Effects of Respirators to Reduce Fine Particulate Matter Exposures on Blood Pressure and Heart Rate Variability: A Systematic Review and Meta-Analysis

Sasan Faridi[1#], Robert D Brook[2#], Fatemeh Yusefian[3], Mohammad Sadegh Hassanvand[1,4], Ramin Nabizadeh Nodehi[1, 4], Mansour Shamsipour[5], Sanjay Rajagopalan[6], Kazem Naddafi[1, 4*]

[1] Center for Air Pollution Research (CAPR), Institute for Environmental Research (IER), Tehran University of Medical Sciences, Tehran, Iran

[2] Wayne State University, Detroit Michigan, USA

[3] Department of Environmental Health Engineering, Faculty of Health, Kashan University of Medical Sciences, Kashan, Iran

[4] Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

[5] Department of Research Methodology and Data Analysis, Institute for Environmental Research, Tehran University of Medical Sciences, Tehran, Iran

[6] Case Western Reserve University, Cleveland OH, USA

[#] Contributed equally.

[*] **Corresponding Author:** K. Naddafi, PhD, Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Center for Air Pollution Research (CAPR), Institute for Environmental Research (IER), Tehran University of Medical Sciences, Phone: +98 88978395, Fax: +98 88978397, 8th Floor, No. 1547, North Kargar Avenue, Tehran, Iran (knadafi@tums.ac.ir).

(1)	N95 (8210 N95 Respirator, 3M Science, MN, United States)	 https://www.3m.com/3M/en_US/p/d/v000585997/
(2)	Validated N95 respirator (a new Dettol SiTi shield Protect Plus Smart Mask)	 https://www.dettolsitishield.co.in/products/smart-mask/

		 https://www.dettolsitishield.co.in/products/smart-mask/
(3)	3M respirator 9002V	 https://waytotrade.en.made-in-china.com/product/jorQqFtCkwfv/China-3m-9002V-Particulate-Respirators-Dust-Mist-Mask.html

(4)	Dust Respirator 8812; 3M, St. Paul, MN, USA	 https://www.3m.com/3M/en_LB/p/d/v000061052/
(5)	Validated N95 respirator (8210V; 3M)	 https://www.3m.com/3M/en_US/p/d/v000057815/

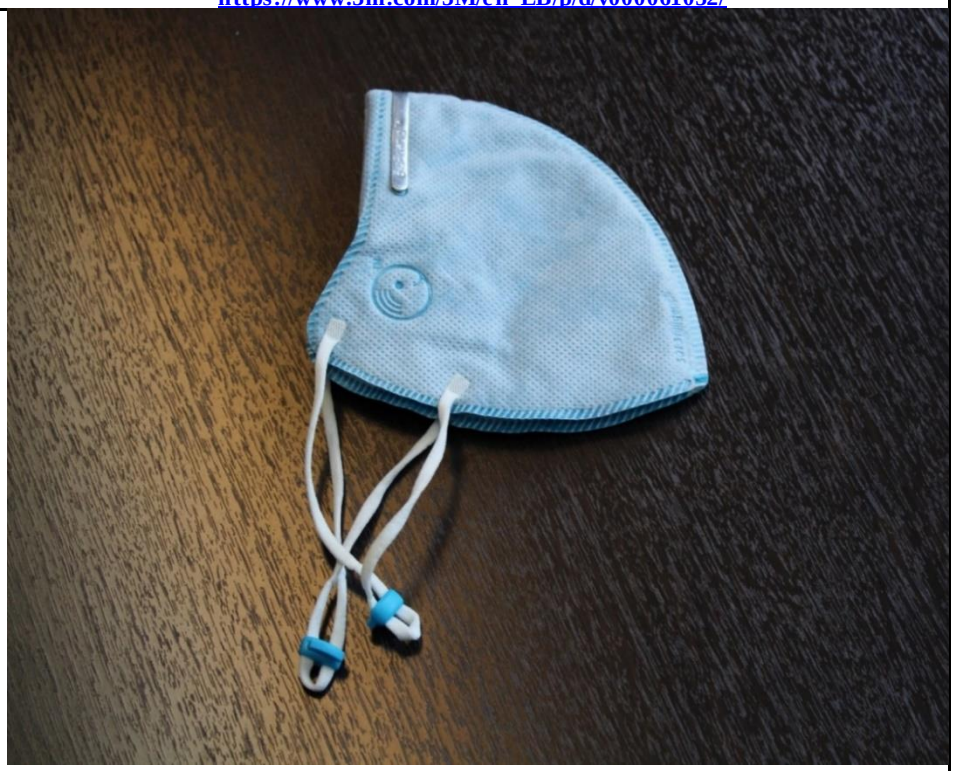
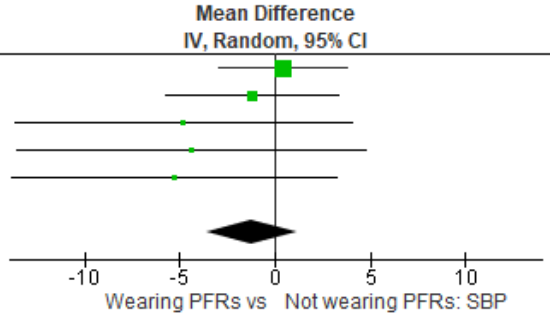
(6)	Dust Respirator 8812, 3 M, St Paul USA	 https://www.3m.com/3M/en_LB/p/d/v000061052/
(7)	Biomask	 **Reported in the supplementary material of the study of Faridi et al(7).**

Figure S1. Types of PFRs used by participants in the included studies (Some PFR images have been downloaded from the Internet based on the mentioned commercial brands and their numbers in the included studies).

A

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2012, 24hr	121.2	11.9	98	120.8	12.4	98	49.8%	0.40 [-3.00, 3.80]	2012
Langrish et al. 2012, 2hr walking in city center	126.9	15.9	98	128.1	16.5	98	28.0%	-1.20 [-5.74, 3.34]	2012
Lim et al. 2020, Combination pre and post	122.7	14.2	21	127.5	14.9	21	7.4%	-4.80 [-13.60, 4.00]	2020
Lim et al. 2020, Post-intervention	122.7	14.2	21	127.1	16.1	21	6.8%	-4.40 [-13.58, 4.78]	2020
Lim et al. 2020, Pre-intervention	122.7	14.2	21	128	13.9	21	8.0%	-5.30 [-13.80, 3.20]	2020
Total (95% CI)			**259**			**259**	**100.0%**	**-1.22 [-3.62, 1.18]**	

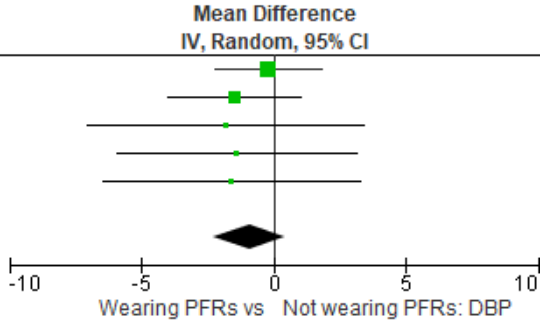
Heterogeneity: Tau² = 0.00; Chi² = 2.85, df = 4 (P = 0.58); I² = 0%
Test for overall effect: Z = 0.99 (P = 0.32)



