PHYSIOLOGY RESEARCH GROUP

mobi

Introduction

CYCLING

- Cycling is a form of Active transport
- Health benefits (Oja, 2011)
- Economic & environmental advantages (Mueller, 2015; Woodcock, 2008)

OLDER ADULTS & CYCLING

- Bicycles are commonly used as means of transport by older adults (65+) (Van Cauwenberg, 2018)
- This tendency will continue → electrically assisted bicycles (EAB – limited 250 Watt)

OLDER ADULTS & CYCLING

FACT CHECK

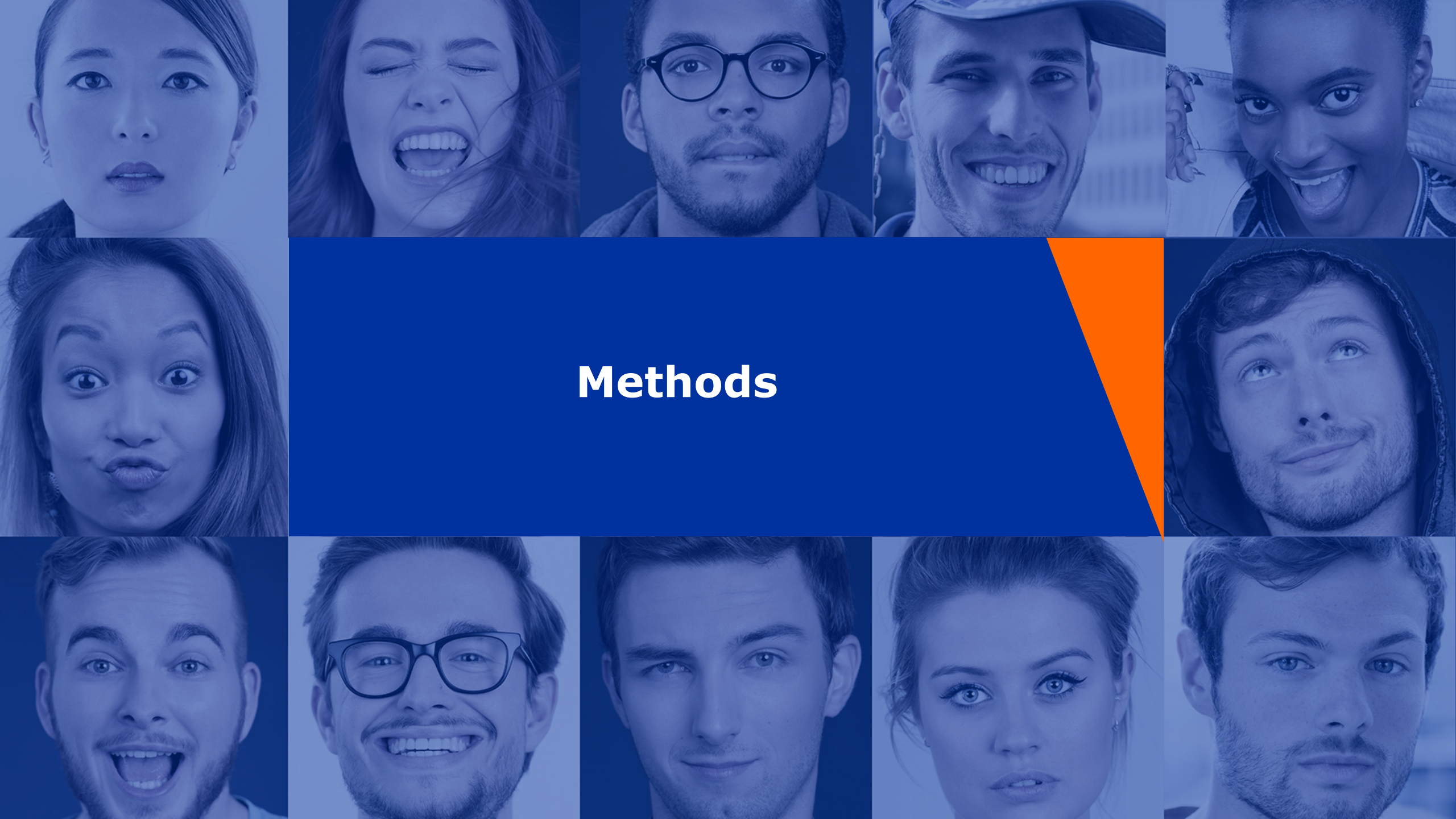
- Older adults → most severe injuries and higher risk (Feleke, 2018)
- Limited number of studies focused on older adults (55+) (Vanparijs, 2015)
- Even less studies on combination older adults (65+) + EAB

