

Health impact assessment of cycling network expansions in European cities  
Supplementary material

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## **Health impact assessment of cycling network expansions in European cities**

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## A. CYCLING NETWORK AND MODE SHARE DATA OF 168 EUROPEAN CITIES

**Table S1. Cycling network and mode share data of 168 European cities**

Country	City	Population <sup>a</sup>	Mode share (%) <sup>a</sup>				Year	Cycle network (km) <sup>b</sup>
			Walk	Bike	PT	Car		
Austria	Graz	257328	19	14	20	47	2013	127.47
Austria	Linz	190000	22	5	24	49	2008	48.80
Austria	Salzburg	145700	20	20	15	45	2012	51.44
Austria	Wien	1797337	28	6	39	27	2015	715.45
Belgium	Ghent	251000	24	20	9	47	2012	298.06
Belgium	Charleroi	202598	3	1	12	84	2008	65.94
Belgium	Liege	192504	6	2	16	76	2008	30.53
Belgium	Brussels	171459	25	3	28	44	2010	80.03
Belgium	Brugge	117000	11	28	18	44	2011	261.16
Belgium	Namur	108950	6	2	22	70	2008	88.75
Belgium	Antwerp	493517	20	23	16	41	2011	451.24
Denmark	Copenhagen	591000	17	30	20	33	2014	422.05
Denmark	Odense	187000	19	27	26	28	2008	378.18
France	Paris	2211297	47	3	33	17	2008	285.92
France	Lyon	138000	34	2	19	45	2015	615.92
France	Marseille	118000	34	1	11	54	2009	106.24
France	Lille	109000	32	2	10	57	2006	98.69
France	Bordeaux	881000	21	3	9	67	2009	132.30
France	Nantes	580000	27	5	16	52	2012	136.98
France	Toulon	575000	27	1	5	67	2008	24.79

France	Nice	508000	40	1	11	48	2009	47.26
France	Strasbourg	439000	33	8	12	47	2009	210.57
France	Rouen	396000	26	1	8	65	2007	25.25
France	Grenoble	393000	31	4	17	49	2010	54.32
France	Rennes	392000	28	4	13	55	2007	128.02
France	Lens	368000	28	2	4	66	2006	6.99
France	Tours	348000	28	4	8	61	2008	78.14
France	Aix	317000	26	1	7	66	2009	21.60
France	Le Havre	267000	34	1	8	57	2007	65.63
France	Nancy	258000	36	1	12	51	2013	12.72
France	Reims	228000	30	1	9	60	2006	62.23
France	Amiens	174000	33	2	7	58	2010	28.87
France	Chambéry	117000	28	2	6	64	2006	40.85
Germany	Berlin	3506239	30	13	26	31	2008	1335.28
Germany	Hamburg	1735663	28	12	18	42	2008	815.46
Germany	München	1326807	28	14	21	37	2008	697.91
Germany	Köln	989766	24	12	21	43	2006	213.99
Germany	Frankfurt	680000	31	11	20	38	2008	228.41
Germany	Düsseldorf	629005	27	11	22	40	2008	188.46
Germany	Stuttgart	592915	27	5	24	44	2009	34.21
Germany	Bremen	547735	21	25	14	40	2008	587.71
Germany	Hannover	518386	25	19	18	38	2011	472.21
Germany	Leipzig	515418	27	14	19	40	2008	289.80
Germany	Dresden	512546	22	16	21	41	2008	219.12
Germany	Nürnberg	50600	23	11	22	44	2011	107.89
Germany	Bochum	374737	18	6	20	56	2010	91.96

Germany	Wuppertal	349470	15	2	25	58	2011	66.10
Germany	Mannheim	326964	27	13	16	44	2008	147.23
Germany	Bielefeld	323270	15	15	16	54	2010	146.92
Germany	Bonn	317949	28	12	14	46	2008	89.70
Germany	Karlsruhe	298000	24	25	17	34	2012	177.96
Germany	Münster	280000	16	38	10	36	2007	437.45
Germany	Augsburg	265000	24	13	16	47	2010	94.84
Germany	Chemnitz	249500	26	6	14	54	2008	81.45
Germany	Aachen	249000	22	12	15	51	2012	171.07
Germany	Halle (Saale)	238837	29	14	18	39	2008	96.20
Germany	Magdeburg	234977	21	10	21	48	2008	156.95
Germany	Halle	233000	26	12	18	44	2010	30.18
Germany	Mainz	201500	28	10	21	41	2008	60.63
Germany	Erfurt	201368	29	8	24	39	2008	106.61
Germany	Kassel	198167	29	7	22	42	2008	39.98
Germany	Hamm	182459	11	17	11	61	2008	122.51
Germany	Saarbrücken	175741	23	4	17	56	2010	45.10
Germany	Osnabrück	164405	19	12	16	53	2010	162.78
Germany	Solingen	161779	14	3	22	61	2008	50.84
Germany	Oldenburg	159563	17	22	6	55	2007	145.25
Germany	Neuss	153758	12	10	14	64	2012	83.75
Germany	Potsdam	149687	23	20	19	38	2008	90.08
Germany	Darmstadt	143499	27	15	13	45	2011	52.40
Germany	Heidelberg	139200	20	25	18	37	2010	38.75
Germany	Göttingen	123594	25	27	13	35	2009	139.75
Germany	Heilbronn	122302	20	8	12	60	2008	13.70