B

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2012, 24hr	73.8	7.2	98	74	7.3	98	45.9%	-0.20 [-2.23, 1.83]	2012
Langrish et al. 2012, 2hr walking in city center	78	9.3	98	79.5	8.6	98	30.1%	-1.50 [-4.01, 1.01]	2012
Lim et al. 2020, Post-intervention	74.8	8.2	21	76.6	9.1	21	6.9%	-1.80 [-7.04, 3.44]	2020
Lim et al. 2020, Pre-intervention	74.8	8.2	21	76.2	6.8	21	9.1%	-1.40 [-5.96, 3.16]	2020
Lim et al. 2020, Combination pre and post	74.8	8.2	21	76.4	7.9	21	8.0%	-1.60 [-6.47, 3.27]	2020
Total (95% CI)			**259**			**259**	**100.0%**	**-0.92 [-2.30, 0.45]**	

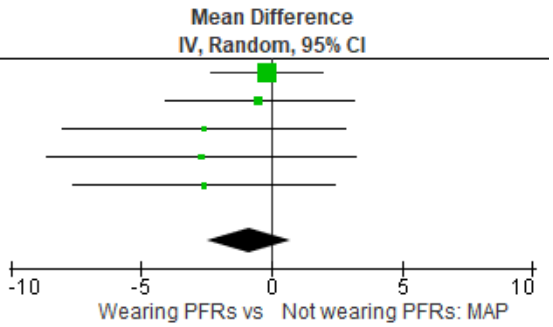
Heterogeneity: Tau² = 0.00; Chi² = 0.91, df = 4 (P = 0.92); I² = 0%
Test for overall effect: Z = 1.31 (P = 0.19)



C

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2012, 24hr	89.8	7.5	98	90	7.9	98	54.6%	-0.20 [-2.36, 1.96]	2012
Langrish et al. 2012, 2hr walking in city center	93.8	8.3	39	94.3	8	39	19.4%	-0.50 [-4.12, 3.12]	2012
Lim et al. 2020, Combination pre and post	90.8	9	21	93.4	9	21	8.6%	-2.60 [-8.04, 2.84]	2020
Lim et al. 2020, Post-intervention	90.8	9	21	93.5	10.5	21	7.3%	-2.70 [-8.61, 3.21]	2020
Lim et al. 2020, Pre-intervention	90.8	9	21	93.4	7.5	21	10.1%	-2.60 [-7.61, 2.41]	2020
Total (95% CI)			**200**			**200**	**100.0%**	**-0.89 [-2.48, 0.71]**	

Heterogeneity: Tau² = 0.00; Chi² = 1.62, df = 4 (P = 0.80); I² = 0%
Test for overall effect: Z = 1.09 (P = 0.27)



D

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2012, 24hr	77.6	11.3	98	76.7	11.1	98	29.4%	0.90 [-2.24, 4.04]	2012
Langrish et al. 2012, 2hr walking in city center	81.5	8.7	98	81.5	10.1	98	41.6%	0.00 [-2.64, 2.64]	2012
Lim et al. 2020, Combination pre and post	68.8	9.8	21	68.1	8.2	21	9.7%	0.70 [-4.77, 6.17]	2020
Lim et al. 2020, Post-intervention	68.8	9.8	21	68.2	7.9	21	10.0%	0.60 [-4.78, 5.98]	2020
Lim et al. 2020, Pre-intervention	68.8	9.8	21	68	8.6	21	9.3%	0.80 [-4.78, 6.38]	2020
Total (95% CI)			**259**			**259**	**100.0%**	**0.47 [-1.23, 2.17]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.22, df = 4 (P = 0.99); I² = 0%
Test for overall effect: Z = 0.54 (P = 0.59)

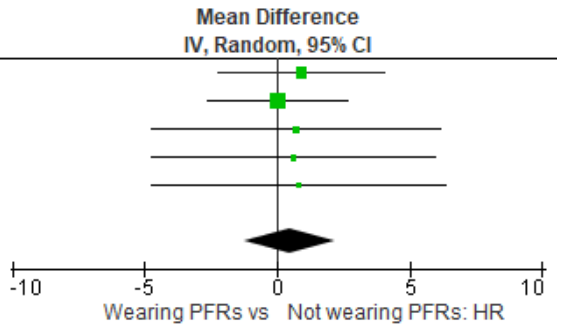
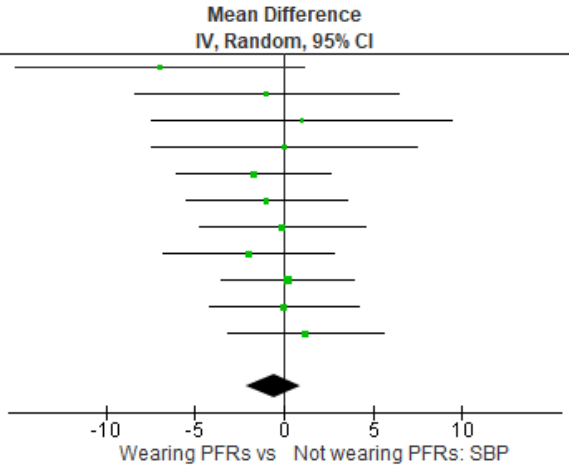


Figure S2. Sensitivity analysis of PFRs effect on SBP (**A**), DBP (**B**), MAP (**C**) and HR (**D**) restricted to studies enrolling aged subjects.

A

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2009, 24hr	114	11.3	15	121	11.3	15	3.5%	-7.00 [-15.09, 1.09]	2009
Langrish et al. 2009, 2hr walking near-roadway	109	9.4	15	110	11.3	15	4.1%	-1.00 [-8.44, 6.44]	2009
Langrish et al. 2009, Day time	101	10.3	15	100	13.1	15	3.2%	1.00 [-7.43, 9.43]	2009
Langrish et al. 2009, Night time	106	9.4	15	106	11.3	15	4.1%	0.00 [-7.44, 7.44]	2009
Shi et al. 2017, 24hr	107.3	8	24	109	7.4	24	12.0%	-1.70 [-6.06, 2.66]	2017
Yang et al. 2018, 4hr travelling by Metro	116	10.3	39	117	10	39	11.3%	-1.00 [-5.51, 3.51]	2018
Morishita et al. 2019, 2hr near-roadway exposures	119.2	11.7	50	119.3	12	50	10.6%	-0.10 [-4.75, 4.55]	2019
Han et al. 2021, 2hr walking near-roadway	122	10.8	39	124	10.8	39	9.9%	-2.00 [-6.79, 2.79]	2021
Faridi et al. 2021, 24hr	115.3	6.4	26	115.1	7.2	26	16.7%	0.20 [-3.50, 3.90]	2021
Faridi et al. 2021, Day time	117.4	7.6	26	117.4	7.9	26	12.9%	0.00 [-4.21, 4.21]	2021
Faridi et al. 2021, Night time	107.1	8.8	26	105.9	7.4	26	11.7%	1.20 [-3.22, 5.62]	2021
Total (95% CI)			**290**			**290**	**100.0%**	**-0.61 [-2.12, 0.91]**	