EXPOSURE

- Exposure: frequency, distance and/or time cycled
- Only few studies measure & include exposure
- Exposure = crucial for calculation of risks & incidence rates (Vanparijs, 2015)

PURPOSE

- Characteristics conventional vs EAB users (+45 years)
- Determine factors that increase likelihood of a bicycle crash
- Include exposure to calculate the risk of having a crash (conventional vs EAB)



Methods

STUDY DESIGN

- Retrospective
- Cross-sectional
- Self-reported
- Online and Paper&pencil Survey

INCLUSION & EXCLUSION

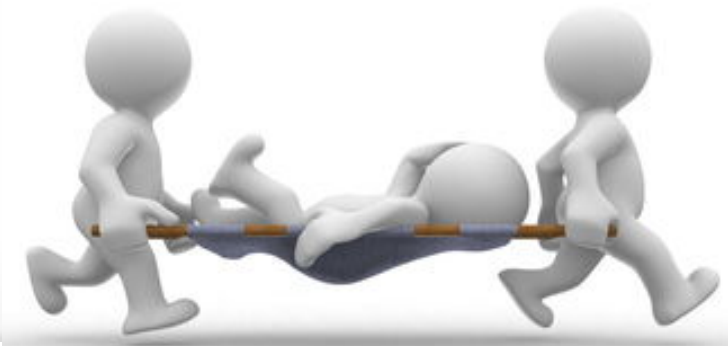
Participants

- Dutch speaking male/female
- Living in Flanders or the Netherlands
- Aged +45 years

INCLUSION & EXCLUSION

Bicycle crash?

- Collision or fall
- Potentially associated with physical or material damage
- Crashes during bike races excluded



PARTICIPANTS

RECRUITMENT

- Panel of the National Foundation for Elderly (the Netherlands)
  - Online or paper&pencil version of the survey

- Flemish Senior Council, Fietsersbond and Fietsberaad (Flanders)
  - Online or telephone interview

DATA COLLECTION

➢ Data collection: 1 June 2017 – 31 August 2017

MEASURES

SOCIO-DEMOGRAPHIC CHARACTERISTICS

- Age
- Gender
- (Former) main occupation
- Educational level
- Marital status
- Body Mass Index (BMI)
- Perceived health

MEASURES

QUESTIONNAIRE

- Crash characteristics
- Experiences while cycling: 9 questions were clustered into:
  - Mental
  - Strength and functionality
- Limitations during activities of daily living (ADL)
- Life space area
- Medication usage

MEASURES

EXPOSURE

- Bicycle exposure for conventional bike & EAB: preceding 12 months

# trips	Never	<1 day / month	1-3 days / month	1-2 days / week	3-4 days / week	5-7 days / week
Spring						
Summer						
Fall						
Winter						

STATISTICAL ANALYSIS

- IBM SPSS 25.0 & Microsoft Excel
- Socio-demographic - & crash characteristics → Descriptive statistics
  - Socio-demographics (3 groups)
  - Crash characteristics (2 groups)

STATISTICAL ANALYSIS

Examine crash likelihood → Logistic regression models

- Conventional & EAB separately
- Dependent variable: crash / no crash (dichotomous)
- Independent variable:
  - Characteristics (age, gender, BMI and perceived health)
  - Limitations in ADL
  - Life area displacement
  - Medication usage
  - Experiences while cycling

STATISTICAL ANALYSIS

Logistic regression analyses

- Step 1: Logistic regression with 1 independent variable and exposure as covariate
- Step 2: Logistic regression with all significant independent variables from step 1 and exposure as covariate