Germany	Ulm	121648	28	9	11	52	2008	15.18
Germany	Offenbach am Main	120500	26	9	13	52	2008	26.36
Germany	Reutlingen	112258	22	15	10	53	2007	57.37
Germany	Jena	110097	39	10	16	35	2008	24.18
Germany	Gera	105689	29	4	19	48	2008	32.35
Germany	Kaiserslautern	105352	29	3	14	54	2008	41.28
Germany	Hildesheim	103593	22	12	11	55	2007	91.77
Germany	Witten	100248	16	3	13	68	2006	21.56
Italy	Torino	900000	7	1	28	64	2011	143.45
Italy	Palermo	678492	12	1	9	78	2015	3.88
Italy	Bologna	373026	21	7	26	46	2007	121.06
Italy	Bari	322751	3	1	20	76	2013	20.08
Italy	Verona	265368	18	9	8	65	2008	55.80
Italy	Messina	245159	18	1	8	73	2006	5.92
Italy	Padua	205631	5	16	22	57	2011	87.04
Italy	Trieste	201814	19	1	20	60	2012	10.78
Italy	Parma	187214	6	6	13	75	2010	84.56
Italy	Reggio Emilia	163928	10	18	8	64	2012	158.18
Italy	Perugia	162097	10	0	14	76	2011	4.44
Italy	Ravenna	154288	23	15	24	39	2012	91.90
Italy	Ferrara	135000	12	27	5	56	2008	95.89
Italy	Bolzano	104000	29	29	8	34	2009	68.39
Italy	Rome	2869461	16	1	29	54	2014	120.10
Netherlands	Amsterdam	747093	20	22	20	38	2008	844.91
Netherlands	Rotterdam	582951	18	16	17	49	2008	791.05
Netherlands	Utrecht	316000	17	26	16	41	2012	386.23

Netherlands	Eindhoven	220782	13	40	5	42	2014	344.52
Netherlands	Tilburg	202091	14	23	6	57	2008	256.34
Netherlands	Almere	183270	16	19	13	52	2008	418.12
Netherlands	Groningen	182484	15	31	10	44	2008	297.79
Netherlands	Breda	180053	0	27	5	68	2013	264.23
Netherlands	Nijmegen	161251	16	24	9	51	2008	230.84
Netherlands	Apeldoorn	155108	13	28	4	55	2008	473.75
Netherlands	Enschede	154753	15	26	4	55	2008	254.53
Netherlands	Haarlem	147640	15	26	10	49	2008	163.57
Netherlands	Arnhem	143582	15	19	10	56	2008	315.17
Netherlands	Zaanstad	142863	15	25	7	53	2008	144.30
Netherlands	Amersfoort	141211	13	28	7	52	2008	202.16
Netherlands	Haarlemmermeer	140648	9	17	9	65	2008	392.51
Netherlands	's-Hertogenbosch	136481	14	19	7	60	2008	276.95
Netherlands	Zoetermeer	119504	18	19	7	56	2008	187.88
Netherlands	Maastricht	118004	19	22	7	52	2008	141.44
Netherlands	Leiden	116878	15	33	12	40	2008	139.82
Netherlands	Zwolle	116365	11	30	8	51	2008	216.75
Netherlands	Emmen	109151	12	25	2	61	2008	371.48
Netherlands	Ede	107686	13	25	4	58	2008	417.24
Portugal	Porto	237584	22	0	26	52	2011	21.04
Spain	Madrid	3233527	29	0	42	29	2012	292.64
Spain	Valencia	786189	41	4	23	32	2012	191.90
Spain	Sevilla	702355	37	6	22	35	2011	176.13
Spain	Málaga	561000	38	1	12	49	2008	74.78
Spain	Tarragona	528000	49	1	4	46	2006	3.62