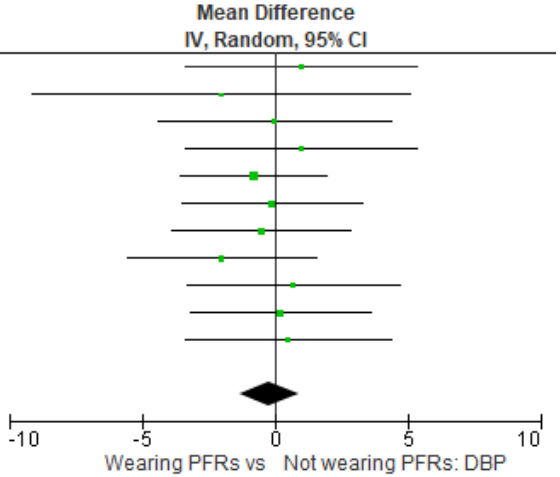
Heterogeneity: Tau² = 0.00; Chi² = 4.12, df = 10 (P = 0.94); I² = 0%
Test for overall effect: Z = 0.79 (P = 0.43)



B

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2009, 24hr	70	5.6	15	69	6.6	15	6.7%	1.00 [-3.38, 5.38]	2009
Langrish et al. 2009, 2hr walking near-roadway	79	8.4	15	81	11.3	15	2.5%	-2.00 [-9.13, 5.13]	2009
Langrish et al. 2009, Day time	73	5.6	15	73	6.6	15	6.7%	0.00 [-4.38, 4.38]	2009
Langrish et al. 2009, Night time	64	5.6	15	63	6.6	15	6.7%	1.00 [-3.38, 5.38]	2009
Shi et al. 2017, 24hr	70	5	24	70.8	4.8	24	16.8%	-0.80 [-3.57, 1.97]	2017
Yang et al. 2018, 4hr travelling by Metro	74.6	7.8	39	74.7	7.6	39	11.0%	-0.10 [-3.52, 3.32]	2018
Morishita et al. 2019, 2hr near-roadway exposures	74.2	8.5	50	74.7	8.6	50	11.5%	-0.50 [-3.85, 2.85]	2019
Han et al. 2021, 2hr walking near-roadway	75	8.3	39	77	7.7	39	10.2%	-2.00 [-5.55, 1.55]	2021
Faridi et al. 2021, Night time	61.8	7.7	26	61.1	7.1	26	8.0%	0.70 [-3.33, 4.73]	2021
Faridi et al. 2021, 24hr	68.7	5.9	26	68.5	6.6	26	11.1%	0.20 [-3.20, 3.60]	2021
Faridi et al. 2021, Day time	70.7	7.1	26	70.2	7.1	26	8.7%	0.50 [-3.36, 4.36]	2021
Total (95% CI)			**290**			**290**	**100.0%**	**-0.20 [-1.34, 0.93]**	

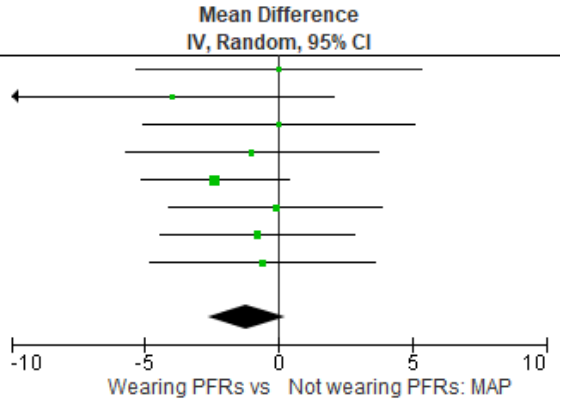
Heterogeneity: Tau² = 0.00; Chi² = 2.40, df = 10 (P = 0.99); I² = 0%
Test for overall effect: Z = 0.35 (P = 0.73)



C

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2009, 24hr	82	7.5	15	82	7.5	15	7.3%	0.00 [-5.37, 5.37]	2009
Langrish et al. 2009, 2hr walking near-roadway	90	7.5	15	94	9.4	15	5.7%	-4.00 [-10.09, 2.09]	2009
Langrish et al. 2009, Day time	85	7.5	15	85	6.6	15	8.3%	0.00 [-5.06, 5.06]	2009
Langrish et al. 2009, Night time	75	7.5	15	76	5.6	15	9.4%	-1.00 [-5.74, 3.74]	2009
Yang et al. 2018, 4hr travelling by Metro	93.3	9.7	98	95.7	10	98	27.8%	-2.40 [-5.16, 0.36]	2018
Faridi et al. 2021, Night time	74.1	8	26	74.2	6.6	26	13.3%	-0.10 [-4.09, 3.89]	2021
Faridi et al. 2021, 24hr	81.3	5.9	26	82.1	7.3	26	16.2%	-0.80 [-4.41, 2.81]	2021
Faridi et al. 2021, Day time	83.4	7.3	26	84	8.1	26	12.0%	-0.60 [-4.79, 3.59]	2021
Total (95% CI)			**236**			**236**	**100.0%**	**-1.20 [-2.66, 0.25]**	

Heterogeneity: Tau² = 0.00; Chi² = 2.37, df = 7 (P = 0.94); I² = 0%
Test for overall effect: Z = 1.62 (P = 0.10)



D

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2009, Day time	78	8.4	15	79	9.4	15	5.3%	-1.00 [-7.38, 5.38]	2009
Langrish et al. 2009, Night time	61	6.6	15	64	5.6	15	11.3%	-3.00 [-7.38, 1.38]	2009
Langrish et al. 2009, 24hr	72	7.5	15	74	6.6	15	8.5%	-2.00 [-7.06, 3.06]	2009
Langrish et al. 2009, 2hr walking near-roadway	91	11.3	15	88	11.3	15	3.3%	3.00 [-5.09, 11.09]	2009
Yang et al. 2018, 4hr travelling by Metro	77.2	8.2	39	78.1	9.4	39	14.2%	-0.90 [-4.81, 3.01]	2018
Han et al. 2021, 2hr walking near-roadway	81	8.5	39	80	8.5	39	15.3%	1.00 [-2.77, 4.77]	2021
Faridi et al. 2021, 24hr	72.4	6.8	26	72.1	6.8	26	15.9%	0.30 [-3.40, 4.00]	2021
Faridi et al. 2021, Day time	74.1	7.1	26	74	6.8	26	15.2%	0.10 [-3.68, 3.88]	2021
Faridi et al. 2021, Night time	66.8	8.7	26	64.2	7.7	26	10.9%	2.60 [-1.87, 7.07]	2021
Total (95% CI)			**216**			**216**	**100.0%**	**-0.09 [-1.57, 1.38]**	

Heterogeneity: Tau² = 0.00; Chi² = 4.81, df = 8 (P = 0.78); I² = 0%
Test for overall effect: Z = 0.12 (P = 0.90)

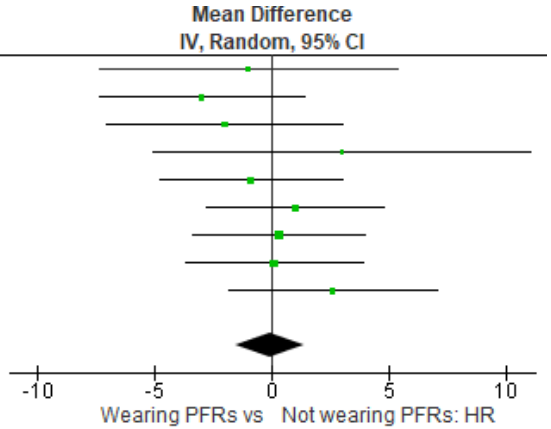
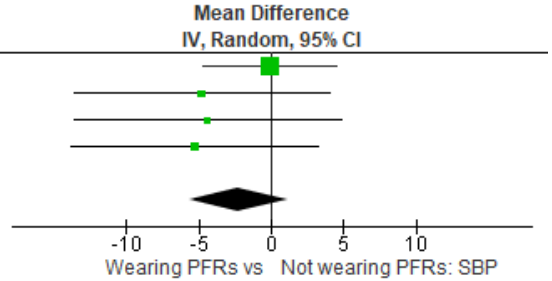


Figure S3. Sensitivity analysis of PFRs effect on SBP (**A**), DBP (**B**), MAP (**C**) and HR (**D**) restricted to studies enrolling younger subjects.