Results & Discussion

DIFFERENCES IN CHARACTERISTICS BETWEEN EAB & CONVENTIONAL

Table 1: Mean and standard deviation score

Variable	Conventional	EAB	Combination	F- / H- / Chi²-value	P
Age[c] (M±SD)	66.2 ± 9.7	68.4 ± 8.3	65.7 ± 9.0	12.6	.002*,#
Gender[b] (%women)	47.5	60.0	52.1	14.2	.001
Education[b] (%high education)	75.4	67.4	73.3	12.4	.054
Work status[b] (%retired)	65.4	74.2	62.1	15.5	.017
BMI[a] (M±SD)	25.9 ± 4.1	27.5 ± 4.2	26.4 ± 4.2	18.0	<0.001*,#
Perceived health[b] (%very good to excellent)	28.8	17.2	26.5	24.9	.001
Exposure[c] (M±SD)	167.0 ± 109.9	156.9 ± 103.3	242.8 ± 140.9	84.4	<0.001$,#
Mental[c] (M±SD)	1.2 ± 1.0	1.5 ± 1.1	1.2 ± 0.9	12.7	0.002*,#
Strength & functionality[c] (M±SD)	0.8 ± 0.8	1.1 ± 0.9	0.8 ± 0.7	24.8	<0.001*,#

[a]: One-Way Anova; [b]: Chi²; [c]: Kruskal-Wallis;
**: significant difference between conventional and EAB;*
$: significant difference between conventional and combination;
#: significant difference between combination and EAB

DIFFERENCES IN CHARACTERISTICS BETWEEN EAB & CONVENTIONAL

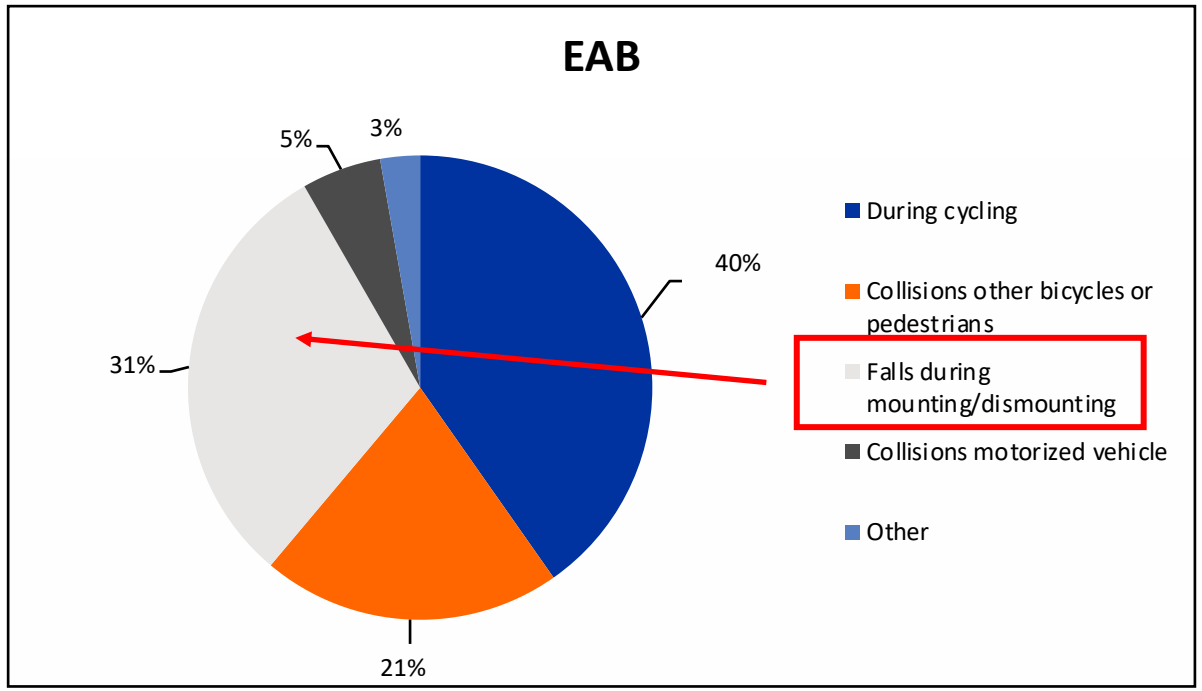
- Schepers (2014)
  - "It is plausible that EAB users exhibit characteristics and behaviour that influences their crash likelihood."
- Vlakveld (2015)
  - "EAB cyclists might have a poorer physical state than conventional cyclists."

