

**eAppendix to:**

**Respiratory Effects of Commuters' Exposure to Air Pollution in Traffic**

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**Table 1: Number counts, PM<sub>2.5</sub>, PM<sub>10</sub> and soot concentrations during commuting by bus, car or bicycle**

	Exposure		Dose	
	N (days)	Median (min-max)	N (personal measurements)	Median (min-max)
<b>PNC<sup>§</sup></b>		*10 <sup>3</sup> pt/cm <sup>3</sup>		*10 <sup>9</sup> pt/hr
Bus diesel	15	3.66 (2.32;7.16)	55	28.9 (12.7;81.8)
Bus electric	15	2.66 (1.55;4.70)	55	20.0 (8.48;44.1)
Car diesel	16	3.85 (2.33;6.26)	55	25.8 (7.89;65.5)
Car petrol	15	3.73 (3.02;6.80)	57	25.7 (9.92;117)
Bike high-traffic	16	4.63 (2.60;9.11)	59	55.9 (20.9;183)
Bike low-traffic	16	3.47 (1.41;8.31)	60	45.7 (12.9;174)
<b>PM<sub>2.5</sub><sup>§</sup></b>		µg/m <sup>3</sup>		µg/hr
Bus diesel	14	39.1 (15.5;324)	51	31.1 (8.5;359)
Bus electric	14	26.3 (10.7;131)	51	21.7 (6.0;118)
Car diesel	15	58.1 (2.7;358)	51	38.0 (1.5;331)
Car petrol	15	68.1 (5.3;403)	57	41.4 (2.5;382)
Bike high-traffic	16	49.8 (8.7;219)	59	60.8 (5.7;317)
Bike low-traffic	16	65.2 (5.5;241)	60	64.3 (6.7;455)
<b>PM<sub>10</sub></b>		µg/m <sup>3</sup>		µg/hr
Bus diesel	14	42.6 (22.8;221)	53	30.8 (16.3;245)
Bus electric	15	42.4 (30.0;107)	55	31.5 (11.1;112)
Car diesel	15	49.1 (29.1;427)	51	35.7 (13.6;428)
Car petrol	16	47.6 (26.9;161)	61	30.2 (7.8;163)
Bike high-traffic	16	42.5 (16.9;60.0)	59	52.4 (12.6;132)
Bike low-traffic	15	37.0 (17.3;53.4)	56	47.2 (11.3;125)
<b>Soot</b>		x10 <sup>-5</sup> /m		EC (µg/hr)
Bus diesel	15	6.8 (2.9;31)	55	7.4 (2.3;55)
Bus electric	15	4.6 (1.5;8.8)	55	4.9 (1.2;17)
Car diesel	16	7.8 (4.4;15)	55	8.3 (3.5;23)
Car petrol	16	8.5 (5.9;16)	61	8.6 (2.9;26)
Bike high-traffic	16	6.6 (2.0;14)	59	11.9 (3.1;44)
Bike low-traffic	16	4.9 (2.3;11)	60	8.7 (2.7;39)

Values in bus, in car and on bicycle are not directly comparable, as measurements were performed on different sampling days with different weather conditions and different urban background air pollution levels. For a comparison between the modes of transport, corrected for differences in urban background levels, see [Zuurbier M, Hoek G, Oldenwening M et al. Commuters' exposure to particulate matter air pollution is affected by mode of transport, fuel type, and route. \*Environ Health Perspect\* 2010;118:783-789.](#)

<sup>§</sup>)Median values of two-hour mean. Minimum and maximum values are the lowest and highest two-hour mean occurring during the sampling days.

**Table 2: Correlation between air pollutants**

	Exposure				Dose			
	PN <sup>§</sup>	PM <sub>2.5</sub> <sup>§</sup>	PM <sub>10</sub>	Soot	PN <sup>§</sup>	PM <sub>2.5</sub> <sup>§</sup>	PM <sub>10</sub>	EC
PN <sup>§</sup>	1	0.09	-0.00	0.58**	1	0.34**	0.50**	0.74**
PM <sub>2.5</sub> <sup>§</sup>		1	0.38**	0.32**		1	0.50**	0.41**
PM <sub>10</sub>			1	0.45**			1	0.61**
Soot				1				1

Spearman correlation coefficients. PN=particle number. EC=elemental carbon, calculated from absorption (soot).

