# Supporting Information

# Health impacts of active transport in Europe.


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## Section 1. Methods.

### 1.1. Scenarios.

**Table 1. Description of the number of trips in each scenario by city and mode of transport (bold numbers refer to the objective of each scenario).**

| | Scenario | Walking | Bicycling | PT | Car |
|---|---|---|---|---|---|
| Barcelona | BAU | 2.302.569 | 109.282 | 1.484.788 | 457.095 |
| | **A** | 1.646.376 | **1.749.763** | 664.547 | 293.047 |
| | **B** | **2.499.662** | 107.311 | 1.336.968 | 409.793 |
| Basel | BAU | 608.808 | 265.186 | 443.900 | 429.320 |
| | **A** | 468.036 | **617.117** | 267.934 | 394.127 |
| | **B** | **881.596** | 262.458 | 239.309 | 363.851 |
| Copenhagen | BAU | 520.615 | 492.805 | 303.333 | 491.576 |
| | **A** | NA | NA | NA | NA |
| | **B** | **904.165** | 488.970 | 15.671 | 399.524 |
| Paris | BAU | 2.819.239 | 162.147 | 2.027.880 | 731.482 |
| | **A** | 2.033.343 | **2.126.886** | 1.045.510 | 535.008 |
| | **B** | NA | NA | NA | NA |
| Prague | BAU | 888.383 | 9.737 | 1.860.517 | 932.643 |
| | **A** | 375.202 | **1.292.691** | 1.219.040 | 804.348 |
| | **B** | **1.846.701** | 154 | 1.141.779 | 702.647 |
| Warsaw | BAU | 997.820 | 54.818 | 2.520.225 | 1.278.847 |
| | **A** | 303.533 | **1.790.536** | 1.652.366 | 1.105.275 |
| | **B** | **2.557.909** | 39.217 | 1.350.158 | 904.426 |

PT: Public transport; BAU Business as usual; NA: Not applicable; Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking.

Scenarios were built based on assumptions about the modal distribution and shifting between modes of transport, focused on increasing active transport assumed that most of the trips would be substitutes from public transport.

**1.2. Input data.**

All the transport data included in the analysis come from official records or transport surveys from each city. This data may have been collected using different methods but are the best available data. However we acknowledge that there is some uncertainty in the data and that the data may have been more reliable had it been collected using the same methodology, with preferably objective assessment methods such as automatic counters and automatic tracking of individuals

**Table 2. Data sources of each city and area.**

| | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|
| **Transport data** | Travel survey | Travel survey | Travel survey | Travel survey | Travel survey | Travel survey |
| **Air quality data** | Air quality monitors | Air quality monitors | Air quality monitors | Air quality monitors | Air quality monitors | Air quality monitors |
| **Health data** | Health records | Health records | Health records | Health records | Health records | Health records |
| **Demographic data** | City records | City records | City records | City records | City records | City records |
| **Traffic safety data** | Police reports | Police reports | Police reports | Police reports | Police reports | Police reports |

**Assumptions:** Where input variables in Table-2 of the main text were not directly available from sources consulted in each city, either 1) they were derived from secondary analysis of primary data available in the same city (see below for detailed explanation), or 2) when data was not available for secondary analysis either, the average value of the other cities was used as input,.

**Average distance travelled per mode:** Obtained directly from the city records. In cases where the city records did not report this data, it was estimated based on the average trip duration and average speed reported by the city. Cities where this was applied: Barcelona, Copenhagen and Warsaw.

**Average speed:** Obtained directly from the city records. In cases where the city records did not report this data, it was estimated based on the average distance travelled and average trip duration reported by the city. City where this was applied: Basel and Warsaw.

**Road traffic fatalities per year:** This data was obtained for all ages combined, directly from city records. To adjusted for the 16 to 64 years old age group, a 0.77 ratio was applied to overall traffic mortality, based on a report from traffic fatalities in Europe which showed that the 77% of the traffic fatalities were suffered by this ages group (1)**.**

**Deaths per billion kilometre travelled:** Calculated in each city based on road traffic fatalities reported per year and the distance travelled per year by mode in each city.

**Concentration of $PM_{2.5}$:** The city annual average was obtained from the city records. The concentration in each mode of transport were estimated based on the study performed in Barcelona (2) and adjusted by the annual average concentration of each city.

**1.3. Physical activity.**

The health impacts of increased physical activity by active transport taking into account baseline levels of physical activity (METs/H/w) in each city by age group and sex, which we obtained from local and national records and surveys. The baseline levels of physical activity used by the model in each city are presented in the tables 3 to 8 in METs/h/w.

**Table 3. Quartiles of basal level of physical activity reported in Barcelona travel survey.**

| Quartile | METs/h/w |
|---|---|
| Q1 | 0·4 |
| Q2 | 8·5 |
| Q3 | 22·5 |
| Q4 | 42·4 |

METs/h/w : Metabolic equivalent of task per hour per week (e.g. 8·75 METs/h/w = 30 min of walking 7 days per week; 22·05 METs/h/w = 27 min of jogging 7 days per week; 40·83 METs/h/w = 50 min of jogging 7 days per week).

**Table 4. Percentages of basal levels of physical activity by sex and age reported in Switzerland.**

| | | Man | | | | Woman | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Physical activity levels** | **METs/H/w** | 15-34 years | 35-49 years | 50-64 years | => 65 years | 15-34 years | 35-49 years | 50-64 years | => 65 years |
| **Trained** | 45 | 43 | 27 | 23 | 23 | 30 | 23 | 23 | 13 |
| **Regular active** | 37·5 | 37 | 43 | 50 | 50 | 43 | 43 | 43 | 47 |
| **Partially active** | 15 | 13 | 20 | 17 | 13 | 20 | 20 | 20 | 17 |
| **Inactive** | 0 | 7 | 10 | 10 | 13 | 7 | 13 | 13 | 23 |

METs/h/w : Metabolic equivalent of task per hour per week (e.g. 8·75 METs/h/w = 30 min of walking 7 days per week; 22·05 METs/h/w = 27 min of jogging 7 days per week; 40·83 METs/h/w = 50 min of jogging 7 days per week).

**Table 5. Percentages of basal levels of physical activity by sex and age reported in Denmark.**

| | | Man | | | | | Woman | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Physical activity levels** | **METs/H/w** | 15-24 years | 25-44 years | 45-64 years | 65-79 years | => 80 years | 15-24 years | 25-44 years | 45-64 years | 65-79 years | => 80 years |
| **Competitive sports** | 30 | 26 | 7 | 2 | 1 | 0 | 9 | 3 | 1 | 0 | 0 |
| **Heavy physical exercise** | 24 | 30 | 34 | 25 | 18 | 6 | 29 | 24 | 16 | 10 | 3 |
| **Light physical exercise** | 12 | 32 | 45 | 60 | 65 | 56 | 51 | 63 | 72 | 72 | 48 |
| **Sedentary** | 0 | 12 | 13 | 11 | 14 | 34 | 10 | 10 | 10 | 16 | 45 |

METs/h/w : Metabolic equivalent of task per hour per week (e.g. 8·75 METs/h/w = 30 min of walking 7 days per week; 22·05 METs/h/w = 27 min of jogging 7 days per week; 40·83 METs/h/w = 50 min of jogging 7 days per week).