Spain	Bilbao	353000	60	1	28	11	2006	30.25
Spain	Córdoba	330000	43	2	10	45	2010	154.96
Spain	Pamplona	321000	43	1	15	41	2006	43.98
Spain	A Coruña	246146	48	2	13	37	2013	16.51
Spain	Vitoria-Gasteiz	240000	54	13	8	25	2014	139.84
Spain	San Sebastián	186185	49	4	19	28	2011	56.24
Spain	Burgos	178500	45	4	23	28	2010	57.56
Spain	León	137064	64	1	6	29	2009	20.74
Spain	Barcelona	1620943	32	2	40	26	2012	155.09
Sweden	Stockholm	1889945	17	1	35	47	2006	959.36
Sweden	Göteborg	543000	24	7	28	41	2014	470.31
Sweden	Malmö	313000	15	22	21	42	2013	264.23
Sweden	Linköping	141200	15	20	10	55	2008	131.21
Sweden	Uppsala	140175	19	28	11	42	2010	332.32
Sweden	Norrköping	129985	18	13	10	59	2010	185.09
Sweden	Lund	110332	16	26	16	42	2007	212.53
Sweden	Umeå	110000	16	19	8	57	2006	287.64
Sweden	Örebro	138952	11	25	9	55	2012	355.12
Switzerland	Basel	169464	29	20	28	23	2010	34.30
Switzerland	Zürich	410404	27	4	39	30	2015	118.96
UK	Leeds	770800	4	1	38	57	2010	190.68
UK	Sheffield	534500	10	1	34	55	2010	77.40
UK	Portsmouth	442252	15	7	11	67	2008	62.38
UK	Bristol	437000	21	14	16	49	2013	108.07
UK	Nottingham	303900	17	4	25	54	2011	146.31
UK	Leicester	294700	28	2	35	35	2011	89.84

UK	Plymouth	256700	18	3	12	67	2010	80.49
UK	Stoke-on-Trent	240000	11	1	16	72	2011	113.97
UK	Southampton	234100	14	3	24	59	2010	51.55
UK	York	197800	20	12	11	57	2011	147.11
UK	Milton Keynes	195687	10	4	11	75	2009	411.92
UK	Swindon	184000	6	7	2	85	2010	130.26
UK	Southend-on-Sea	174300	15	3	23	59	2011	28.72
UK	Peterborough	164000	25	6	8	61	2008	187.08
UK	Thurrock	158300	6	2	22	70	2011	41.59
UK	Oxford	150200	19	19	21	41	2011	99.19
UK	Blackburn w/ Darwen	147700	20	1	9	70	2011	11.46
UK	Blackpool	141900	17	1	2	80	2010	6.66
UK	Norwich	132512	25	10	10	55	2011	18.48
UK	Ipswich	128000	30	2	8	60	2009	45.32
UK	Watford	121000	22	2	10	66	2008	19.81
UK	Exeter	118000	26	4	9	61	2008	89.19
UK	Preston	114000	23	2	10	65	2006	64.46
UK	London	8673713	30	3	29	38	2015	938.18

<sup>a</sup>Population and mode share data were available through the European Platform on Mobility Management (EPOMM, 2011)

<sup>b</sup>Cycling network distance data was available through OpenStreetMap

**Table S2. OpenStreetMap labels for designated, non-shared cycle ways**

<b>Category</b>	<b>Query string</b>
highway_cycleway	way[highway=cycleway]
highway_cycleway	way[highway=cycleway][moped=no]
highway_cycleway	way[highway=cycleway][mofa=no]
cycleway=cyclestreet	way[cycleway=cyclestreet]
cycleway=cyclestreet	way[cyclestreet=yes]
cycleway=cyclestreet	way[cycleway~'track'][highway!=cycleway]
cycleway=cyclestreet	way['cycleway:right'~'track']
cycleway=cyclestreet	way['cycleway:left'~'track']
cycleway=cyclestreet	way[cycleway=lane]
cycleway=cyclestreet	way[cycleway=opposite_lane]
cycleway=cyclestreet	way['cycleway:right'=opposite_lane]
cycleway=cyclestreet	way['cycleway:left'=opposite_lane]
cycleway=cyclestreet	way['cycleway:left'=lane]