§)Two-hour mean

\*\*p<0.01

\*)p<0.05

**Table 3: Estimates for relative differences in FEV1 per IQR change in exposure and dose**

	10am versus 8am Adjusted <sup>§</sup>	10am versus 8am Unadjusted	4pm versus 8am Adjusted <sup>§#</sup>	4pm versus 8am Unadjusted
<b>PN</b>				
<b>exposure</b>	0.42* (-0.06;0.90)	0.39 (-0.25;1.0)	-0.11 (-0.63; 0.41)	0.07 (-0.52; 0.66)
<b>dose</b>	0.10 (-0.29;0.50)	0.10 (-0.36; 0.56)	-0.46** (-0.89;-0.03)	-0.30 (-0.73; 0.12)
<b>PM<sub>2.5</sub></b>				
<b>exposure</b>	0.02 (-0.41; 0.45)	0.25 (-0.29; 0.78)	0.21 (-0.26; 0.67)	0.30 (-0.21; 0.80)
<b>dose</b>	0.00 (-0.32; 0.32)	0.07 (-0.32; 0.46)	0.18 (-0.17; 0.52)	0.16 (-0.21; 0.53)
<b>PM<sub>10</sub></b>				
<b>exposure</b>	-0.19 (-0.64; 0.26)	-0.10 (-0.31; 0.11)	0.10 (-0.39; 0.59)	-0.01 (-0.20; 0.19)
<b>dose</b>	-0.37 (-0.96; 0.22)	-0.29 (-0.66;0.09)	-0.36 (-1.1; 0.33)	-0.31* (-0.67;0.05)
<b>Soot</b>				
<b>exposure</b>	0.42* (-0.01; 0.84)	-0.04 (-0.55; 0.48)	0.38 (-0.10; 0.85)	0.35 (-0.17; 0.88)
<b>dose<sup>‡</sup></b>	0.18 (-0.19; 0.54)	-0.23 (-0.68; 0.23)	-0.06 (-0.46; 0.34)	-0.14 (-0.59; 0.31)

Change was calculated as estimate divided by the mean baseline value. Change per IQR change (95% confidence interval in parentheses). IQRs of two hour mean values: Particle number (PN) 18,195 pt/cm<sup>3</sup> (exposure) and 2.40\*10<sup>10</sup> pt/m<sup>2</sup> (dose), PM<sub>2.5</sub> 68.1 µg/m<sup>3</sup> (exposure) and 61.9 µg/m<sup>2</sup> (dose), PM<sub>10</sub> 20.8 µg/m<sup>3</sup> (exposure) and 32.4 µg/m<sup>2</sup> (dose), soot 3.51\*10<sup>-5</sup>/m (exposure) and 6.31 µg/m<sup>2</sup> (EC dose, calculated from soot absorption). Doses are adjusted for body surface area. 1% of data points with highest Cook's Distance removed.

<sup>§</sup>)Adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, first test-day or not, time spent in traffic before 8am

<sup>#</sup>)Additionally adjusted for time spent in traffic between 10am and 4pm