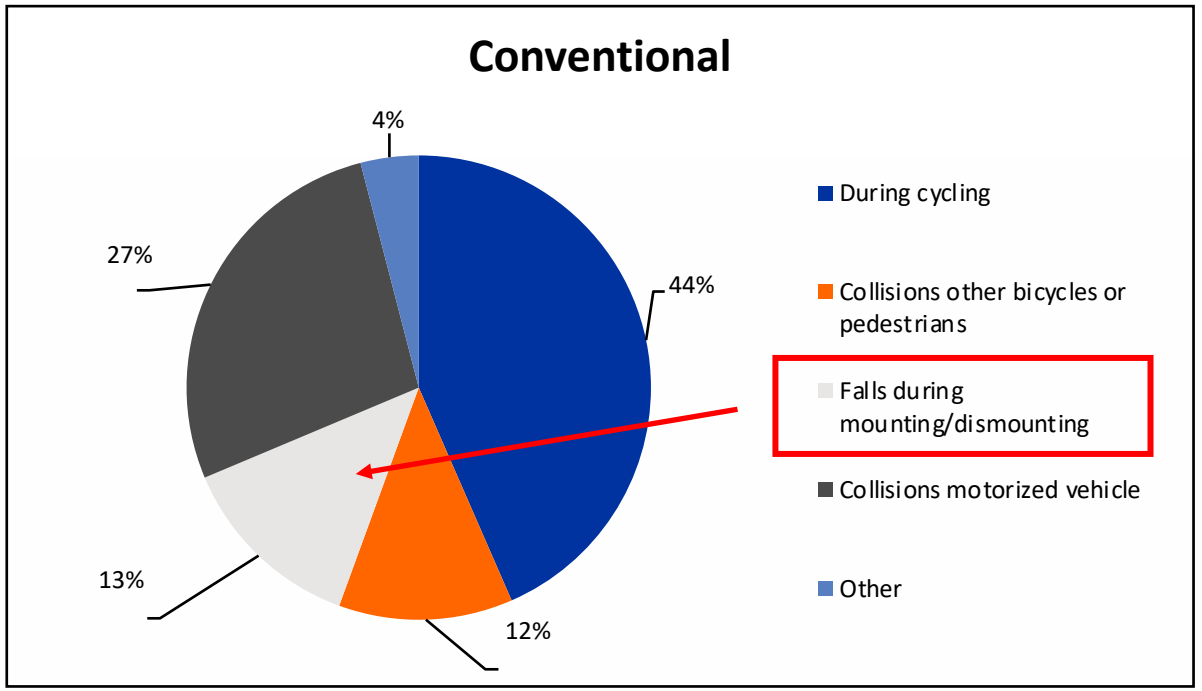
➔ Our findings confirm previous hypotheses

DIFFERENCES IN CHARACTERISTICS BETWEEN EAB & CONVENTIONAL

CRASH CHARACTERISTICS

Crash cause





DIFFERENCES IN CHARACTERISTICS BETWEEN EAB & CONVENTIONAL

CRASH CHARACTERISTICS

- Falls when (dis)mounting more than two times more frequent in EAB group

  → Corresponds with Schepers (2014)

- Why?
  - EAB +/- 10 kilo heavier (Vlakveld, 2015)
  - EAB cyclist: older and poorer physical condition (Vlakveld, 2015)
- Falls while (dis)mounting → typical crash type for older adults (75+) (BoeleVos, 2016)

DIFFERENCES IN CHARACTERISTICS BETWEEN EAB & CONVENTIONAL

EXPOSURE

- No significant difference in #trips between EAB and conventional group (p=0.166)
- No significant difference in #trips between men and women in EAB group (p=0.316)
- No significant difference in #trips between men and women in conventional group (p=0.539)

➔ Significant differences might be present in distance and time.