**Table 6. Percentages of basal levels of physical activity by sex and age reported in France.**

| | | Man | | | | | | Woman | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Physical activity levels** | **METs/H/w** | 15-25 years | 26-34 years | 35-44 years | 45-54 years | 55-64 years | 65-75 years | 15-25 years | 26-34 years | 35-44 years | 45-54 years | 55-64 years | 65-75 years |
| **High** | 25 | 68 | 55 | 48 | 43 | 45 | 43 | 32 | 32 | 36 | 30 | 33 | 39 |
| **Middle** | 17·5 | 16 | 17 | 14 | 19 | 24 | 27 | 33 | 27 | 26 | 26 | 27 | 32 |
| **Limited** | 5 | 14 | 26 | 36 | 37 | 29 | 28 | 34 | 39 | 36 | 43 | 38 | 28 |

METs/h/w : Metabolic equivalent of task per hour per week (e.g. 8·75 METs/h/w = 30 min of walking 7 days per week; 22·05 METs/h/w = 27 min of jogging 7 days per week; 40·83 METs/h/w = 50 min of jogging 7 days per week).

**Table 7. Percentages of basal levels of physical activity by sex reported in Czech Republic.**

| Physical activity levels | METs/H/w | Man | Woman |
|---|---|---|---|
| **High** | 40 | 53 | 23·7 |
| **Middle** | 20 | 22·6 | 42·7 |
| **Sedentary** | 0 | 25 | 33 |

METs/h/w : Metabolic equivalent of task per hour per week (e.g. 8·75 METs/h/w = 30 min of walking 7 days per week; 22·05 METs/h/w = 27 min of jogging 7 days per week; 40·83 METs/h/w = 50 min of jogging 7 days per week).

**Table 8. Percentages of basal levels of physical activity by age reported in Poland.**

| Physical activity levels | METs/H/w | 15-19 years | 20-29 years | 30-39 years | 40-49 years | 50-59 years | 60-69 years | 70-79 years | =>80 years |
|---|---|---|---|---|---|---|---|---|---|
| **High** | 58·2 | 28 | 36 | 39 | 38 | 27 | 13 | 5 | 1 |
| **Middle** | 38 | 64 | 68 | 72 | 74 | 70 | 64 | 53 | 37 |
| **Sedentary** | 0 | 81 | 77 | 76 | 75 | 77 | 80 | 73 | 60 |

METs/h/w : Metabolic equivalent of task per hour per week (e.g. 8·75 METs/h/w = 30 min of walking 7 days per week; 22·05 METs/h/w = 27 min of jogging 7 days per week; 40·83 METs/h/w = 50 min of jogging 7 days per week).

**Table 9. Metabolic equivalent of task for each activity used for the analysis of air pollution and physical activity.(3)**

| Activity | METs/h/w |
|---|---|
| Sleep | 0·9 |
| Rest | 1·0 |
| Riding in a bus | 1·0* |
| Driving an automobile | 2·0 |
| Walking | 2·5 |
| Bicycling 10-11·9 mph, light effort | 6·8 |

METs/h/w : Metabolic equivalent of task per hour per week.
*This was applied to all the public transport modes.

### 1.4. Public transport trips

Public transport trips included metro, train, bus, and tram trips, depending on the city.

Was assumed that public transport trips involved 10 minutes of walking and was included in the model the benefits of physical activity, the risk of suffering a road traffic fatality as a pedestrian and the inhalation of air pollution during the 10 minutes walking in the risk associated with public transport.

### 1.5. Carbon dioxide.

**Table 10. Carbon dioxide emission factors and vehicle fleet description by city.**

| | | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|---|
| Percentage of cars in the city per type of fuel (%) | Gasoline | 56·0 | 67·6 | 60·1 | 60·1 | 56·7 | 60·1 |
| | Diesel | 44·0 | 30·5 | 39·3 | 39·3 | 43·3 | 39·3 |
| Efficiency of cars fleet in the city (L/100km) | Gasoline | 9·0 | 5·2 | 7·1 | 7·1 | 7·1 | 7·1 |
| | Diesel | 7·0 | 3·9 | 5·5 | 5·5 | 5·7 | 5·5 |
| $CO_2$ released (kg/L) | Gasoline | 2·4 | 2·4 | 2·4 | 2·4 | 2·4 | 2·4 |
| | Diesel | 2·6 | 2·6 | 2·6 | 2·6 | 2·6 | 2·6 |

Data comes from the latest data reported available from each city. $CO_2$: Carbon dioxide.

**Section 2. Results.**

**Table 11. Number of deaths per year estimated in each city by scenario and heath exposure.**

| Scenario | Road traffic fatalities | Physical activity | Air pollution |
|---|---|---|---|
| | | **Barcelona** | |
| **A** | -2·73 | -41·61 | 6·54 |
| **B** | 0·52 | -3·71 | 0·17 |
| | | **Basel** | |
| **A** | 0·34 | -7·62 | 1·54 |
| **B** | 0·56 | -7·17 | 0·40 |
| | | **Copenhagen** | |
| **A** | - | - | - |
| **B** | 1·74 | -3·97 | 0·25 |
| | | **Paris** | |
| **A** | 6·41 | -55·10 | 11·22 |
| **B** | - | - | - |
| | | **Prague** | |
| **A** | 4·09 | -87·60 | 22·47 |
| **B** | 13·34 | -26·49 | 1·85 |
| | | **Warsaw** | |
| **A** | -44·98 | -98·67 | 30·26 |
| **B** | 32·50 | -56·74 | 4·36 |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths.

**Table 12. Number of deaths per year by 100,000 travellers estimated in each city by scenario and heath exposure.**

| Scenario | Road traffic fatalities | Physical activity | Air pollution |
|---|---|---|---|
| **Barcelona** | | | |
| **A** | -0·52 | -7·89 | 1·24 |
| **B** | 0·83 | -5·86 | 0·27 |
| **Basel** | | | |
| **A** | 0·33 | -7·36 | 1·50 |
| **B** | 0·70 | -8·93 | 0·51 |
| **Copenhagen** | | | |
| **A** | - | - | - |
| **B** | 1·46 | -4·98 | 0·21 |
| **Paris** | | | |
| **A** | 1·11 | -9·53 | 1·94 |
| **B** | - | - | - |
| **Prague** | | | |
| **A** | 0·93 | -19·80 | 5·08 |
| **B** | 4·04 | -8·01 | 0·56 |
| **Warsaw** | | | |
| **A** | -7·77 | -17·05 | 5·23 |
| **B** | 6·25 | -10·91 | 0·84 |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths.

**Table 13. $CO_2$ emissions (metric tons per year) avoided in each scenario and city**

| **Scenario** | | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|---|
| **A** | 35% of all trips by bicycles | 22,957 | 2,503 | - | 19,923 | 22,819 | 26,423 |
| **B** | 50% of all trips walking | 1,139 | 2,088 | 2,745 | - | 8,320 | 11,611 |