## B. MORTALITY DATA

**Table S3. All-cause mortality rates for the seven PASTA cities**

City	All-cause mortality rate (per 100,000 persons)	Age group	Reference
Antwerp	992	≥ 18 years	Statistics Belgium, 2011
Barcelona	936	≥ 18 years	Agencia de Salud Publica, 2013
London	876	≥ 18 years	UK Office for National Statistics, 2015
Örebro	861	≥ 18 years	Statistik om Örebro Kommun, 2016
Rome	1045	≥ 18 years	NA
Vienna	960	≥ 18 years	Statistik Austria, 2015
Zurich	828	≥ 18 years	Statistisches Jahrbuch Schweiz, 2016

## C. PHYSICAL ACTIVITY

**Table S4. Baseline physical activity levels for Antwerp, Belgium**

Physical activity	All adults (%)	Minutes	MET	MET-min/ week	ME-hr/ week	weighted MET-hr /week
Intensive training/ sport $\geq$ 4 hours/ week	18.2	240	8	1920	32	12.11
Sports >4 hours/ light activities/ week	58.1	150	4	600	10	
Inactive	23.7	30	4	120	2	

Belgian Health Interview Survey, 2013 (Drieskens et al., 2013)

**Table S5. Baseline physical activity levels for Barcelona, Spain**

Physical activity	All adults (%)	Minutes	MET	MET-min/ week	ME-hr/ week	weighted MET-hr/ week
Intensively active	15.6	150	8	1200	20	6.12
Moderately active	10.7	150	4	600	10	
Some activity	11.5	89.5	4	358	5.97	
Inactive	62.2	30	4	120	2	

Barcelona Health Survey, 2011 (Bartoll et al., 2013)

**Table S6. Baseline physical activity levels for London, United Kingdom**

Physical activity	All adults (%)	Minutes	MET	MET-min/ week	ME-hr/ week	weighted MET-hr/ week
Meet recommendation	59.3	150	4	600	10	7.34
Some activity	10.3	104.5	4	418	6.97	
Low activity	5.6	44.5	4	178	2.97	
Inactive	24.2	30	4	120	2	

British Heart Foundation, 2015 (Townsend et al., 2015)

**Table S7. Baseline physical activity levels for Örebro, Sweden**

Physical activity	All adults (%)	Minutes	MET	MET-min/ week	ME-hr/ week	weighted MET-hr /week
Sufficiently active	62.0	150	4	600	10	6.96
Insufficiently active	28.0	30	4	120	2	

Health Survey Örebro County, 2015 (Svenska Folkhälsomyndigheten, 2015)

**Table S8. Baseline physical activity levels for Rome, Italy**

Physical activity	All adults (%)	Minutes	MET	MET-min/ week	ME-hr/ week	weighted MET-hr /week
Sufficiently active	38.2	150	4	600	10	6.32
Partially active	31.9	89.5	4	358	5.97	
Sedentary	29.9	30	4	120	2	

Italian Ministry of Health, 2011 (Azienda Unita' Sanitaria Locale Roma D, 2011)

**Table S9. Baseline physical activity levels for Vienna, Austria**

Minutes of leisure time activity/ week	All adults (%)	MET-min/ week	MET-hr/week	weighted MET-hr/ week
0	31.8	0	0.0	9.18
1- 30	2.4	60	1.0	
31- 60	7.8	180	3.0	
61- 90	5.1	300	5.0	
91- 120	11.8	420	7.0	
121- 150	2.4	540	9.0	
151- 180	8.6	660	11.0	
181- 210	1.8	780	13.0	
211- 240	5.4	900	15.0	
241- 270	0.6	1020	17.0	
271- 300	4.4	1140	19.0	
301- 330	1.0	1260	21.0	
331- 360	3.6	1380	23.0	
361- 390	0.6	1500	25.0	
391- 420	2.3	1620	27.0	
421+	10.3	1684	28.1	

Austrian Health Survey, 2014 (Klimont and Baldaszti, 2015)

**Table S10. Baseline physical activity levels for Zurich, Switzerland**

<b>Physical activity</b>	<b>Adults (%)</b>	<b>Minutes</b>	<b>MET</b>	<b>MET-min/ week</b>	<b>ME-hr/ week</b>	<b>weighted MET-hr/ week</b>
Trained	30	150	8	1200	20	11.39
Regularly active	13	150	4	600	10	
Unregularly active	27	150	4	600	10	
Partially active	20	89.5	4	358	5.97	
Inactive	10	30	4	120	2	

Swiss Health Survey, 2012 (Bundesamt für Statistik, 2014)