<sup>‡</sup>)Absorption calculated into elemental carbon

\*\*\*)p<0.01

\*\*p<0.05

\*)p<0.10

**Table 4 Effect of particle number exposure and dose in subgroups defined by travel mode and BMI**

	Cycling	Car-bus trips	p-value*	Low-BMI	High BMI	p-value*
	<b>PN exposure</b>			<b>PN exposure</b>		
<b>PEF<sup>#</sup></b>	-0.74 (-2.7;1.2)	-1.7 (-3.0;-0.35)	0.43	-0.35 (-1.4;0.73)	-2.0 (-3.4;-0.57)	0.07
<b>Exhaled NO<sup>†</sup></b>	2.5 (-4.5;10)	5.0 (0.3;9.8)	0.58	0.2 (-4.3;4.9)	0.5 (-3.9;5.1)	0.92
<b>Airway resistance<sup>§</sup></b>	0.9 (-8.3;11)	4.8 (-3.6;14)	0.56	0.8 (-6.9;9.1)	4.7 (-2.9;13)	0.50
	<b>PN dose</b>			<b>PN dose</b>		
<b>PEF<sup>#</sup></b>	0.04 (-0.91;0.99)	-2.6 (-4.3;-0.79)	0.01	0.27 (-0.49;1.0)	-1.9 (-3.4;-0.54)	0.01
<b>Exhaled NO<sup>†</sup></b>	-1.6 (-5.3;2.3)	6.8 (-0.2;14)	0.04	-1.4 (-4.9;2.2)	-1.3 (-5.6;3.2)	0.96
<b>Airway resistance<sup>§</sup></b>	2.4 (-1.8;6.7)	16 (3.6;30)	0.04	2.4 (-3.2;8.4)	7.7 (0.2;16)	0.28

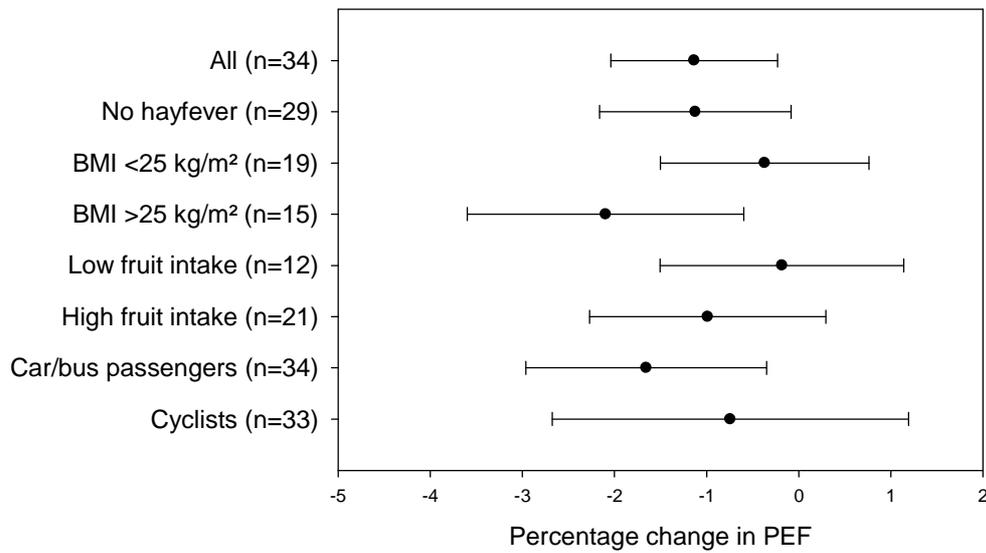
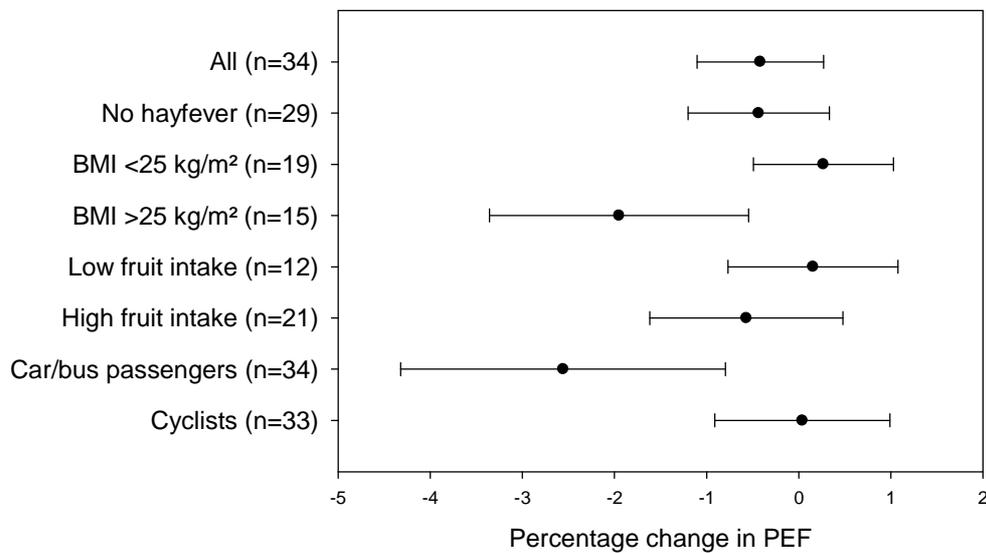
Percentage change, 95% confidence interval are given in parentheses. Change in PEF was calculated as estimate divided by the mean baseline value. PEF and airway resistance values are differences between 10am compared to 8am. Exhaled NO changes are differences between 4pm compared to 8am. IQRs of two hour mean values: PN 18,195 pt/cm<sup>3</sup> (exposure) and 2.40\*10<sup>10</sup> pt/m<sup>2</sup> (dose). Doses are adjusted for body surface area. Estimates are adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, first testday, time spent in traffic before 8am.