**Section 3. Sensitivity analysis.**

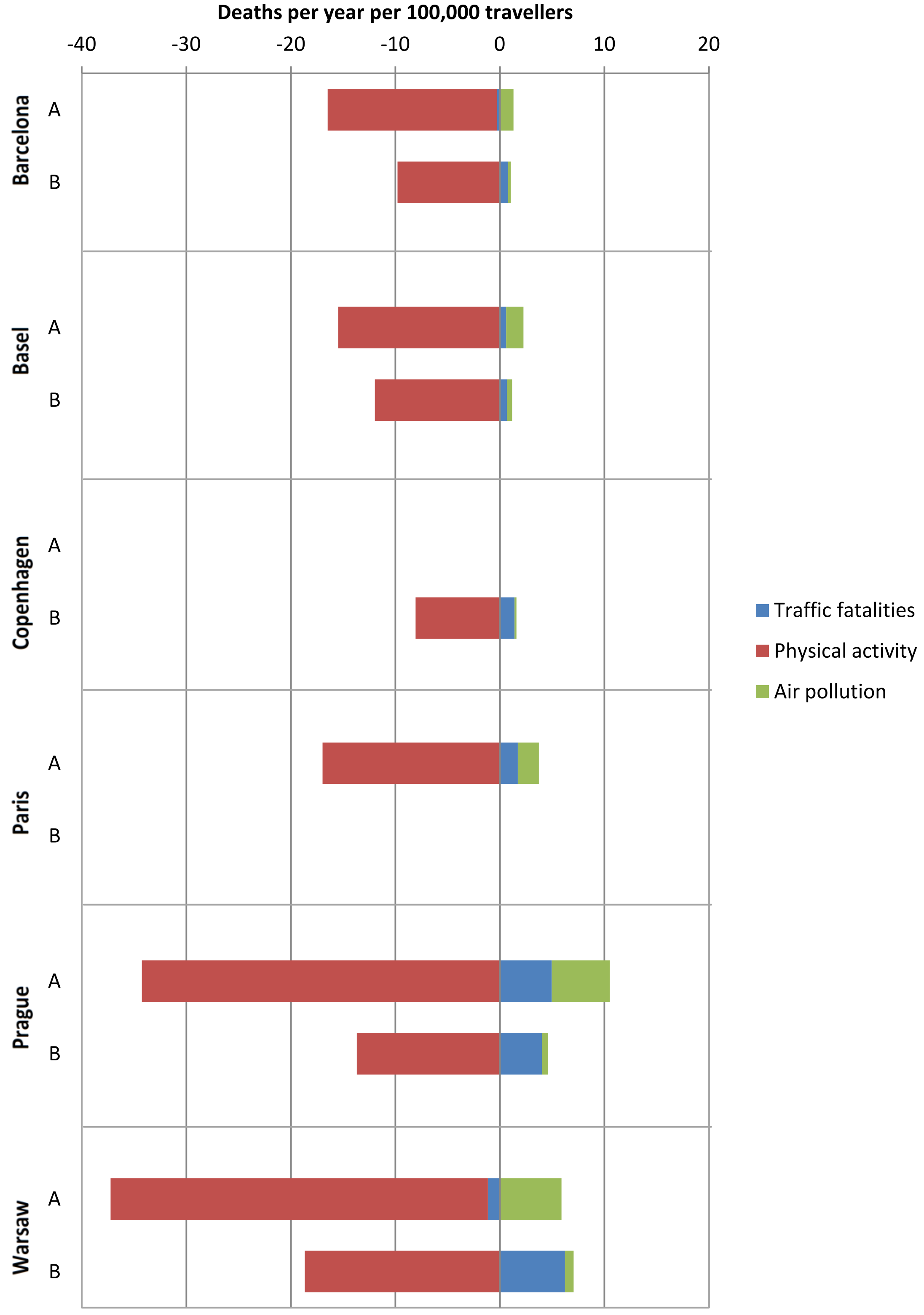
**3.1. Car trips substitution.**

**Table 14. Number of deaths avoided** or postponed **per year per 100,000 travellers (95% confidence intervals) by scenario and city (related to physical activity, air pollution and road traffic fatalities), assuming a 50% of trips coming from car trips.**

| Scenario | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|
| **Main result (CI)** | | | | | | |
| **A** | -7·1 (-4, -10) | -5·5 (-3, -9) | - | -6·5 (-3, -11) | -13·8 (-6, -23) | -19·6 (-13, -28) |
| **B** | -4·7 (-3, -7) | -7·7 (-5, -11) | -3·1 (-1, -5) | - | -3·4 (-1, -6) | -3·8 (-1, -8) |
| **Sensitivity analysis , applying 50% of car trips substitution by bicycling or walking (CI)** | | | | | | |
| **A** | -15·2 (-10, -22) | -13·2 (-8, -20) | - | -13·2 (-8, -21) | -23·7 (-13, -39) | -31·4 (-20, -47) |
| **B** | -8·8 (-6, -12) | -10·8 (-7, -16) | -6·5 (-4, -10) | - | -9·1 (-5, -14) | -11·6 (-7, -19) |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. CI: Confidence intervals.

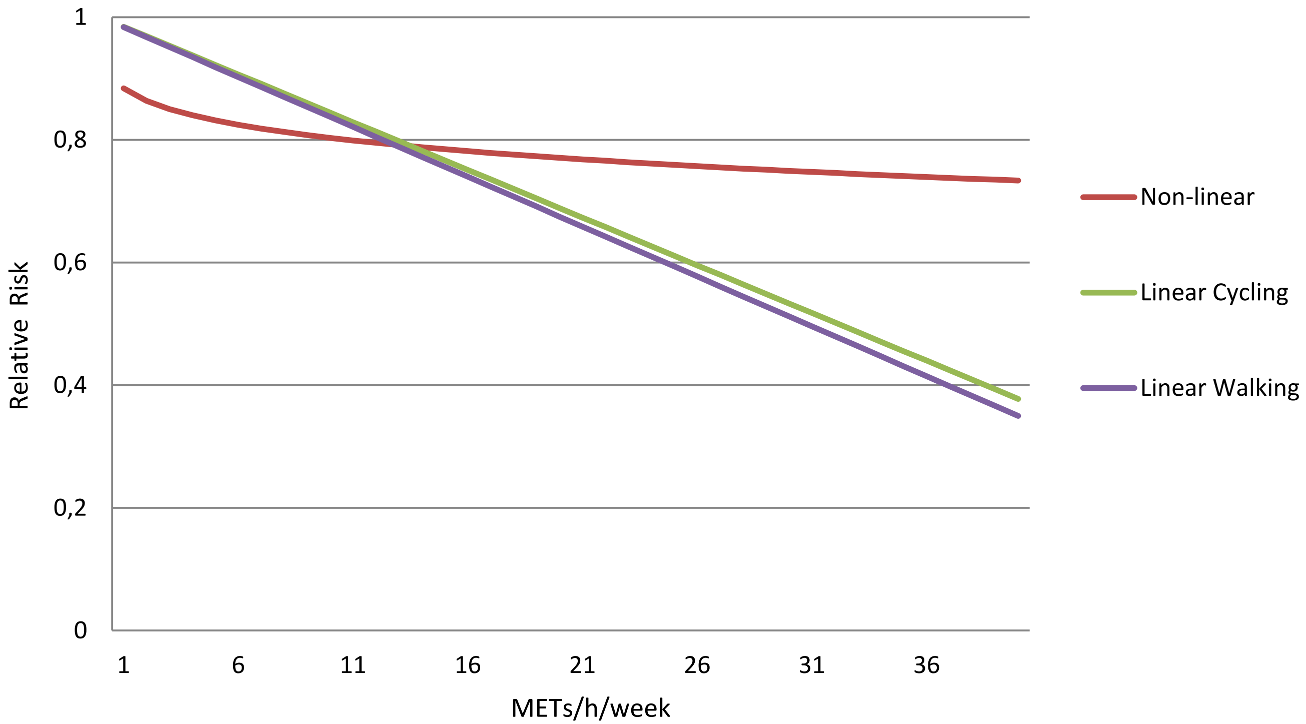
**Fig 1. Number of deaths per year by 100,000 travellers by scenario, health exposure and city, assuming a 50% of trips coming from car trips.**




Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking.