A

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Morishita et al. 2019, 2hr near-roadway exposures	119.2	11.7	50	119.3	12	50	54.5%	-0.10 [-4.75, 4.55]	2019
Lim et al. 2020, Combination pre and post	122.7	14.2	21	127.5	14.9	21	15.2%	-4.80 [-13.60, 4.00]	2020
Lim et al. 2020, Post-intervention	122.7	14.2	21	127.1	16.1	21	14.0%	-4.40 [-13.58, 4.78]	2020
Lim et al. 2020, Pre-intervention	122.7	14.2	21	128	13.9	21	16.3%	-5.30 [-13.80, 3.20]	2020
Total (95% CI)			**113**			**113**	**100.0%**	**-2.26 [-5.69, 1.17]**	

Heterogeneity: Tau² = 0.00; Chi² = 1.85, df = 3 (P = 0.60); I² = 0%
Test for overall effect: Z = 1.29 (P = 0.20)



B

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Morishita et al. 2019, 2hr near-roadway exposures	74.2	8.5	50	74.7	8.6	50	41.3%	-0.50 [-3.85, 2.85]	2019
Lim et al. 2020, Post-intervention	74.8	8.2	21	76.6	9.1	21	16.9%	-1.80 [-7.04, 3.44]	2020
Lim et al. 2020, Pre-intervention	74.8	8.2	21	76.2	6.8	21	22.3%	-1.40 [-5.96, 3.16]	2020
Lim et al. 2020, Combination pre and post	74.8	8.2	21	76.4	7.9	21	19.5%	-1.60 [-6.47, 3.27]	2020
Total (95% CI)			**113**			**113**	**100.0%**	**-1.14 [-3.29, 1.02]**	

Heterogeneity: Tau² = 0.00; Chi² = 0.25, df = 3 (P = 0.97); I² = 0%
Test for overall effect: Z = 1.03 (P = 0.30)

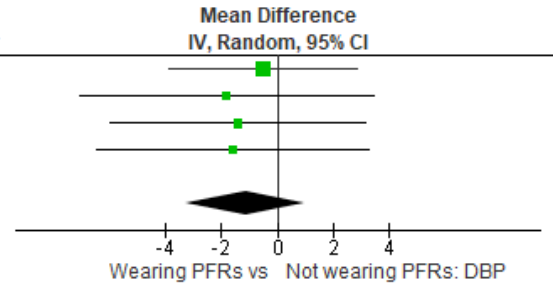
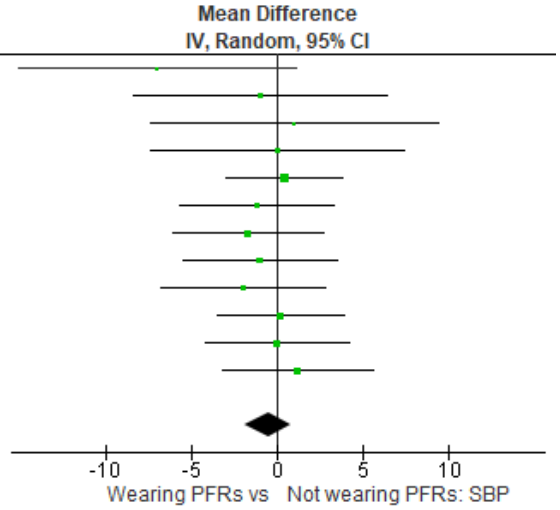


Figure S4. Sensitivity analysis of PFRs effect on SBP (**A**) and DBP (**B**) restricted to studies with the $PM_{2.5}$ levels less than 25 $\mu g/m^3$.

A

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2009, 24hr	114	11.3	15	121	11.3	15	2.9%	-7.00 [-15.09, 1.09]	2009
Langrish et al. 2009, 2hr walking near-roadway	109	9.4	15	110	11.3	15	3.4%	-1.00 [-8.44, 6.44]	2009
Langrish et al. 2009, Day time	101	10.3	15	100	13.1	15	2.7%	1.00 [-7.43, 9.43]	2009
Langrish et al. 2009, Night time	106	9.4	15	106	11.3	15	3.4%	0.00 [-7.44, 7.44]	2009
Langrish et al. 2012, 24hr	121.2	11.9	98	120.8	12.4	98	16.4%	0.40 [-3.00, 3.80]	2012
Langrish et al. 2012, 2hr walking in city center	126.9	15.9	98	128.1	16.5	98	9.2%	-1.20 [-5.74, 3.34]	2012
Shi et al. 2017, 24hr	107.3	8	24	109	7.4	24	10.0%	-1.70 [-6.06, 2.66]	2017
Yang et al. 2018, 4hr travelling by Metro	116	10.3	39	117	10	39	9.4%	-1.00 [-5.51, 3.51]	2018
Han et al. 2021, 2hr walking near-roadway	122	10.8	39	124	10.8	39	8.3%	-2.00 [-6.79, 2.79]	2021
Faridi et al. 2021, 24hr	115.3	6.4	26	115.1	7.2	26	13.9%	0.20 [-3.50, 3.90]	2021
Faridi et al. 2021, Day time	117.4	7.6	26	117.4	7.9	26	10.7%	0.00 [-4.21, 4.21]	2021
Faridi et al. 2021, Night time	107.1	8.8	26	105.9	7.4	26	9.7%	1.20 [-3.22, 5.62]	2021
Total (95% CI)			**436**			**436**	**100.0%**	**-0.54 [-1.92, 0.84]**	

Heterogeneity: Tau² = 0.00; Chi² = 4.47, df = 11 (P = 0.95); I² = 0%
Test for overall effect: Z = 0.77 (P = 0.44)