<sup>\*</sup>)For difference between subgroups

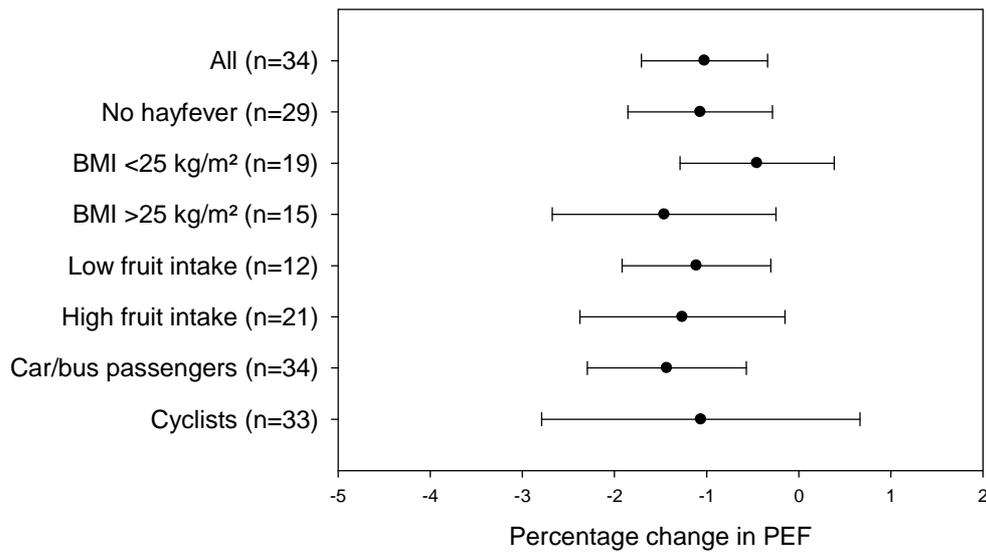
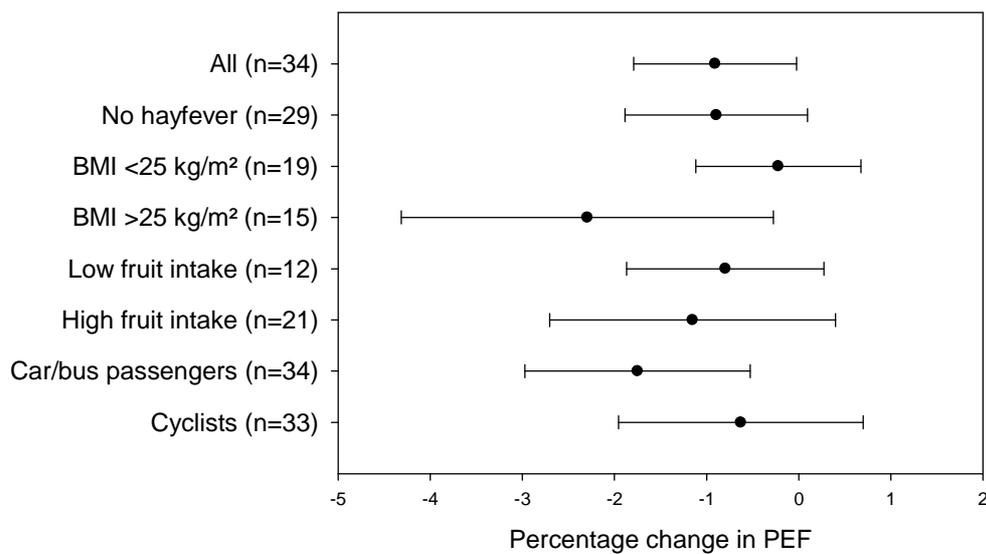
<sup>#</sup>)Additionally adjusted for first testday