### 3.2. Physical activity.

**Fig 2. Dose response functions for physical activity and all-cause mortality.**



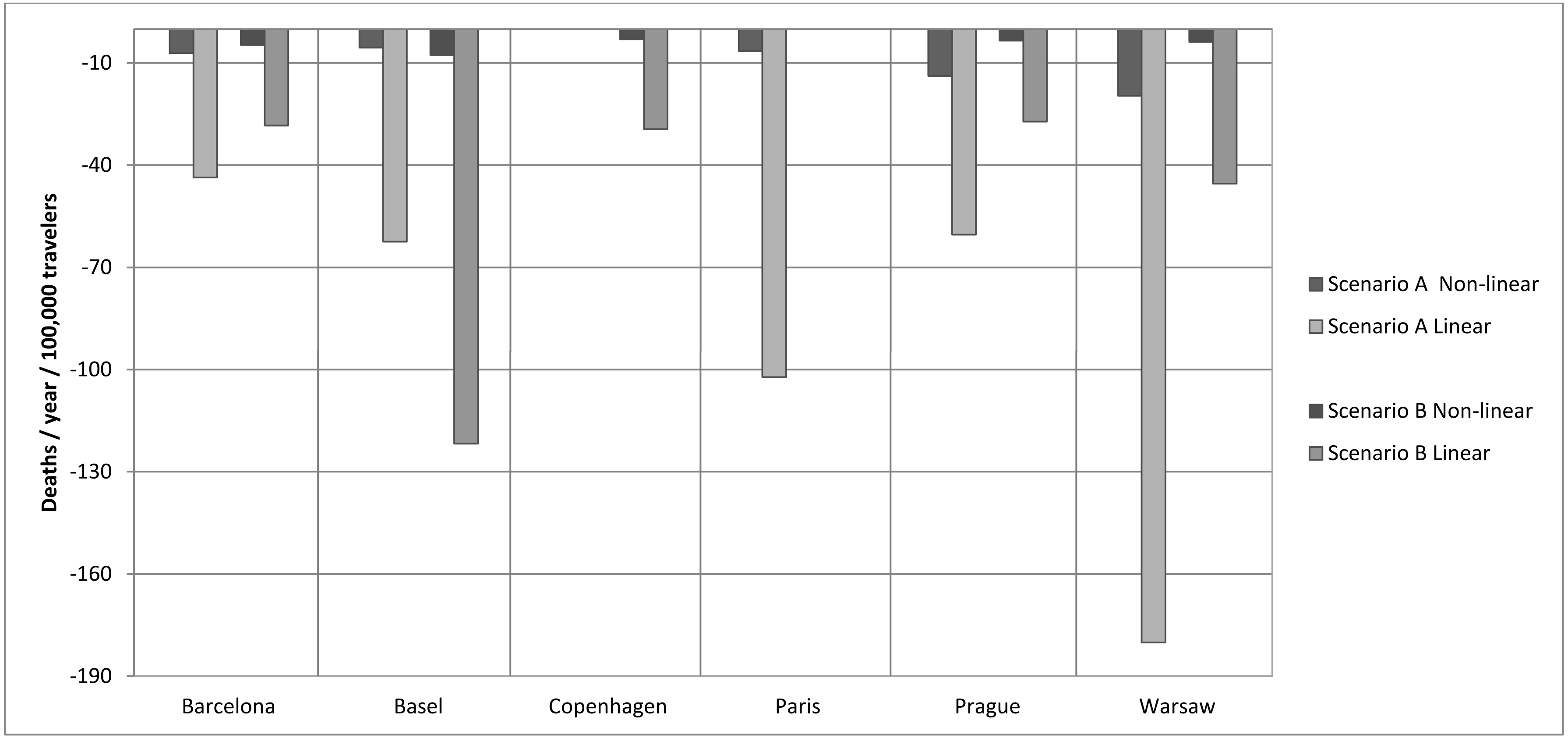

METs/h/w : Metabolic equivalent of task per hour per week.; Non-linear dose response function from Woodcock J et al, 2010(4); Linear Cycling and Linear Walking from Kahlmeier S, et al, 2011(5).

**Table 15. Number of deaths avoided** or postponed **per year per 100,000 travellers (95% confidence intervals) by scenario and city (related to physical activity, air pollution and road traffic fatalities), assuming a linear dose response function for walking and cycling and all-cause mortality.**

| Scenario | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|
| **Main result (CI)** | | | | | | |
| **A** | -7·1<br>(-4, -10) | -5·5<br>(-3, -9) | - | -6·5<br>(-3, -11) | -13·8<br>(-6, -23) | -19·6<br>(-13, -28) |
| **B** | -4·7<br>(-3, -7) | -7·7<br>(-5, -11) | -3·1<br>(-1, -5) | - | -3·4<br>(-1, -6) | -3·8<br>(-1, -8) |
| **Sensitivity analysis , applying linear dose response function for physical activity (CI)** | | | | | | |
| **A** | -43·6<br>(-26, -78) | -62·4<br>(-28, -93) | - | -102·2<br>(-34, -124) | -60·4<br>(-56, -112) | -180·1<br>(-74, -225) |
| **B** | -28·3<br>(-1, -62) | -121·7<br>(-4, -166) | -29·4<br>(-1, -65) | - | -27·2<br>(2, -73) | -45·4<br>(3, -153) |

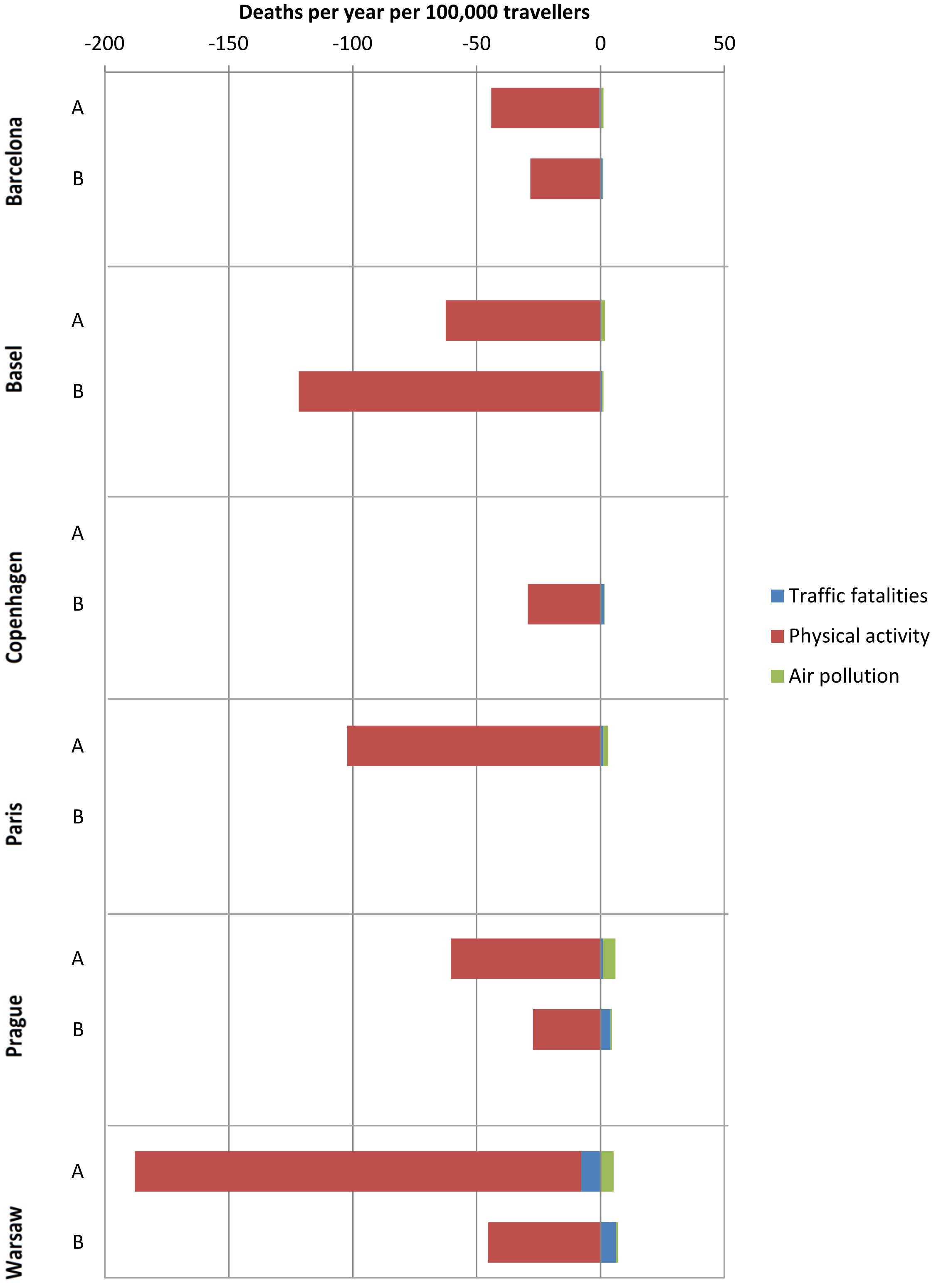
Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. RR Linear function for cycling and walking from Kahlmeier S, et al, 2011(5). Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. CI: Confidence intervals.