B

Study or Subgroup	Intervention group Mean [mmHg]	SD [mmHg]	Total	Control group Mean [mmHg]	SD [mmHg]	Total	Weight	Mean Difference IV, Random, 95% CI	Year
Langrish et al. 2009, 24hr	70	5.6	15	69	6.6	15	4.8%	1.00 [-3.38, 5.38]	2009
Langrish et al. 2009, 2hr walking near-roadway	79	8.4	15	81	11.3	15	1.8%	-2.00 [-9.13, 5.13]	2009
Langrish et al. 2009, Day time	73	5.6	15	73	6.6	15	4.8%	0.00 [-4.38, 4.38]	2009
Langrish et al. 2009, Night time	64	5.6	15	63	6.6	15	4.8%	1.00 [-3.38, 5.38]	2009
Langrish et al. 2012, 24hr	73.8	7.2	98	74	7.3	98	22.3%	-0.20 [-2.23, 1.83]	2012
Langrish et al. 2012, 2hr walking in city center	78	9.3	98	79.5	8.6	98	14.6%	-1.50 [-4.01, 1.01]	2012
Shi et al. 2017, 24hr	70	5	24	70.8	4.8	24	12.0%	-0.80 [-3.57, 1.97]	2017
Yang et al. 2018, 4hr travelling by Metro	74.6	7.8	39	74.7	7.6	39	7.9%	-0.10 [-3.52, 3.32]	2018