<sup>†</sup>)Additionally adjusted for ambient NO, id of instrument, time spent in traffic between 10am and 4pm

<sup>§</sup>)Additionally adjusted for technician taking test

**A****B**

**Figure 1: Effect of particle number exposure (A) and dose (B) on peak expiratory flow**  
 Change calculated as estimate divided by the mean baseline value. Estimates (and 95% confidence limits) for change in peak expiratory flow (PEF) at 10am compared to 8am, per IQR change of 18,195 pt/cm<sup>3</sup> particle number (PN) exposure (Figure A) and per IQR change of  $2.40 \times 10^{10}$  pt/m<sup>2</sup> PN inhaled dose (Figure B). 1% of data points with highest Cook's Distance removed. Adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, first test-day, time spent in traffic before 8am. One third of the 352 measurements were made while cycling, two thirds while riding in bus or car. Volunteers repeatedly commuted by bicycle, car and bus. High fruit intake: seven or more fruits per week or taking vitamin supplements on five days or more.

**A****B****Figure 2: Effect of PM<sub>10</sub> exposure (A) and dose (B) on peak expiratory flow**

Change calculated as estimate divided by the mean baseline value. Estimates (and 95% confidence limits) for change in peak expiratory flow (PEF) at 10am compared to 8am, per IQR change of 20.8  $\mu\text{g}/\text{m}^3$  PM<sub>10</sub> exposure (Figure A) and per IQR change of 32.4  $\mu\text{g}/\text{m}^2$  PM<sub>10</sub> inhaled dose (Figure B). 1% of data points with highest Cook's Distance removed. Adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, first test-day, time spent in traffic before 8am.

One third of the 352 measurements were made while cycling, two thirds while riding in bus or car. Volunteers repeatedly commuted by bicycle, car and bus. High fruit intake: seven or more fruits per week or taking vitamin supplements on five days or more.

**Table 5: Estimates for relative differences in exhaled NO per IQR change in exposure and dose**

	Adjusted <sup>§</sup>	Unadjusted	Adjusted without outlier ambient NO <sub>2</sub> <sup>§</sup>
<b>PN</b>			
exposure	0.3 (-2.9,3.6)	0.5 (-2.6,3.7)	1.9 (-1.5,5.5)
dose	-1.3 (-4.0,1.4)	-1.3 (-3.5,1.0)	-0.3 (-3.2,2.7)
<b>PM<sub>2.5</sub></b>			
exposure	-1.1 (-3.8,1.6)	-2.0 (-4.3,0.3)	-1.4 (-4.1,1.4)
dose	-1.0 (-3.0,1.1)	-2.2 (-3.9,-0.4)	-1.0 (-3.0,1.1)
<b>PM<sub>10</sub></b>			
exposure	0.8 (-1.3,3.0)	-0.1 (-1.0,0.9)	-0.4 (-3.4,2.7)
dose	0.2 (-2.7,3.3)	-0.6 (-2.4,1.2)	-1.8 (-5.6,2.2)
<b>Soot</b>			
exposure	1.3 (-1.0,3.7)	1.1 (-1.1,3.4)	1.3 (-1.8,4.6)
dose <sup>‡</sup>	0.3 (-1.8,2.4)	-0.3 (-2.4,1.8)	0.1 (-2.7,2.9)