**Fig 3. Number of deaths per year by 100,000 travellers estimated for each scenario and each city (related to physical activity, air pollution and road traffic fatalities), comparing non-linear vs linear dose response function for physical activity and all-cause mortality.**




Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. Non-linear dose response function from Woodcock J et al, 2010(4); Linear Cycling and Linear Walking from Kahlmeier S, et al, 2011(5).

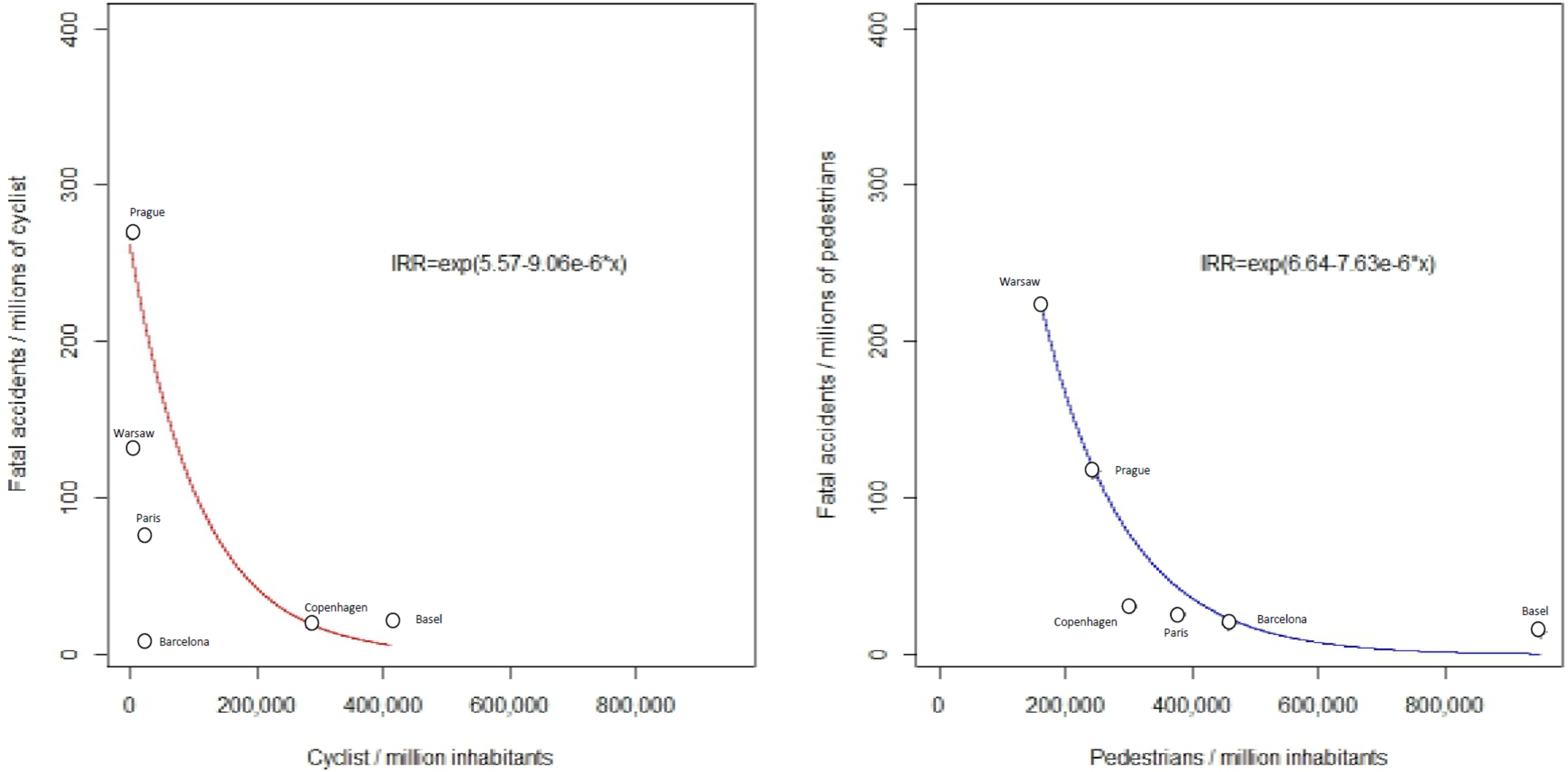
**Fig 4. Number of deaths per year by 100,000 travellers by scenario, health exposure and city, using a linear dose response function for physical activity and all-cause mortality.**




Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking.

### 3.3. Road traffic fatality.

**Fig 5. Incidence Rate Ratio of fatal traffic accidents and number of cyclist and pedestrians used in the "safety in numbers" approach.**