Han et al. 2021, 2hr walking near-roadway	75	8.3	39	77	7.7	39	7.3%	-2.00 [-5.55, 1.55]	2021
Faridi et al. 2021, Night time	61.8	7.7	26	61.1	7.1	26	5.7%	0.70 [-3.33, 4.73]	2021
Faridi et al. 2021, 24hr	68.7	5.9	26	68.5	6.6	26	7.9%	0.20 [-3.20, 3.60]	2021
Faridi et al. 2021, Day time	70.7	7.1	26	70.2	7.1	26	6.2%	0.50 [-3.36, 4.36]	2021
Total (95% CI)			**436**			**436**	**100.0%**	**-0.37 [-1.33, 0.59]**	

Heterogeneity: Tau² = 0.00; Chi² = 3.29, df = 11 (P = 0.99); I² = 0%
Test for overall effect: Z = 0.75 (P = 0.45)

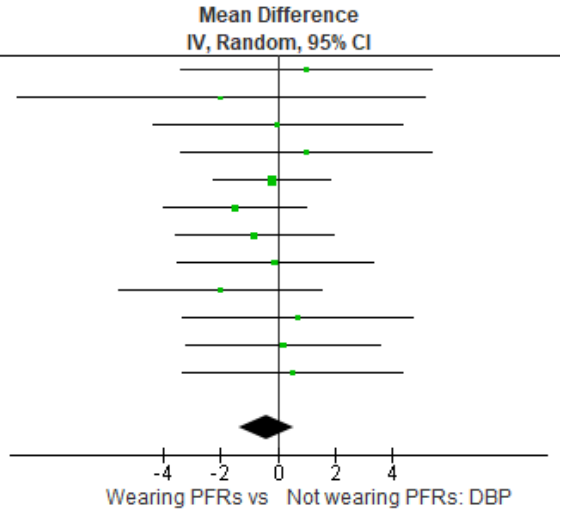


Figure S5. Sensitivity analysis of PFRs effect on SBP (**A**) and DBP (**B**), restricted to studies with the $PM_{2.5}$ levels more than 25 $\mu g/m^3$.

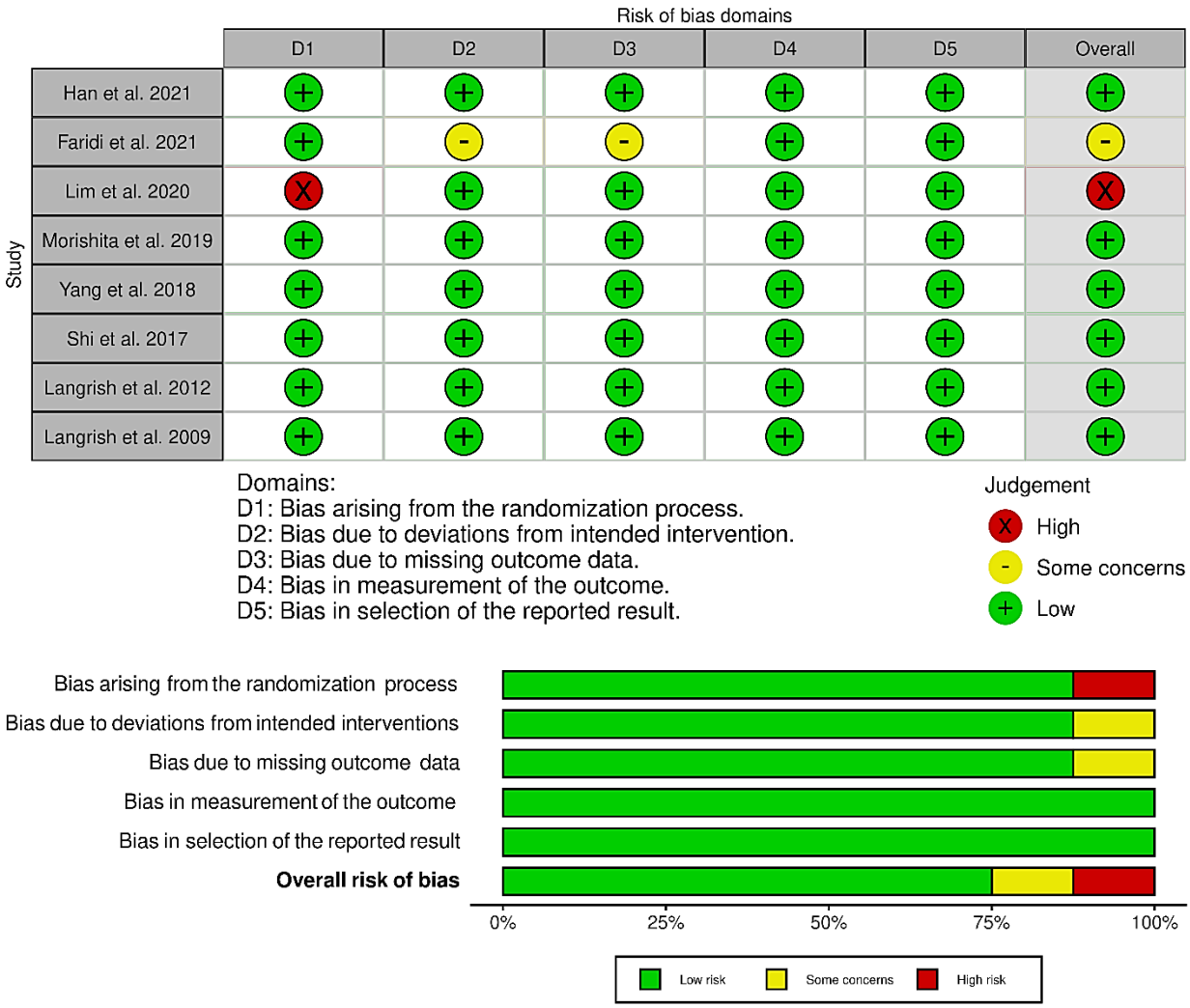
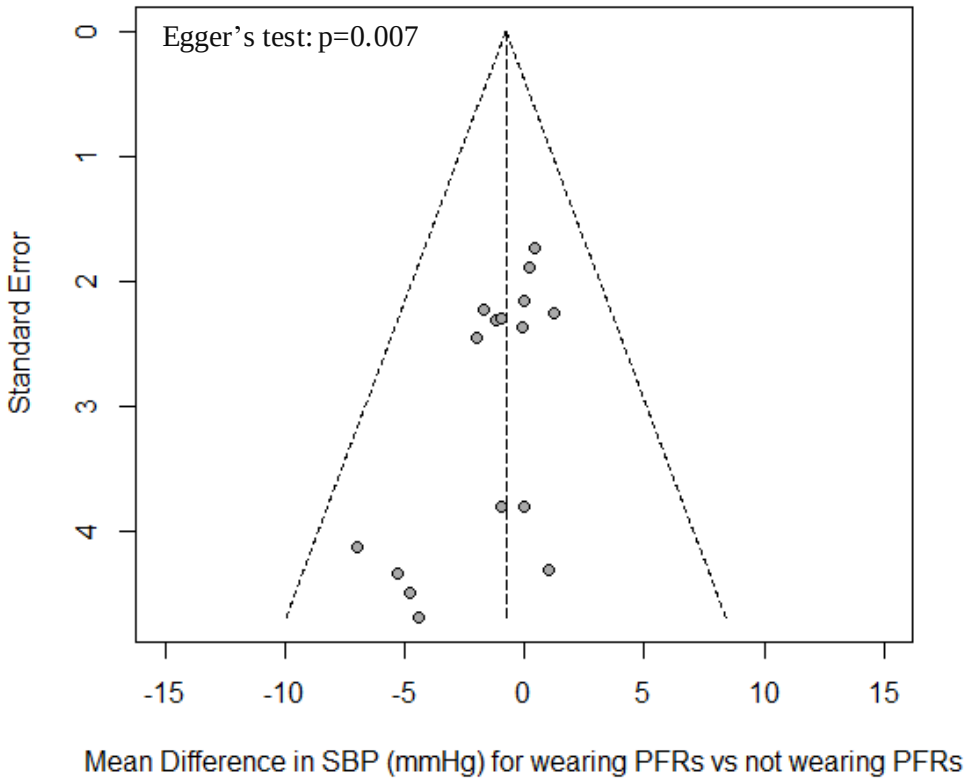
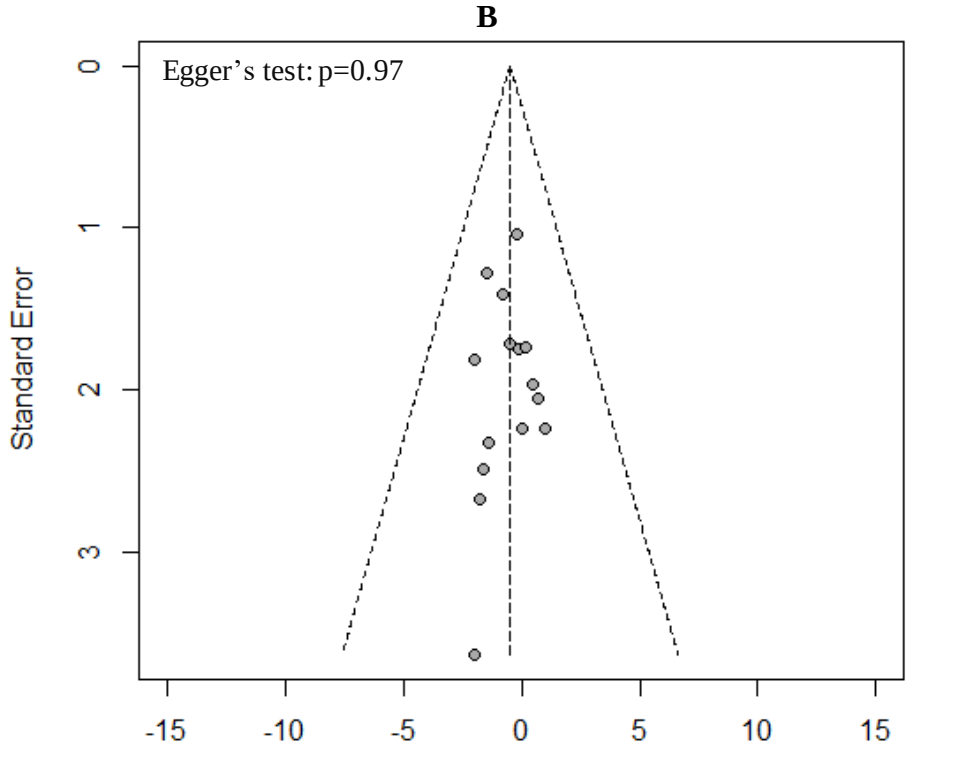