## D. AIR POLLUTION

**Table S11. Background air pollution data for the seven PASTA cities**

City	Background PM2.5 ( $\mu\text{g}/\text{m}^3$ )	Data source	Reference
Antwerp	17.0	Flemish Environment Agency, 2012	?
Barcelona	16.6	European Study of Cohorts for Air Pollution Effects Land Use Regression study (ESCAPE)	(Eeftens et al., 2012)
London	16.4	Transport for London (roadside), 2008-2015	(Transport for London, 2015)
Örebro	10.2	2005?	?
Rome	20.6	?	?
Zurich	12.9	Health and Environment Department, 2015	(Nationales Beobachtungsnetz für Luftfremdstoffe (NABEL), 2015)
Vienna	17.0	Environmental Protection Department, 2012	(Augustyn et al., 2013)

**Table S12. Air pollution exposure by activity**

Leisure time and transport activities	Air pollution Example: Barcelona	
	PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )	Ratios <sup>a</sup>
Background	16.60	1.00
Sleep	16.60	1.00
Rest	16.60	1.00
Car	24.90	1.50
Public transport	24.90	1.50
Bicycle	21.41	1.29
Walking	21.41	1.29

<sup>a</sup>Ratios are applied for all cities and compare to background concentrations (de Nazelle et al., 2017).

**E. TRAFFIC FATALITIES**

**Table S13. Baseline traffic fatalities by mode of transport in the seven PASTA cities**

City	Traffic fatalities by mode											
	Car			Public transport			Bicycle			Walking		
	Fatalities/ year	Km/ year	Fatalities/ billion km	Fatalities/ year	Km/ year	Fatalities/ billion km	Fatalities/ year	Km/ year	Fatalities/ billion km	Fatalities/ year	Km/ year	Fatalities / billion km
Antwerp <sup>a</sup>	3	1,276,653,235	2	0	381,205,479	0	4	286,142,382	14	7	95,877,344	17
Barcelona <sup>b</sup>	9	2,917,369,018	3	0	3,434,219,641	0	3	89,663,002	30	20	552,796,013	36
London <sup>c</sup>	19	13,689,383,696	1	0	10,447,161,241	0	13	463,174,636	28	64	1,543,915,454	41
Örebro <sup>d</sup>	1	312,636,654	3	0	64,757,880	0	2	59,361,390	34	1	9,497,822	105
Rome <sup>e</sup>	35	6,048,779,232	6	2	2,485,547,287	1	4	44,754,760	83	46	275,924,880	165
Vienna <sup>f</sup>	4	2,623,812,297	2	0	2,899,904,287	0	3	232,962,226	11	8	418,913,095	19
Zurich <sup>g</sup>	0	1,069,533,348	0	1	1,063,867,987	1	1	56,976,836	18	4	148,195,066	27

<sup>a</sup>mean annual traffic fatalities by mode of transport (2011-2014). (Verkeerspolitie Antwerpen, 2015)

<sup>b</sup>mean annual traffic fatalities by mode of transport (2011-2015). (Agència de Salut Pública, 2016)

<sup>c</sup>annual traffic fatalities by mode of transport 2014. (Transport for London, 2015)

<sup>d</sup>mean annual traffic fatalities by mode of transport (2011-2015). ?

<sup>e</sup>mean annual traffic fatalities by mode of transport (2010-06/2016). ?

<sup>f</sup>mean annual traffic fatalities by mode of transport (2010-2015). (Kuratorium für Verkehrssicherheit, 2014; Statistik Austria, 2015)

<sup>g</sup>annual traffic fatalities by mode of transport 2015. (Stadt Zürich. Dienstabteilung Verkehr., 2016)

## F. SENSITIVITY ANALYSES

**Table S14. Sensitivity analysis. Mortality impact for each scenario under the assumption that the new cycling trips come by 75% from previous car trips and by 25% from previous public transport trips**