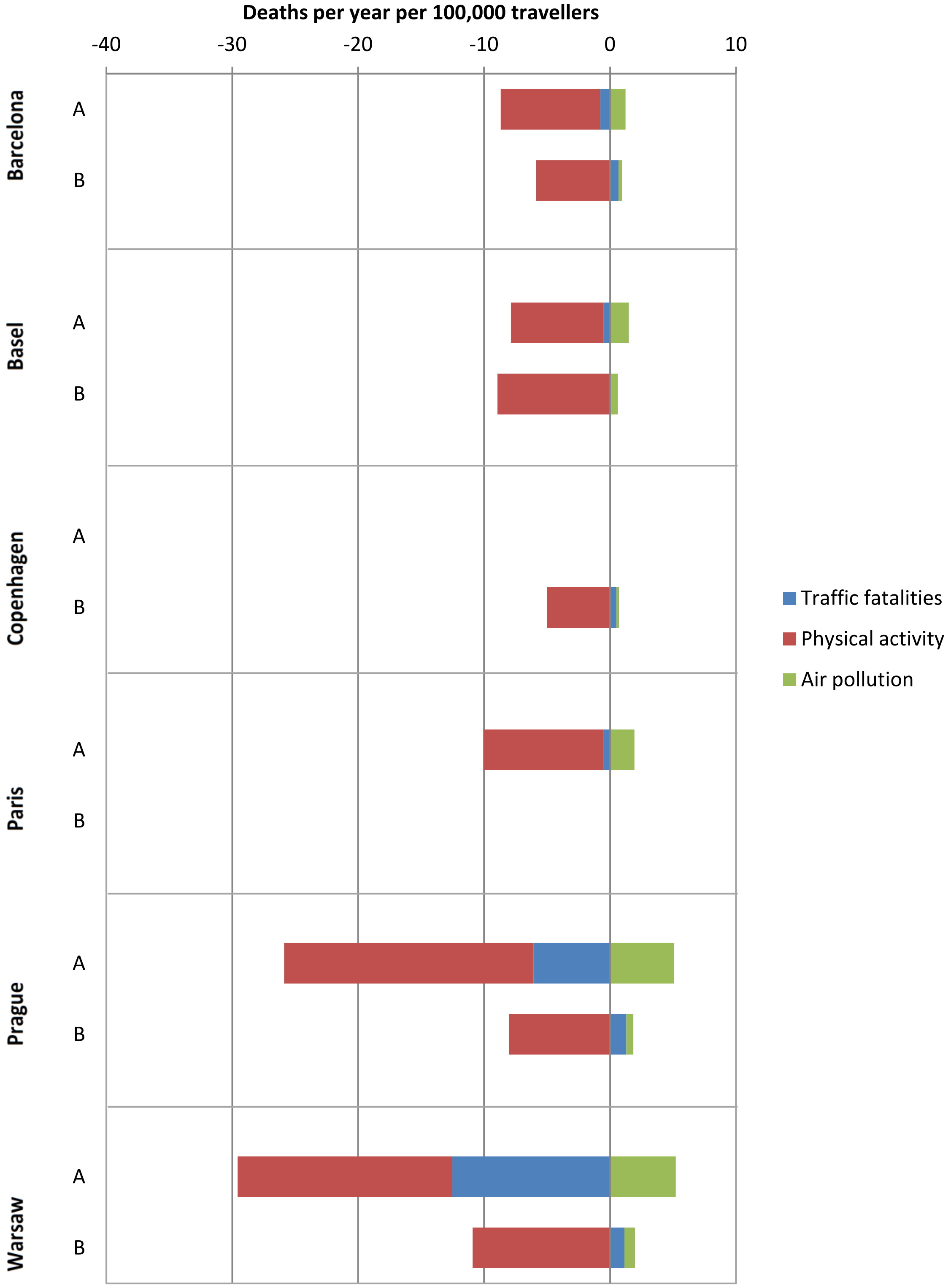

This graph shows a reduction in the fatal accidents per million of travellers (cyclist or pedestrians) when the number of travellers (cyclist or pedestrians) increases in the population. Base on these data from the six cities, a incidence rate ratio (IRR) of fatal accidents was estimated for cyclist or pedestrians. This IRR (for cyclist or pedestrians) was used to quantify the reduction of fatal accidents in the different cities according with the expected increment of travellers (cyclist or pedestrians) in each scenario.

**Table 16. Number of deaths avoided** or postponed **per year per 100,000 travellers (95% confidence intervals) by scenario and city (related to physical activity, air pollution and road traffic fatalities) using a quantitative approach of "safety in numbers".**

| Scenario | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|
| **Main result (CI)** | | | | | | |
| **A** | -7·1 (-4, -10) | -5·5 (-3, -9) | - | -6·5 (-3, -11) | -13·8 (-6, -23) | -19·6 (-13, -28) |
| **B** | -4·7 (-3, -7) | -7·7 (-5, -11) | -3·1 (-1, -5) | - | -3·4 (-1, -6) | -3·8 (-1, -8) |
| **Sensitivity analysis, applying "safety in numbers" approach (CI)** | | | | | | |
| **A** | -7·4 (-4, -11) | -6·3 (-3, -9) | - | -8·1 (-4, -12) | -20·8 (-13, -30) | -24·3 (-18, -33) |
| **B** | -4·9 (-3, -7) | -8·3 (-5, -12) | -4·2 (-2, -6) | - | -6·1 (-3, -9) | -8·9 (-5, -13) |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. The "safety in numbers" approach, was based on the incidence rate ratio of fatal traffic accidents (in cyclists or pedestrians) estimated by the six cities data. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. CI: Confidence intervals.

**Fig 6. Number of deaths per year by 100,000 travellers by scenario, health exposure and city, using a quantitative approach of "safety in numbers".**



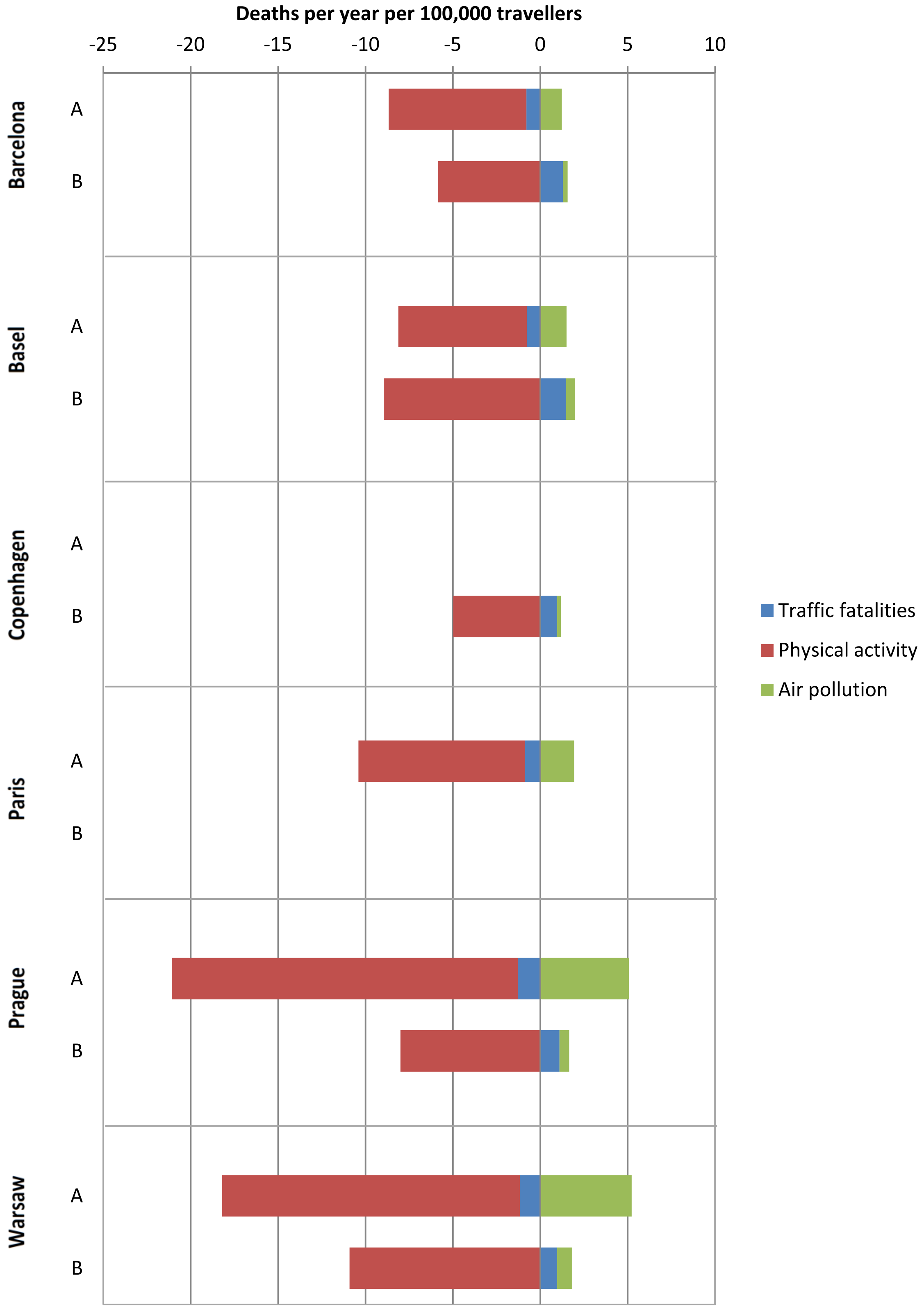

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. The "safety in numbers" approach, was based on the incidence rate ratio of fatal traffic accidents (in cyclists or pedestrians) estimated by the six cities data.