Figure S6. Summary of risk of bias for the included studies in our meta-analysis.

A


Egger's test: p=0.007
Standard Error
0
1
2
3
4
-15
-10
-5
0
5
10
15
Mean Difference in SBP (mmHg) for wearing PFRs vs not wearing PFRs

B


Egger's test: p=0.97
Standard Error
0
1
2
3
-15
-10
-5
0
5
10
15
Mean Difference in DBP (mmHg) for wearing PFRs vs not wearing PFRs

C

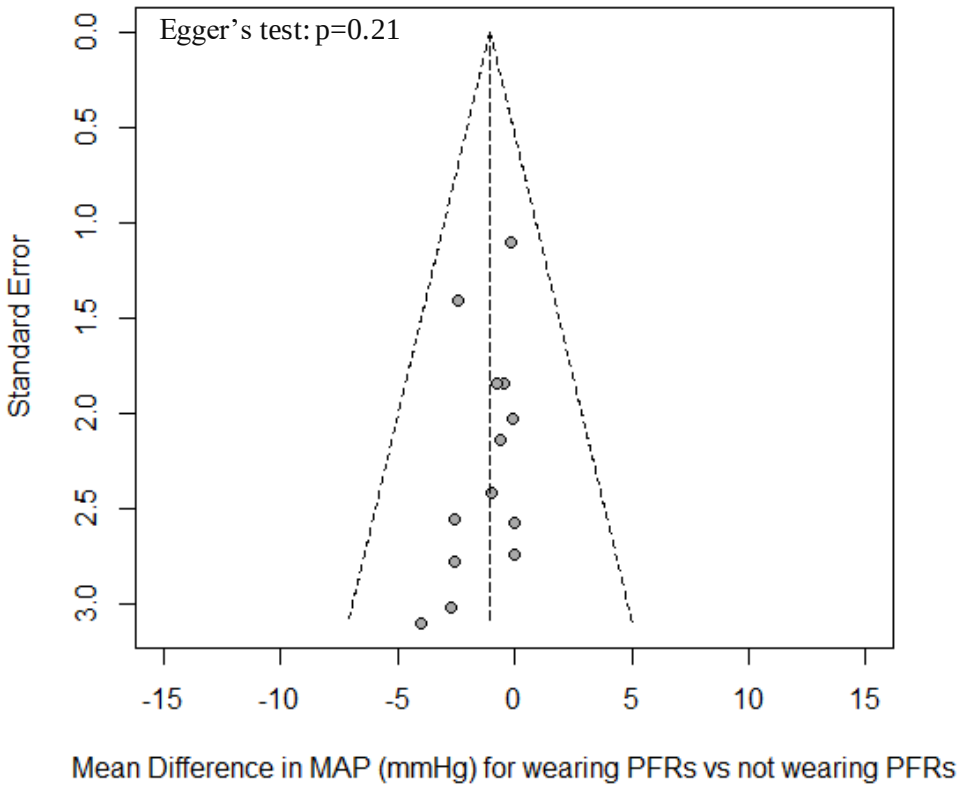
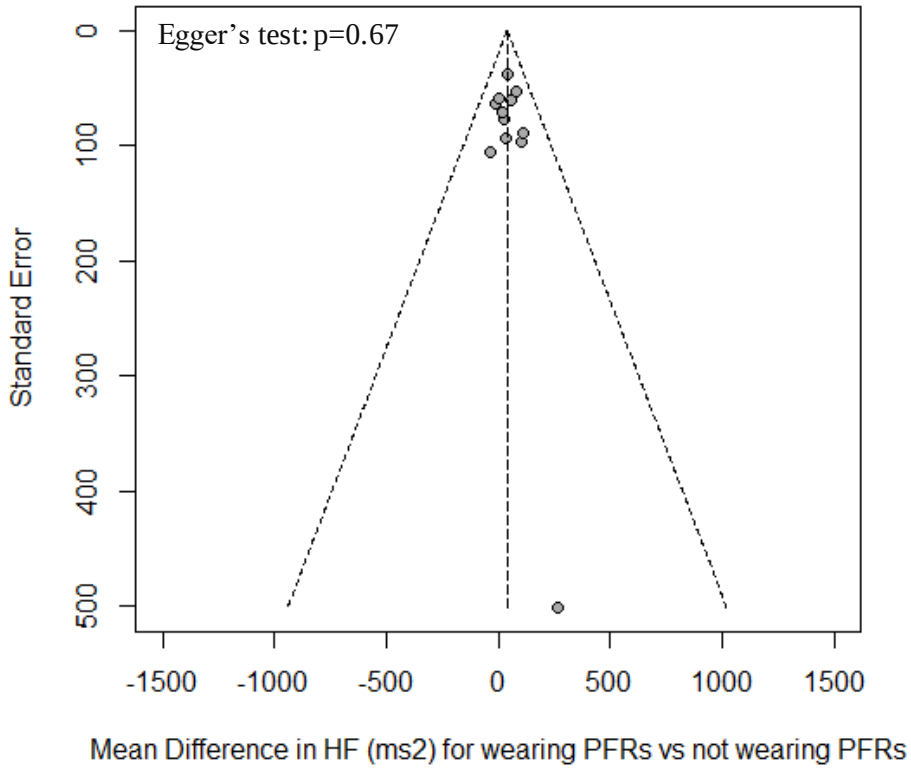
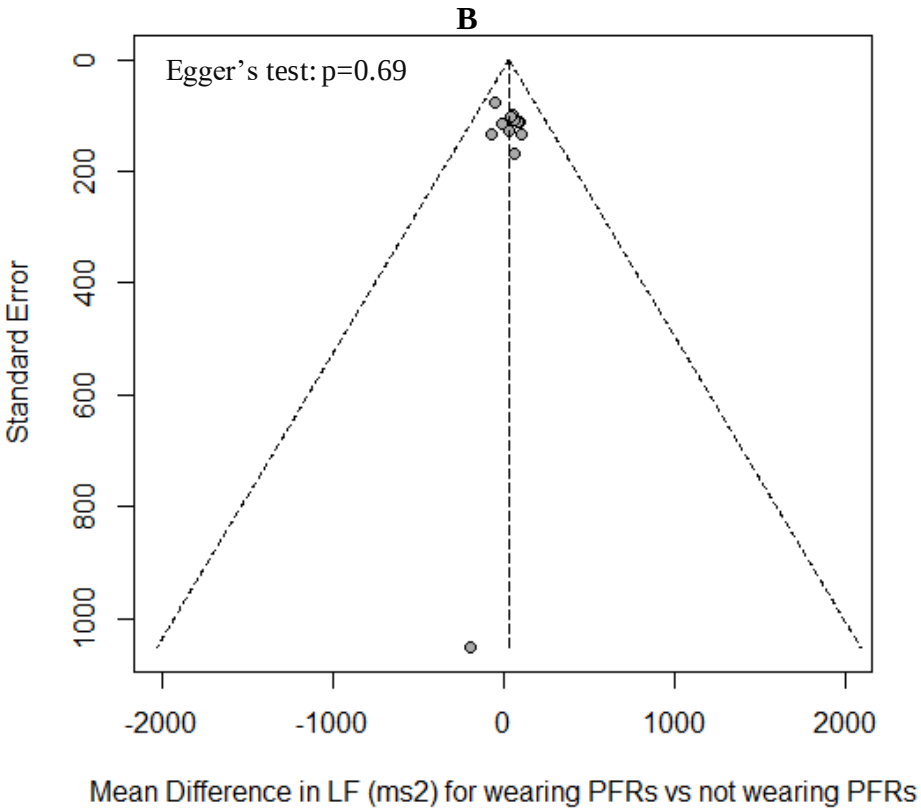


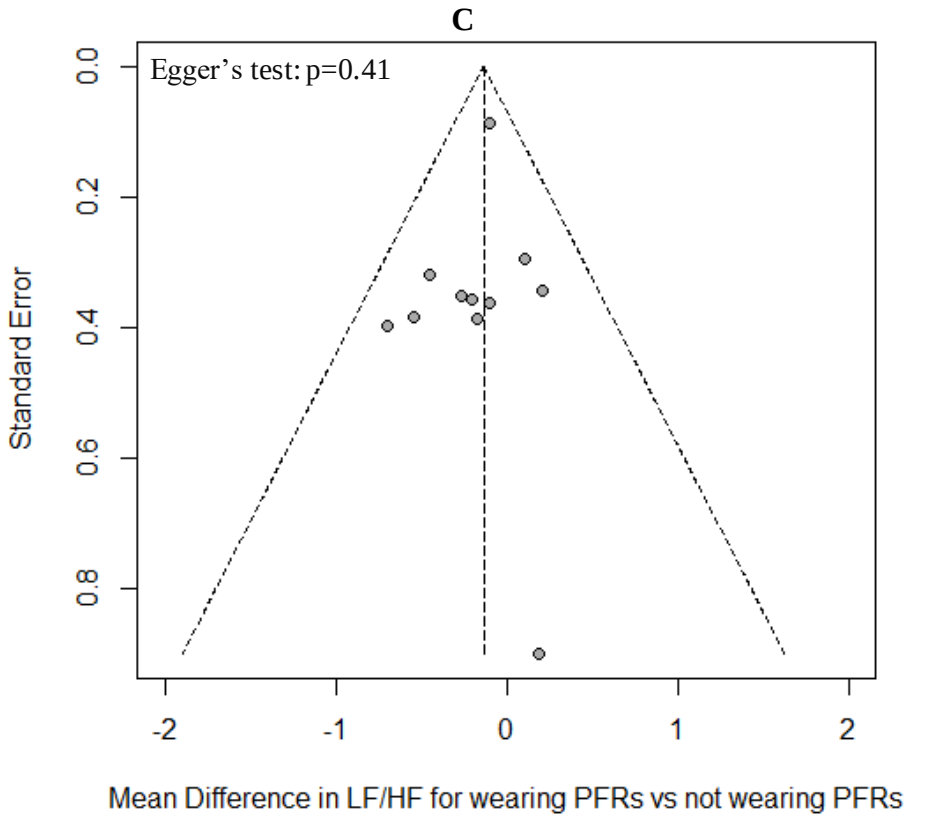
Figure S7. Begg funnel plots and Egger's test of BP outcomes in our meta-analysis.