City	Physical activity (deaths avoided) (95% CI)	Air pollution active traveler (additional deaths) (95% CI)	Traffic incidents (additional deaths) (95% CI)	Total deaths (95% CI)	Total deaths (per 100,000 persons) (95% CI)
<b>Antwerp</b>					
S1 10%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S2 50%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S3 100%	-3 (-2;-4)	1 (0;0)	0 (0;0)	-2 (-2;-4)	0 (0;-1)
S4 'Go-Örebro'	-5 (-4;-6)	1 (1;1)	0 (0;0)	-4 (-2;-6)	-1 (0;-1)
S5 'All-streets'	-5 (-4;-6)	1 (1;1)	0 (0;0)	-4 (-2;-6)	-1 (0;-1)
<b>Barcelona</b>					
S1 10%	-10 (-7;-13)	1 (1;2)	0 (0;0)	-8 (-5;-11)	0 (0;-1)
S2 50%	-16 (-12;-22)	2 (1;3)	1 (1;1)	-13 (-8;-20)	-1 (0;-1)
S3 100%	-25 (-18;-34)	4 (2;5)	1 (1;1)	-20(-11;-27)	-1 (-1;-2)
S4 'Go-Örebro'	-224(-165;-309)	33 (19;42)	11 (11;11)	-180 (-113;-279)	-11 (-7;-17)
S5 'All-streets'	-171 (-126;-236)	25 (15;32)	8 (8;8)	-138 (-86;-213)	-8 (-5;-13)
<b>London</b>					
S1 10%	-9 (-7;-12)	2 (1;2)	1 (1;1)	-7 (-4;-11)	0 (0;0)
S2 50%	-42 (-31;-58)	7 (4;9)	3 (3;3)	-32 (-19;-52)	0 (0;-1)
S3 100%	-88 (-65;-122)	15 (9;15)	5 (5;5)	-68 (-41;-108)	-1 (-1;-1)
S4 'Go-Örebro'	-961 (-707;-1331)	163 (95;207)	58 (58;58)	-740 (-442;-1178)	-9(-5;-14)
S5 'All-streets'	-941 (-693;-1304)	160 (93;203)	57 (57;57)	-724 (-433;-1154)	-8 (-5;-13)
<b>Örebro</b>					
S1 10%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S2 50%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S3 100%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S4 'Go-Örebro'	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S5 'All-streets'	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
<b>Rome</b>					
S1 10%	-15 (-11;-21)	3 (2;4)	1 (1;1)	-12 (-7; -19)	0 (0;-1)
S2 50%	-18 (-14;-26)	4 (2;5)	1 (1;1)	-14 (-8; -22)	0 (0;-1)
S3 100%	-23 (-17;-32)	5 (3;6)	1 (1;1)	-17 (-10;-28)	-1 (0;-1)
S4 'Go-Örebro'	-325(-240;-451)	66 (38;66)	17 (17;17)	-243 (-139;-395)	-8 (-5;-14)
S5 'All-streets'	-326 (-240;-452)	66 (38;66)	17 (17;17)	-244 (-140;-396)	-8 (-5;-14)
<b>Vienna</b>					
S1 10%	-26 (-19;-36)	6 (3;8)	1 (1;1)	-19 (-11;-32)	-1 (-1;-2)
S2 50%	-49 (-36;-69)	11 (7;14)	1 (1;1)	-37 (-21;-61)	-2 (-1;-3)
S3 100%	-74 (-54;-103)	17 (10;21)	2 (2;2)	-55 (-31;-91)	-3 (-2;-5)
S4 'Go-Örebro'	-125 (-91;-174)	28 (16;36)	3 (3;3)	-93 (-52;-154)	-5 (-3;-9)
S5 'All-streets'	-123 (-90;-172)	28 (16;36)	3 (3;3)	-92 (-51;-152)	-5 (-3;-8)
<b>Zurich</b>					
S1 10%	-6 (-4;-8)	1 (1;1)	0 (0;0)	-5 (-3;-7)	-1 (-1;-2)
S2 50%	-11 (-8;-15)	2 (1;2)	1 (1;1)	-8 (-5;-13)	-2 (-1;-3)
S3 100%	-17 (-12;-23)	3 (2;3)	1 (1;1)	-13 (-8;-21)	-3 (-2;-5)
S4 'Go-Örebro'	-38 (-28;-53)	6 (4;8)	2 (2;2)	-30 (-18;-47)	-7 (-4;-12)
S5 'All-streets'	-38 (-28;-53)	6 (4;8)	2 (2;2)	-30 (-18;-47)	-7 (-4;-12)

CI=confidence interval

**Table S15. Sensitivity analysis. Mortality impact for each scenario under the consideration of the safety-in-numbers effect**