INCIDENCE RATES

- EAB: 291 participants – 102 crashes (40.1% of all crashes)
- Conventional: 952 participants – 150 crashes (58.5% of all crashes)
- Combination: 317 participants

Type	Incidence rate (95% CI) (per 1000 trips)
Overall	0.937 (95% CI 0.824–1.051)
Conventional - MEN	0.856 (95% CI 0.673 – 1.038)
Conventional - WOMEN	0.701 (95% CI 0.534 – 0.868)
EAB - MEN	0.883 (95% CI 0.582 – 1.185)
EAB - WOMEN	1.489 (95% CI 1.145 – 1.833)

CRASH LIKELIHOOD PREDICTION

FINAL BINARY LOGISTIC REGRESSION

Table 4: Final logistic regression for EAB crashes

Dependent variable	p	OR	95% CI
Gender	.250	1.324	.821 – 2.137
Perceived Health	.960	1.010	.686 – 1.486
Activities of daily living	.926	.999	.989 – 1.010
Experiences during cycling			
Mental	.001*	1.547	1.193 – 2.006
Strength & Functionality	.012*	1.572	1.103 – 2.242

*OR: Odds Ratio; CI: Confidence Interval; *: significant Odds Ratio*

Table 5: Final logistic regression for conventional bicycle crashes

Dependent variable	p	OR	95% CI
Perceived Health	.622	1.069	.819 – 1.395
Activities of daily living	.165	1.006	.997 – 1.015
Experiences during cycling			
Mental	<0.001*	1.634	1.327 – 2.014
Strength & Functionality	.872	1.025	.762 – 1.378

*OR: Odds Ratio; CI: Confidence Interval; *: significant Odds Ratio*

- Poor strength & functionality beliefs and experiences → main argument for cyclists to choose for an EAB (Vlakveld, 2015; Scheiman, 2010)
- Our questionnaire → Screening tool?

Limitations

DISCUSSION

STUDY LIMITATIONS

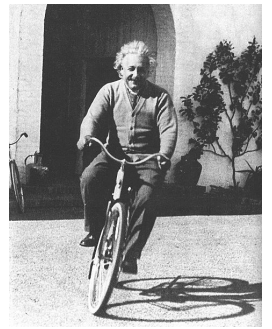
- Overrepresentation of well-educated participants
- Recall bias → retrospective design
- Selection bias → organizations and snowball sampling
- No amount of kilometres or time spent cycling

Conclusion

CONCLUSION

- Different characteristics between EAB & conventional bike users
- EAB → older and less physical fitness
- Main cause of crash:
  - For both types: 'during cycling'
  - EAB: falls during mounting & dismounting
  - Conventional bicycle: collision with motorised vehicle
- Incidence rate is highest for women on EAB
- 'Mental' and 'Strength&Functionality' increase the likelihood of crashes