Log-transformed exhaled nitric oxide values were used. Estimates are calculated into percentage change at 4pm compared to 8am, per IQR change (95% confidence interval in parentheses). IQRs of two hour mean values: Particle number (PN) 18,195 pt/cm<sup>3</sup> (exposure) and 2.40\*10<sup>10</sup> pt/m<sup>2</sup> (dose), PM<sub>2.5</sub> 68.1 µg/m<sup>3</sup> (exposure) and 61.9 µg/m<sup>2</sup> (dose), PM<sub>10</sub> 20.8 µg/m<sup>3</sup>, (exposure) and 32.4 µg/m<sup>2</sup> (dose), soot 3.51\*10<sup>-5</sup>/m (exposure) and 6.31 µg/m<sup>2</sup> (EC dose, calculated from soot absorption).

Doses are adjusted for body surface area.

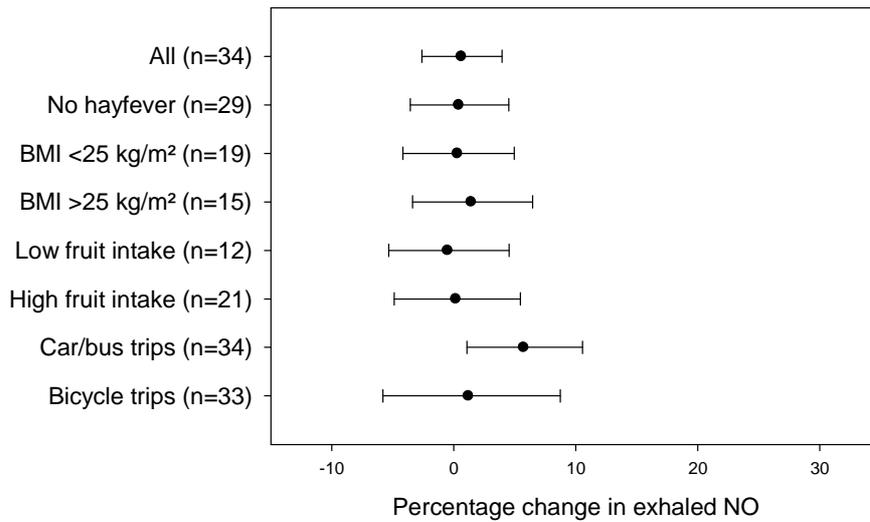
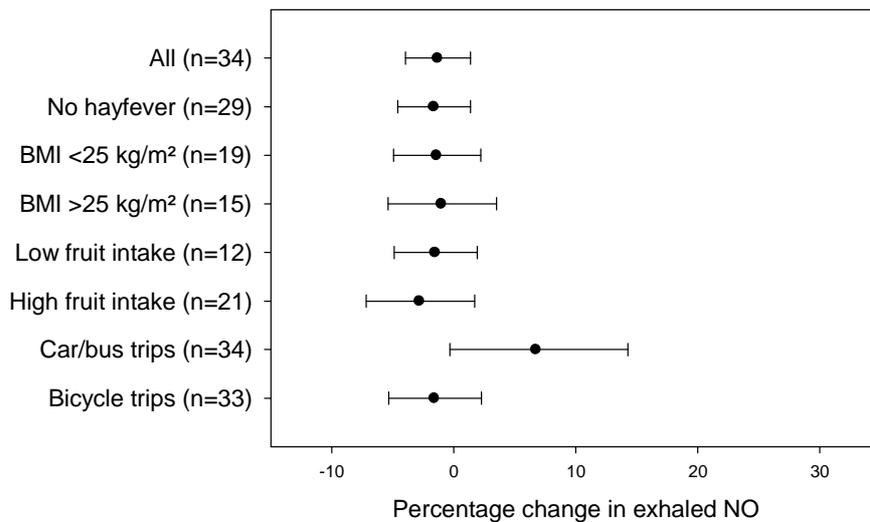
<sup>§</sup>)Adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, ambient NO, instrument ID, time spent in traffic before 8am and between 10am and 4pm.