**Table 17. Number of deaths avoided** or postponed **per year per 100,000 travellers (95% confidence intervals) by scenario and city (related to physical activity, air pollution and road traffic fatalities) applying to all the cities Copenhagen's death rate per kilometre travelled by bike for scenario A and Paris' pedestrian deaths rate per kilometre travelled for scenario B.**

| **Scenario** | **Barcelona** | **Basel** | **Copenhagen** | **Paris** | **Prague** | **Warsaw** |
|---|---|---|---|---|---|---|
| **Main result (CI)** | | | | | | |
| **A** | -7·1<br>(-4, -10) | -5·5<br>(-3, -9) | - | -6·5<br>(-3, -11) | -13·8<br>(-6, -23) | -19·6<br>(-13, -28) |
| **B** | -4·7<br>(-3, -7) | -7·7<br>(-5, -11) | -3·1<br>(-1, -5) | - | -3·4<br>(-1, -6) | -3·8<br>(-1, -8) |
| **Sensitivity analysis , applying deaths rate per km travelled of reference city (CI)** | | | | | | |
| **A** | -7·4<br>(-5, -11) | -6·6<br>(-4, -10) | - | -8·4<br>(-5, -13) | -16·0<br>(-8, -25) | -12·9<br>(-6, -21) |
| **B** | -4·2<br>(-2, -7) | -6·9<br>(-4, -10) | -3·8<br>(-2, -5) | - | -6·3<br>(-4, -9) | -9·1<br>(-6, -13) |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. CI: Confidence intervals.

**Fig 7. Number of deaths per year by 100,000 travellers by scenario, health exposure and city, applying to all the cities Copenhagen's death rate per kilometre travelled by bike for scenario A and Paris' pedestrian deaths rate per kilometre travelled for scenario B.**




Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking.

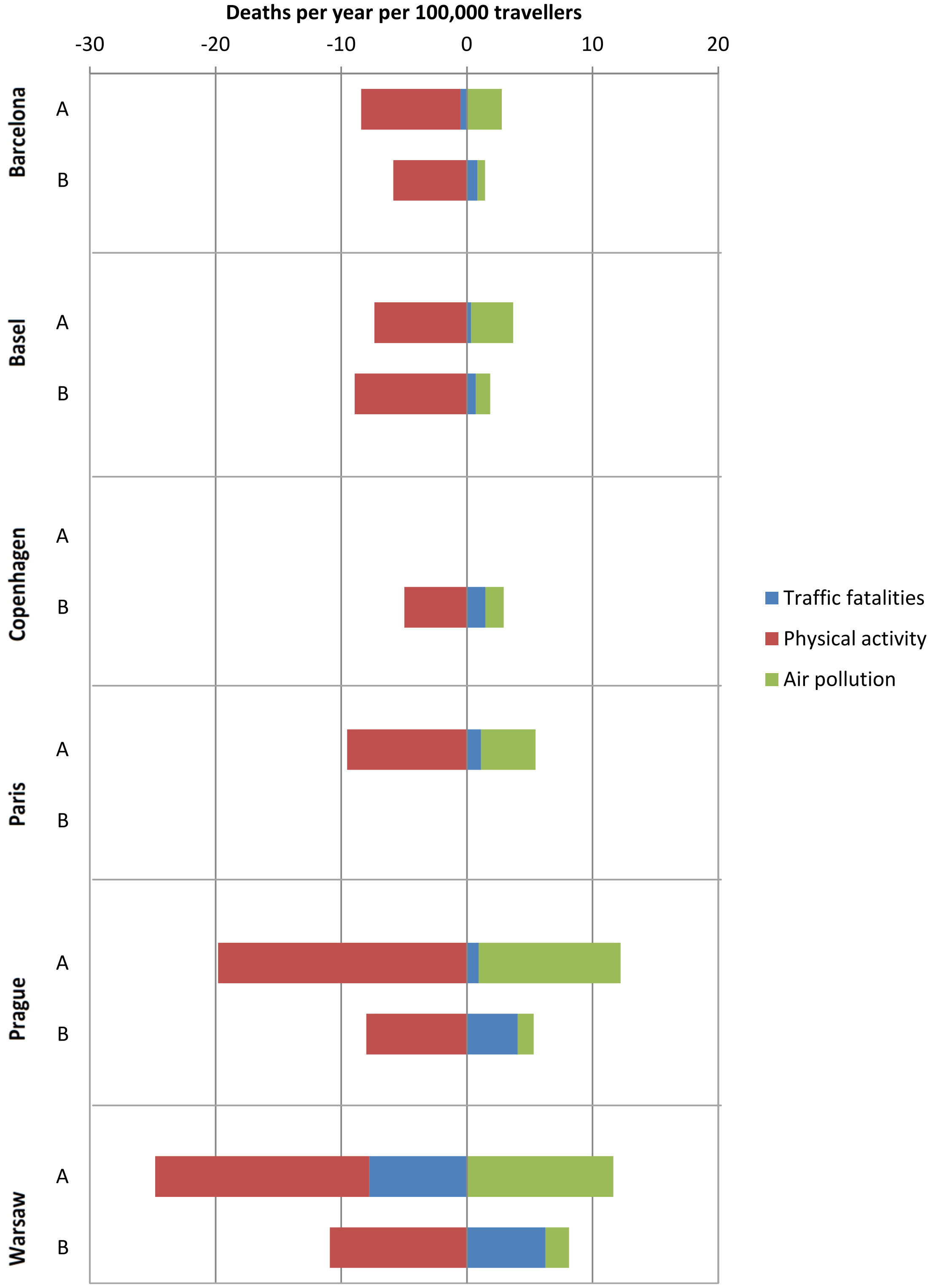
### 3.4. Air pollution.

**Table 18. Number of deaths avoided** or postponed **per year per 100,000 travellers (95% confidence intervals) by scenario and city (related to physical activity, air pollution and road traffic fatalities), assuming a dose response function of air pollution (PM2.5) and all-cause mortality (1.07 per 5 µg/m$^3$) derived from the ESCAPE project (European Study of Cohorts for Air Pollution Effects).**

| Scenario | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|
| **Main result (CI)** | | | | | | |
| **A** | -7·1<br>(-4, -10) | -5·5<br>(-3, -9) | - | -6·5<br>(-3, -11) | -13·8<br>(-6, -23) | -19·6<br>(-13, -28) |
| **B** | -4·7<br>(-3, -7) | -7·7<br>(-5, -11) | -3·1<br>(-1, -5) | - | -3·4<br>(-1, -6) | -3·8<br>(-1, -8) |
| **Sensitivity analysis, applying ESCAPE dose response function (CI)** | | | | | | |
| **A** | -5·6<br>(-1, -10) | -3·8<br>(1, -9) | - | -4·0<br>(1, -11) | -7·5<br>(6, -23) | -13·1<br>(0 , -28) |
| **B** | -4·4<br>(-2, -7) | -7·1<br>(-3, -11) | -3·0<br>(-1, -5) | - | -2·7<br>(0, -6) | -2·7<br>(1, -8) |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. ESCAPE project reference: Beleen R, et al, 2014(6). Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. CI: Confidence intervals.

**Fig 8. Number of deaths per year by 100,000 travellers by scenario, health exposure and city, assuming a dose response function of air pollution (PM2.5) and all-cause mortality (1. 07 per 5 μg/m³) derived from the ESCAPE project (European Study of Cohorts for Air Pollution Effects).**




Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. ESCAPE project reference: Beleen R, et al, 2014(6).