Scientists for cycling



Thank you for your attention

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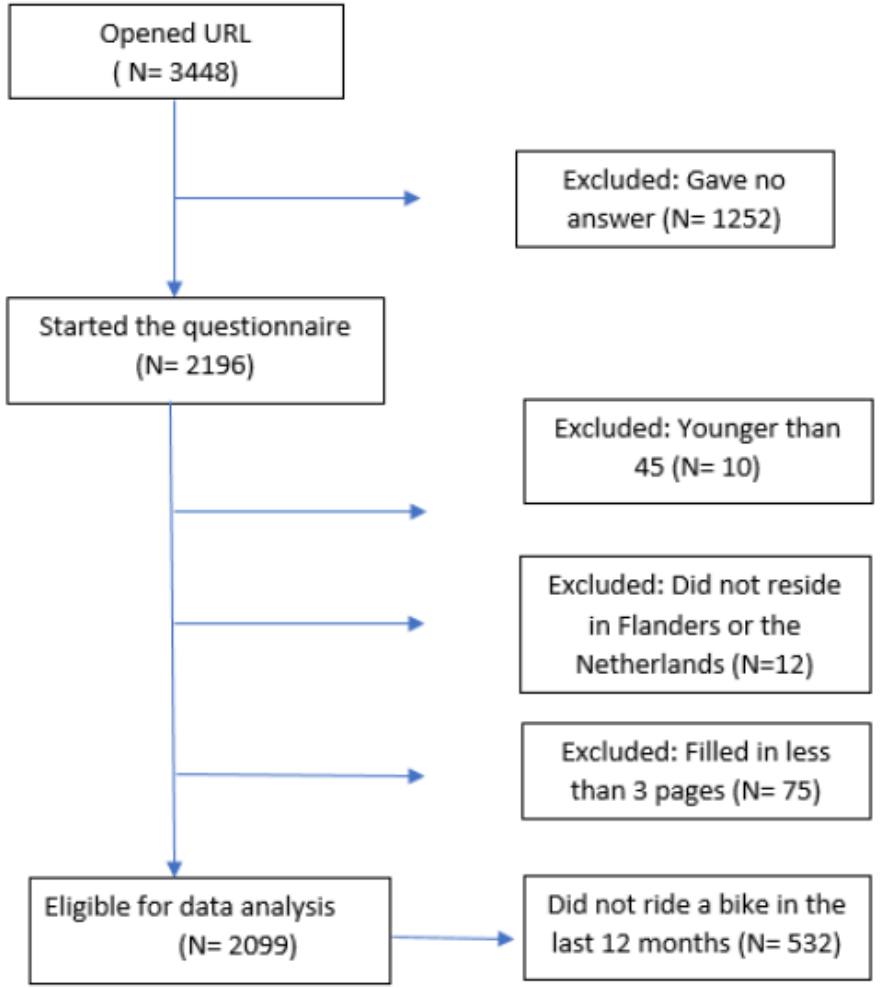
APPENDIX B

FLOW CHART

7.2 Appendix B

Figure 1: Flow chart recruitment



APPENDIX A

INTRACLASS CORRELATION

- Clustering → 'Mental', 'Strength & Functionality', 'Limitations during activities of daily living'
  - Two way ICC > 0.70
  - $p < 0.05$

7.1 Appendix A

Results two-way mixed intraclass correlation.

Cluster	Intraclass Correlation	Sig
Activities of daily living	.832	.000
Mental	.812	.000
Strength & functionality	.767	.000

APPENDIX C

COLLINEARITY ANALYSIS

- Collinearity analysis (Field, 2009)
  - Tolerance < 0.1 and/or VIF > 10.0 → Multicollinearity

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7.3 Appendix C

Results collinearity analysis.

Variable	Collinearity Statistics	
	Tolerance	VIF
Sex	.878	1.139
Age	.737	1.357
BMI	.900	1.112
Perceived Health	.654	1.529
Activities of daily living	.559	1.789
Medicines:		
Sleeping pills or tranquilizers	.913	1.095
Depression or anxiety medication	.935	1.070
Epilepsy	.984	1.016
Mental disorders	.981	1.019
Allergy, antihistamines	.908	1.101
Strong painkillers, opiates	.890	1.124
Parkinson	.970	1.031
Blood thinners	.753	1.328
No medicines	.683	1.464
Life area displacement:		
Places in the neighbourhood	.691	1.446
Within village / town / city	.576	1.735
Outside village / town / city	.624	1.404
Experiences during cycling		
Mental	.624	1.602
Strength + Functionality	.483	2.069
E-bike possession	.878	1.139

LOGISTIC REGRESSION

STEP 1 - EAB

Table 2: Univariate logistic regressions for EAB crashes

Dependent variable	p	OR	95% CI
Gender	.028*	1.659	1.055 – 2.609
Age	.605	.994	.969 – 1.018
BMI	.982	1.003	.780 – 1.290
Perceived Health	.014*	1.490	1.083 – 2.051
Activities of daily living	.002*	1.012	1.004 – 1.020
Medication:			
Sleeping pills or tranquilizers	.716	1.160	.521 – 2.586
Depression or anxiety medication	.160	1.822	.789 – 4.209
Epilepsy	.999	.000	.000
Mental disorders	.737	1.480	.150 – 14.655
Allergy, antihistamines	.975	1.012	.476 – 2.151
Strong painkillers, opiates	.835	1.102	.441 – 2.756
Parkinson	.999	.000	.000
Blood thinners	.277	.757	.459 – 1.250
Life area displacement:			
Places in the neighbourhood	.720	1.038	.847 – 1.271
Within village / town / city	.898	1.014	.819 – 1.256
Outside village / town / city	.958	1.006	.813 – 1.244
Experiences during cycling			
Mental	<.001*	1.911	1.537 – 2.378
Strength & Functionality	<.001*	2.064	1.600 – 2.662
E-bike possession	.785	.973	.798 – 1.186