<sup>‡</sup>)Absorption calculated into elemental carbon

\*\*\*)p<0.01

\*\*p<0.05

\*)p<0.10

**A****B****Figure 3: Effect of particle number exposure (A) and dose (B) on exhaled NO.**

Estimates (and 95% confidence limits) for change in exhaled NO at 4pm compared to 8am. Log-transformed exhaled NO values were used. Estimates are calculated into percentage change per IQR change of 18,195 pt/cm<sup>3</sup> particle number (PN) exposure (Figure A) and per IQR change of  $2.40 \times 10^{10}$  pt/m<sup>2</sup> PN inhaled dose (Figure B). Adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, ambient NO, id of instrument, time spent in traffic before 8am and between 10am and 4pm. One third of the 352 measurements were made while cycling, two thirds while riding in bus or car. Volunteers repeatedly commuted by bicycle, car and bus. High fruit intake: seven or more fruits per week or taking vitamin supplements on five days or more.

**Table 6: Estimates for relative differences in airway resistance per IQR change in exposure and dose**

	10am versus 8am		4pm versus 8am	
	Adjusted	Unadjusted	Adjusted <sup>§</sup>	Unadjusted
<b>PN</b>				
exposure	3.1 (-2.7,9.2)	2.4 (-3.1,8.3)	2.1 (-4.8,9.4)	2.8 (-3.5,9.5)
dose	5.1** (0.7,9.6)	3.5* (-0.2,7.4)	3.5 (-2.0,9.3)	2.8 (-1.7,7.6)
<b>PM<sub>2.5</sub></b>				
exposure	-3.3* (-6.8,0.3)	-5.1*** (-8.0,-2.1)	0.1 (-4.2,4.7)	-0.3 (-3.9,3.4)
dose	-1.3 (-4.7,2.3)	-3.5** (-6.2,-0.6)	1.1 (-3.2,5.5)	0.4 (-3.1,4.0)
<b>PM<sub>10</sub></b>				
exposure	-0.1 (-3.6,3.5)	-1.0 (-2.6,0.6)	0.8 (-3.5,5.4)	-0.1 (-2.0,1.8)
dose	3.7 (-1.1,8.8)	-0.7 (-3.6,2.3)	2.4 (-3.6,8.7)	0.6 (-2.8,4.1)
<b>Soot</b>				
exposure	-2.6 (-6.2,1.1)	-2.1 (-5.5,1.4)	-0.2 (-4.7,4.5)	0.5 (-3.5,4.7)
dose <sup>‡</sup>	1.4 (-2.1,5.0)	1.4 (-2.0,4.8)	2.3 (-2.0,6.9)	2.7 (-1.3,6.8)

Log-transformed airway resistance values were used. Estimates are calculated into percentage change per IQR change (95% confidence interval in parentheses). IQRs of two hour mean values: Particle number (PN) 18,195 pt/cm<sup>3</sup> (exposure) and 2.40\*10<sup>10</sup> pt/m<sup>2</sup> (dose), PM<sub>2.5</sub> 68.1 µg/m<sup>3</sup> (exposure) and 61.9 µg/m<sup>2</sup> (dose), PM<sub>10</sub> 20.8 µg/m<sup>3</sup>, (exposure) and 32.4 µg/m<sup>2</sup> (dose), soot 3.51\*10<sup>5</sup>/m (exposure) and 6.31 µg/m<sup>2</sup> (EC dose, ambient NO<sub>2</sub> 13.2 µg/m<sup>3</sup>, ambient O<sub>3</sub> 30.6 µg/m<sup>3</sup>, ambient PM<sub>10</sub> 15.3 µg/m<sup>3</sup>. Doses are adjusted for body surface area. Adjusted for RH, temperature, season, time test was taken, ambient NO<sub>2</sub>, technician taking test, time spent in traffic before 8am