City	Physical activity (deaths avoided) (95% CI)	Air pollution active traveler (additional deaths) (95% CI)	Traffic incidents (additional deaths) (95% CI) Safety-in-numbers <sup>a</sup>	Total deaths (95% CI)
<b>Antwerp</b>				
S1 10%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S2 50%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S3 100%	-3 (-2;-4)	1 (0;0)	0 (0;0)	-2 (-2;-4)
S4 'Go-Örebro'	-4 (-3;-6)	1 (0;1)	0 (0;0)	-3 (-2;-6)
S5 'All-streets'	-5 (-3;-6)	1 (0;1)	0 (0;0)	-4 (-2;-6)
<b>Barcelona</b>				
S1 10%	-9 (-6;-12)	1 (1;1)	0 (0;0)	-7 (-5;-11)
S2 50%	-14 (-10;-19)	2 (1;2)	0 (0;0)	-12 (-8;-18)
S3 100%	-22 (-16;-30)	3 (2;4)	1 (1;1)	-19 (-12;-28)
S4 'Go-Örebro'	-199 (-147;-274)	26 (15;33)	5 (5;5)	-168 (-109;-254)
S5 'All-streets'	-152 (-112;-209)	20 (12;25)	4 (4;4)	-128 (-83;-194)
<b>London</b>				
S1 10%	-8 (-6;-11)	1 (0;1)	0 (0;0)	-6 (-4;-10)
S2 50%	-36 (-27;-50)	5 (3;7)	1 (1;1)	-30 (-19;-46)
S3 100%	-76 (-56;-105)	11 (6;14)	2 (2;2)	-62 (-39;-96)
S4 'Go-Örebro'	-823 (-606;-1139)	120 (69;152)	25 (25;25)	-679 (-430;-1045)
S5 'All-streets'	-806 (-594;-1116)	117 (68;149)	24 (24;24)	-665 (-421;-1024)
<b>Örebro</b>				
S1 10%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S2 50%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S3 100%	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S4 'Go-Örebro'	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
S5 'All-streets'	0 (0;0)	0 (0;0)	0 (0;0)	0 (0;0)
<b>Rome</b>				
S1 10%	-14 (-10;-19)	3 (2;3)	0 (0;0)	-11 (-7; -17)
S2 50%	-17 (-12;-23)	3 (2;4)	0 (0;0)	-13 (-8; -21)
S3 100%	-21 (-15;-28)	4 (2;5)	0 (0;0)	-16 (-10;-26)
S4 'Go-Örebro'	-291 (-215;-403)	55 (32;70)	5 (5;5)	-231 (-140;-366)
S5 'All-streets'	-292 (-215;-404)	55 (32;70)	5 (5;5)	-232 (-140;-367)
<b>Vienna</b>				
S1 10%	-22 (-16;-31)	5 (3;6)	0 (0;0)	-17 (-10;-28)
S2 50%	-42 (-31;-59)	9 (5;11)	1 (1;1)	-33 (-20;-53)
S3 100%	-63 (-46;-88)	13 (8;16)	1 (1;1)	-50 (-29;-80)
S4 'Go-Örebro'	-107 (-78;-149)	22 (13;28)	1 (1;1)	-84 (-49;-135)
S5 'All-streets'	-106 (-78;-148)	22 (13;28)	1 (1;1)	-83 (-49;-134)
<b>Zurich</b>				
S1 10%	-5 (-4;-7)	1 (0;1)	0 (0;0)	-4 (-3;-7)
S2 50%	-10 (-7;-13)	2 (1;2)	0 (0;0)	-8 (-5;-12)
S3 100%	-15 (-11;-21)	2 (1;3)	0 (0;0)	-12 (-8;-19)
S4 'Go-Örebro'	-34 (-25;-47)	5 (3;7)	1 (1;1)	-28 (-17;-47)
S5 'All-streets'	-34 (-25;-48)	5 (3;7)	1 (1;1)	-28 (-17;-44)

CI=confidence interval

<sup>a</sup>A safety-in-numbers effect assumes a less than proportional increase in traffic incidents with increases in traffic volume. We used the summary coefficient of 0.43 for cycle volume of a recent meta-analysis (Elvik and Bjørnskau, 2017).

**Table S16. Sensitivity analysis. Health impact assessment for 168 European cities**

		Transport mode															
		Car				Public transport				Bicycle				Walking			
Trips/ person/ day	%	Persons/ day	Mean distance (km)	Mean time (h)	%	Persons/ day	Mean distanc e (km)	Mean time (h)	%	Persons/ day	Mean distance (km)	Mean time (h)	%	Persons/ day	Mean distance (km)	Mean time (h)	
3.05	51	879,577	9.39	0.41	16	271,218	8.72	0.61	11	192,710	3.92	0.30	23	390,166	1.19	0.28	

**Table S17. Sensitivity analysis. Mortality and exposure input data derived from the PASTA cities for the health impact assessment of 168 European cities**

City	All-cause mortality rate (per 100,000 persons)	Baseline PA MET-hr/week	Background PM2.5 ( $\mu\text{g}/\text{m}^3$ )	Traffic fatalities by mode			
Average city	928	8.49	15.83	Car	Public transport	Bike	Walk
				10	0	4	25