*OR: Odds Ratio; CI: Confidence Interval; BMI: Body Mass Index; *: significant Odds Ratio*

LOGISTIC REGRESSION

STEP 1 - CONVENTIONAL

Table 3: Univariate logistic regression for conventional bicycle crashes

Dependent variable	P	OR	95% CI
Gender	.398	1.157	.825 – 1.624
Age	.309	.991	.973 – 1.009
BMI	.288	1.121	.908 – 1.385
Perceived Health	.005*	1.391	1.106 – 1.750
Activities of daily living	<.001*	1.013	1.006 – 1.020
Medication:			
Sleeping pills or tranquilizers	.481	.783	.397 – 1.545
Depression or anxiety medication	.131	1.692	.855 – 3.350
Epilepsy	.652	.622	.079 – 4.886
Mental disorders	.999	.000	.000
Allergy, antihistamines	.546	1.201	.662 – 2.180
Strong painkillers, opiates	.299	1.514	.692 – 3.314
Parkinson	.773	.737	.093 – 5.853
Blood thinners	.149	.719	.459 – 1.126
No medicines	.043*	1.431	1.012 – 2.023
Life area displacement:			
Places in the neighbourhood	.769	.975	.826 – 1.152
Within village / town / city	.709	.967	.811 – 1.153
Outside village / town / city	.666	1.037	.878 – 1.226
Experiences during cycling			
Mental	<0.001*	1.752	1.481 – 2.071
Strength & Functionality	<0.001*	1.687	1.368 - 2.080

*OR: Odds Ratio; CI: Confidence Interval; BMI: Body Mass Index; *: significant Odds Ratio*

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EXPOSURE

VRAGENLIJST

Vragen voor fietsers

* **Hoe vaak heeft u zich in de afgelopen 12 maanden met een *gewone (niet-elektrische)* fiets verplaatst in de verschillende seizoenen?**

Denk hierbij aan verplaatsingen met de fiets van en naar het werk, om boodschappen te doen, iemand te bezoeken of fietsen voor ontspanning. Fietsen in competitief verband telt hier niet mee.

	Nooit	Minder dan 1 dag per maand	1-3 dagen per maand	1-2 dagen per week	3-4 dagen per week	5-7 dagen per week
In de lente	○	○	○	○	○	○
In de zomer	○	○	○	○	○	○
In de herfst	○	○	○	○	○	○
In de winter	○	○	○	○	○	○

EXPERIENCES WHILE CYCLING

Q19

* **Hoe vaak heeft u de volgende ervaringen tijdens het fietsen?**

	Nooit	Sporadisch	Af en toe	Regelmatig	Zeer vaak	Altijd
Ik voel me onzeker tijdens het fietsen	○	○	○	○	○	○
Ik heb veel concentratie/aandacht nodig tijdens het fietsen	○	○	○	○	○	○
Het voelt voor mij niet comfortabel in rommelige, chaotische of onduidelijke verkeerssituaties	○	○	○	○	○	○
Ik heb angst om te vallen of te botsen met andere weggebruikers	○	○	○	○	○	○
Mijn reactiesnelheid is verminderd	○	○	○	○	○	○
De kracht in mijn benen maakt fietsen moeilijk	○	○	○	○	○	○
De kracht in mijn armen maakt fietsen en hard remmen moeilijk	○	○	○	○	○	○
Ik merk dat ik minder goed achterom kan kijken dan vroeger	○	○	○	○	○	○
Ik heb coördinatie- of evenwichtsproblemen	○	○	○	○	○	○
Andere klachten	○	○	○	○	○	○

SCHOLING

Q3BIS

Algemene en gezondheidsinformatie

* **Hoeveel jaar scholing heeft u gehad?**

Kies één van de volgende antwoorden

- ○ 0 tot 6 jaar
- ○ 7 tot 9 jaar
- ○ 10 tot 12 jaar
- ○ Meer dan 12 jaar