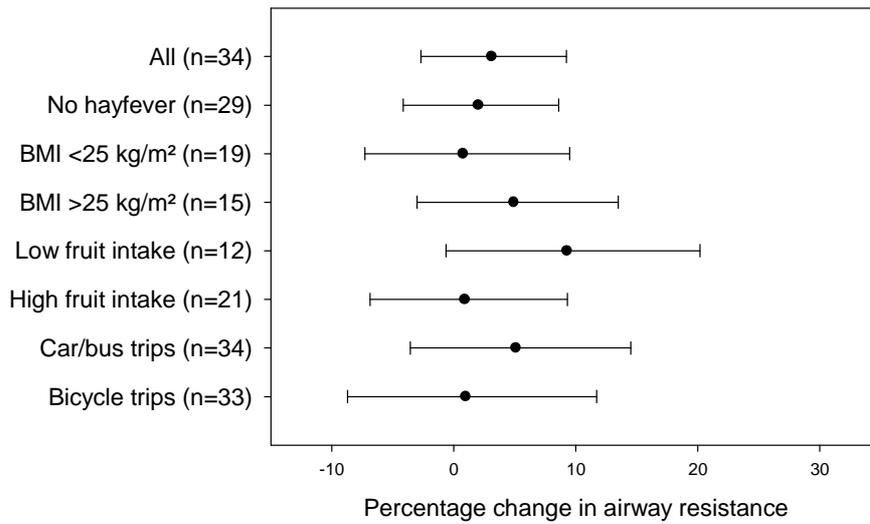
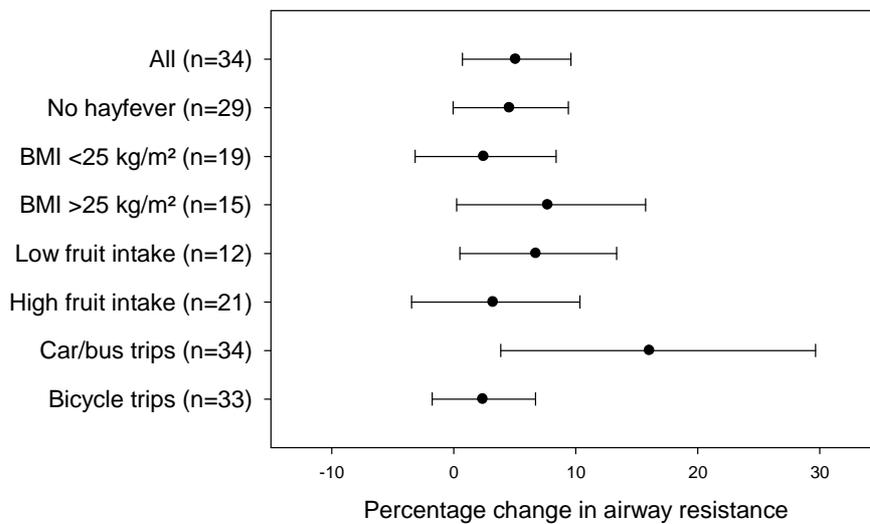
<sup>§</sup>)Additionally adjusted for time spent in traffic between 10am and 4pm

<sup>‡</sup>)Absorption calculated into elemental carbon

\*\*\*)p<0.01

\*\*p<0.05

\*)p<0.10

**A****B****Figure 4: Effect of particle number exposure (A) and dose (B) on airway resistance**

Estimates (and 95% confidence limits) for change in airway resistance at 10am compared to 8am.

Log-transformed airway resistance values were used. Estimates are calculated into percentage

change per IQR change of IQR change of 18,195 pt/cm<sup>3</sup> particle number (PN) exposure (Figure A)

and per IQR change of  $2.40 \times 10^{10}$  pt/m<sup>2</sup> PN inhaled dose (Figure B). Adjusted for RH, temperature,

season, time test was taken, ambient NO<sub>2</sub>, technician taking test, time spent in traffic before 8am. One

third of the 352 measurements were made while cycling, two thirds while riding in bus or car.

Volunteers repeatedly commuted by bicycle, car and bus. High fruit intake: seven or more fruits per week or taking vitamin supplements on five days or more.