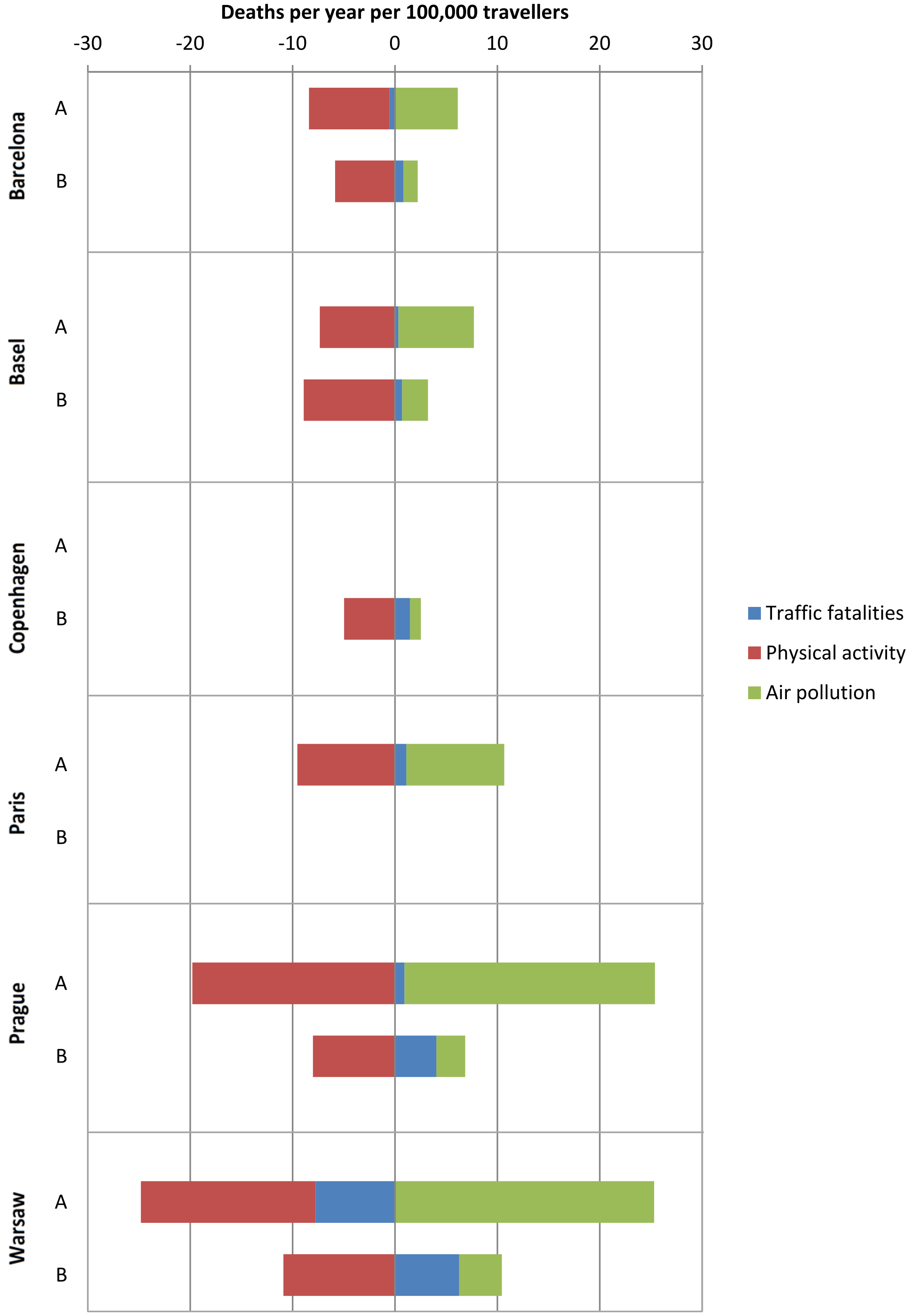
This sensitivity analysis considered that traffic is the most important source of air pollution in the cities and assumed that traffic sources have a fivefold higher toxicity for air pollution, as suggested by previous authors(7;8). For cities like Prague, Warsaw and Paris, which have the highest concentrations of air pollution of the six cities, this fivefold toxicity factor produced small net harms rather than benefits in scenarios A (for Paris and Prague) and B (in Prague and Warsaw). For scenario A (in Paris and Prague) this is due to the high concentrations of air pollution in both cities and the substitution by cycling trips that implies higher inhalation rates in travellers compared with other modes of transport. For scenario B (in Prague and Warsaw) this is due to the combination of the high traffic fatality rates and high concentrations of air pollution in both cities.

**Table 19. Number of deaths avoided** or postponed **per year per 100,000 travellers (95% confidence intervals) by scenario and city (related to physical activity, air pollution and road traffic fatalities), assuming a 5 fold times more toxicity of air pollution.**

| Scenario | Barcelona | Basel | Copenhagen | Paris | Prague | Warsaw |
|---|---|---|---|---|---|---|
| **Main result (CI)** | | | | | | |
| **A** | -7·1<br>(-4, -10) | -5·5<br>(-3, -9) | - | -6·5<br>(-3, -11) | -13·8<br>(-6, -23) | -19·6<br>(-13, -28) |
| **B** | -4·7<br>(-3, -7) | -7·7<br>(-5, -11) | -3·1<br>(-1, -5) | - | -3·4<br>(-1, -6) | -3·8<br>(-1, -8) |
| **Sensitivity analysis, applying 5 fold times more toxicity of PM2·5 (CI)** | | | | | | |
| **A** | -2·2<br>(1, -7) | 0·3<br>(4, -5) | - | 1·1<br>(6, -5) | 5·5<br>(18, -10) | 0·4<br>(12, -14) |
| **B** | -3·6<br>(-1, -6) | -5·7<br>(-2, -10) | -2·4<br>(-1, -4) | - | -1·1<br>(1, -5) | -0·5<br>(3, -5) |

Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking. Negative numbers (-) mean avoided deaths; Positive numbers mean increased deaths. CI: Confidence intervals.

**Fig 9. Number of deaths per year by 100,000 travellers by scenario, health exposure and city, assuming a 5 fold times more toxicity of air pollution.**




Scenario A: 35% of all trips by bicycle; Scenario B: 50% of all trips walking.

References


1. ERSO. Traffic Safety Basic Facts 2010. European Road Safety Observatory. 2010. Directorate-General for Mobility and Transport, European Commission.

2. de Nazelle A, Fruin S, Westerdahl D, Martinez D, Ripoll A, Kubesch N et al. A travel mode comparison of commuters' exposures to air pollutants in Barcelona. Atmospheric Environment 2012;59:151-9.

3. Ainsworth BE, Haskell WL, Whitt MC, Irwin ML, Swartz AM, Strath SJ et al. Compendium of physical activities: an update of activity codes and MET intensities. Med.Sci.Sports Exerc. 2000;32(9 Suppl):S498-S504.

4. Woodcock J, Franco OH, Orsini N, Roberts I. Non-vigorous physical activity and all-cause mortality: systematic review and meta-analysis of cohort studies. Int.J.Epidemiol. 2010.

5. Kahlmeier S, Cavill N, Dinsdale H, Rutter H, Götschi T, Foster C, Kelly P, Clarke D, Oja P, Fordham R, Stone D, and Racioppi F. Health economic assessment tools (HEAT) for walking and for cycling. Methodology and user guide. Economic assessment of transport infrastructure and policies. 2011. Copenhagen, World Health Organization Europe.

6. Beelen R, Stafoggia M, Raaschou-Nielsen O, Andersen ZJ, Xun WW, Katsouyanni K et al. Long-term exposure to air pollution and cardiovascular mortality: an analysis of 22 European cohorts. Epidemiology 2014;25(3):368-78.

7. De Hartog J, Boogaard H, Nijland H, Hoek G. Do the health benefits of cycling outweigh the risks? Environ.Health Perspect. 2010;118(8):1109-16.

8. Laden F, Neas LM, Dockery DW, Schwartz J. Association of fine particulate matter from different sources with daily mortality in six U.S. cities. Environ.Health Perspect. 2000;108(10):941-7.