**Table S18. Sensitivity analysis. Mortality impact of achieving a 25% cycling mode share in 168 European cities**

City	Physical activity (deaths avoided) (95% CI)	Air pollution active traveler (additional deaths) (95% CI)	Traffic incidents (additional deaths) (95% CI)	Total deaths (95% CI)
Scenario 25%	20,124 (14,763;28,002)	3,854 (2,239;4902)	0 (0;0)	16,270 (9,861;25,763)

The HIA for all 168 European cities used population size and mode share data of all 168 cities available through the European Platform on Mobility Management (EPOMM, 2011). For model input averaged transport, exposure and mortality statistics of the seven PASTA cities were used.

## G. COST-BENEFIT ANALYSIS

**Table S19. Cost-benefit analysis input data**

Investment costs/ km (€) <sup>a</sup>	Maintenance costs/ km/ year (€) <sup>a</sup>	Value of statistical life EU28 <sup>b</sup>	Time frame (years) <sup>a</sup>	Discounting (%) <sup>c</sup>
2,000,000	4,000	3,370,891 €	30	5

<sup>a</sup>costs for reconstructing and maintaining a road with mixed traffic including buying land and reconstructing intersections (Schepers et al., 2015)

<sup>b</sup>World Health Organization, 2014a

<sup>c</sup>World Health Organization, 2014b

**Table S20. Results cost-benefit analysis**

City	Difference in km	Costs 30 years	Prevented deaths	Benefits 30 years	Costs:benefits
<b>Antwerp</b>					
S1 10%	45.12	95,663,721	0	8,659,445	1:0
S2 50%	225.62	478,318,607	0	885,311	1:0
S3 100%	451.24	956,637,213	2	214418788	1:0
S4 'Go-Örebro'	810.04	1,717,289,955	3	327,584,260	1:0
S5 'All-streets'	1203.28	2,454,683,104	4	345,452,492	1:0
<b>Barcelona</b>					
S1 10%	15.51	32,880,042	7	6,651,59,952	1:20
S2 50%	77.55	164,400,210	11	1,104,028,373	1:7
S3 100%	155.09	328800420	18	1,714,329,772	1:5
S4 'Go-Örebro'	3987.57	8,453,639,751	162	15,531,827,734	1:2
S5 'All-streets'	1395.69	2,847,198,343	123	11,863,162,022	1:4
<b>London</b>					
S1 10%	93.82	198,893,196	6	573,530,113	1:3
S2 50%	469.09	994465981	28	2,724,268,037	1:3
S3 100%	938.18	1988931962	59	5,706,624,624	1:3
S4 'Go-Örebro'	21229.32	45,006,160,085	646	62,084,634,730	1:1
S5 'All-streets'	15658.72	31,943,798,074	633	60,822,868,482	1:2
<b>Örebro</b>					
S1 10%	35.51	75285659	0	-14,316,592	1:0
S2 50%	177.56	376,428,297	0	-11,949,214	1:0
S3 100%	355.12	752,856,594	0	-11,848,214	1:0
S4 'Go-Örebro'	0	0	0	0	0:0
S5 'All-streets'	2657.75	542,1807,888	0	-17,310,174	1:0
<b>Rome</b>					
S1 10%	12.01	25,462,947	11	1,021,121,080	1:40
S2 50%	60.05	127,314,735	13	1,221,698,435	1:10
S3 100%	120.11	254629471	16	1,522,564,468	1:6
S4 'Go-Örebro'	7213.40	15,292,412,934	224	21,562,065,671	1:1
S5 'All-streets'	8130.91	16,587,059,989	225	21,616,768,586	1:1
<b>Vienna</b>					
S1 10%	71.55	151,675,981	17	1,644,013,166	1:11
S2 50%	357.73	758,379,907	21	3,118,976,135	1:4
S3 100%	715.45	1,516,759,814	49	4,670,011,692	1:3

S4 'Go-Örebro'	3878.02	8,221,401,658	82	7,881,965,435	1:1
S5 'All-streets'	3233.91	6597170805	81	7,814,345,356	1:1
<b>Zurich</b>					
S1 10%	11.90	25,218,799	4	393,040,763	1:16
S2 50%	59.48	126093997	7	718102778	1:6
S3 100%	118.96	252,187,995	12	1,114,851,472	1:4
S4 'Go-Örebro'	929.92	1,971,424,172	27	2,552,293,005	1:1
S5 'All-streets'	1071.18	2185214134	27	2,559,708,868	1:1

CI=confidence interval



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