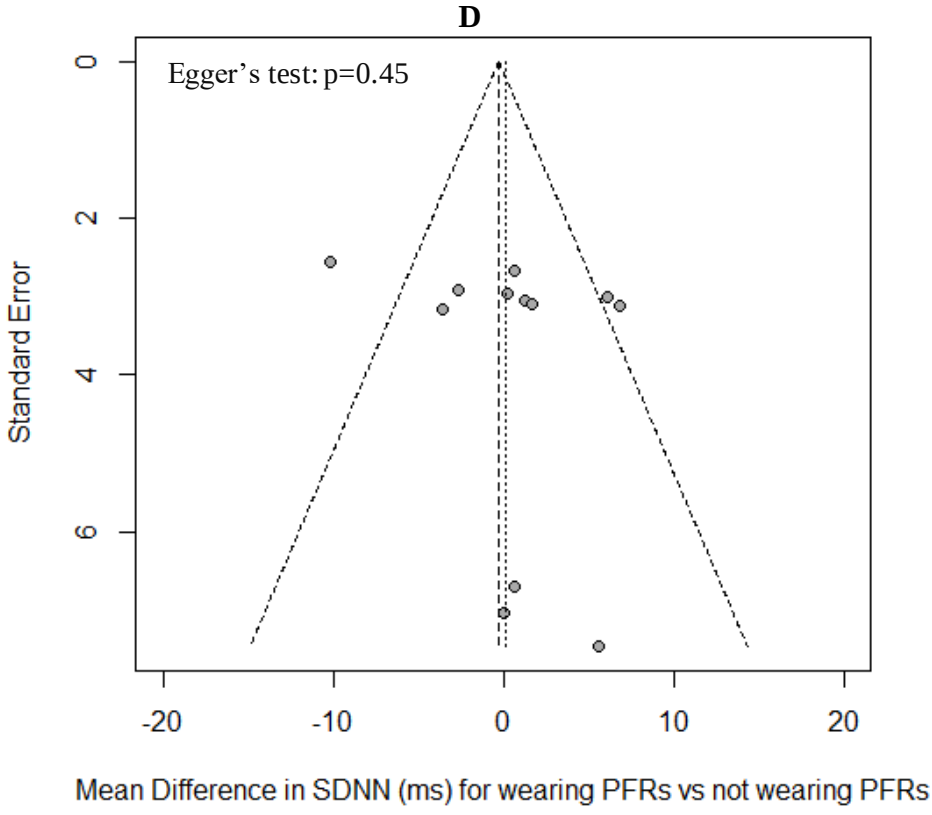
A


Egger's test: p=0.67
Standard Error
0
100
200
300
400
500
-1500
-1000
-500
0
500
1000
1500
Mean Difference in HF (ms2) for wearing PFRs vs not wearing PFRs

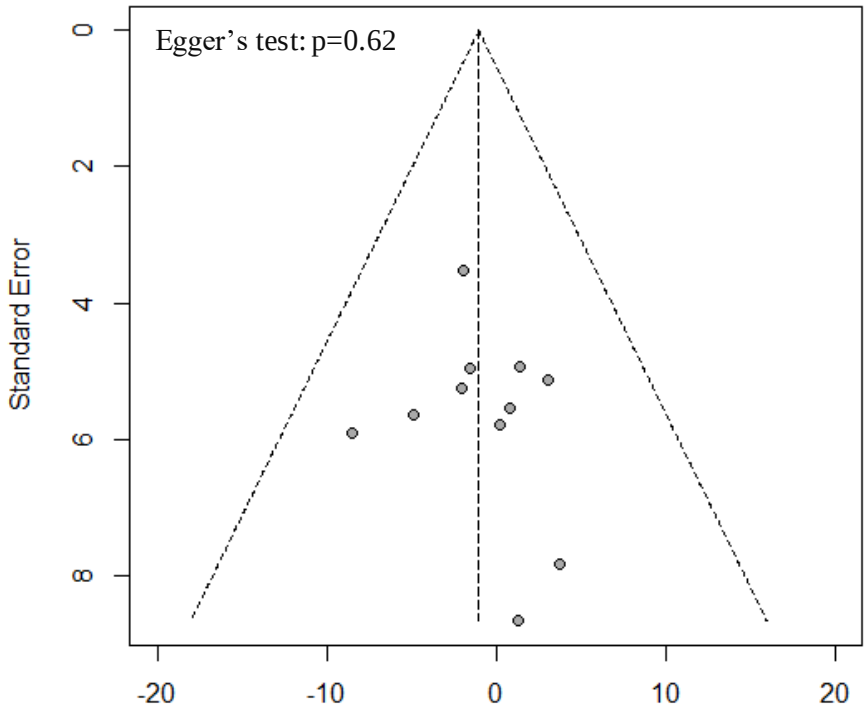
B


Egger's test: p=0.69
Standard Error
0
200
400
600
800
1000
-2000
-1000
0
1000
2000
Mean Difference in LF (ms2) for wearing PFRs vs not wearing PFRs

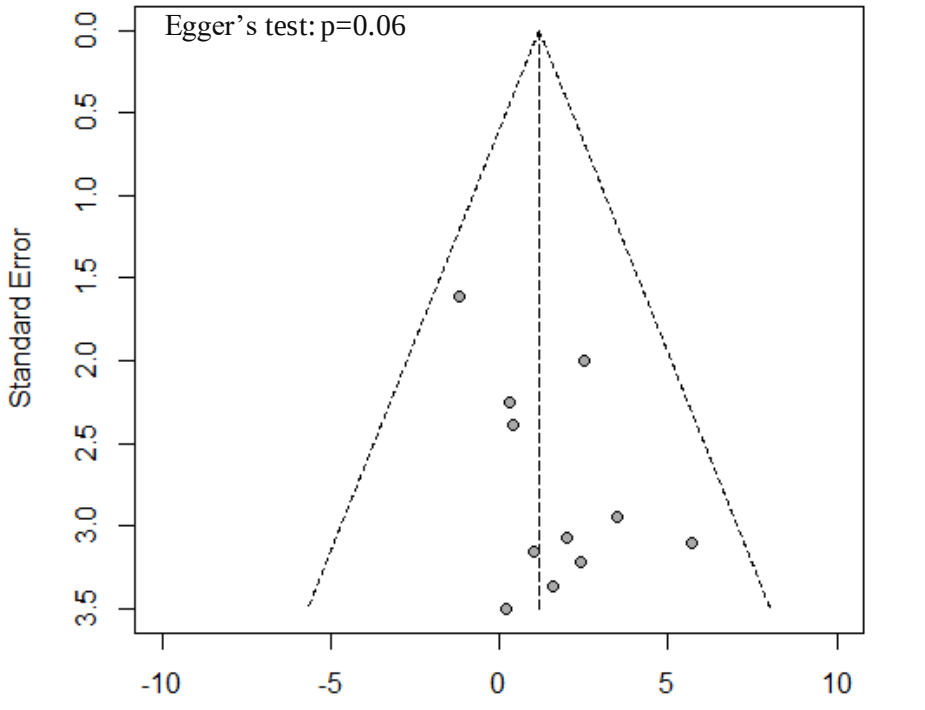

C
Egger's test: p=0.41
Standard Error
0.0
0.2
0.4
0.6
0.8
-2
-1
0
1
2
Mean Difference in LF/HF for wearing PFRs vs not wearing PFRs


D
Egger's test: p=0.45
Standard Error
0
2
4
6
-20
-10
0
10
20
Mean Difference in SDNN (ms) for wearing PFRs vs not wearing PFRs

E


Egger's test: p=0.62
Standard Error
0
2
4
6
8
-20
-10
0
10
20
Mean Difference in rMSSD (ms) for wearing PFRs vs not wearing PFRs

F


Egger's test: p=0.06
Standard Error
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
-10
-5
0
5
10
Mean Difference in pNN50 (%) for wearing PFRs vs not wearing PFRs

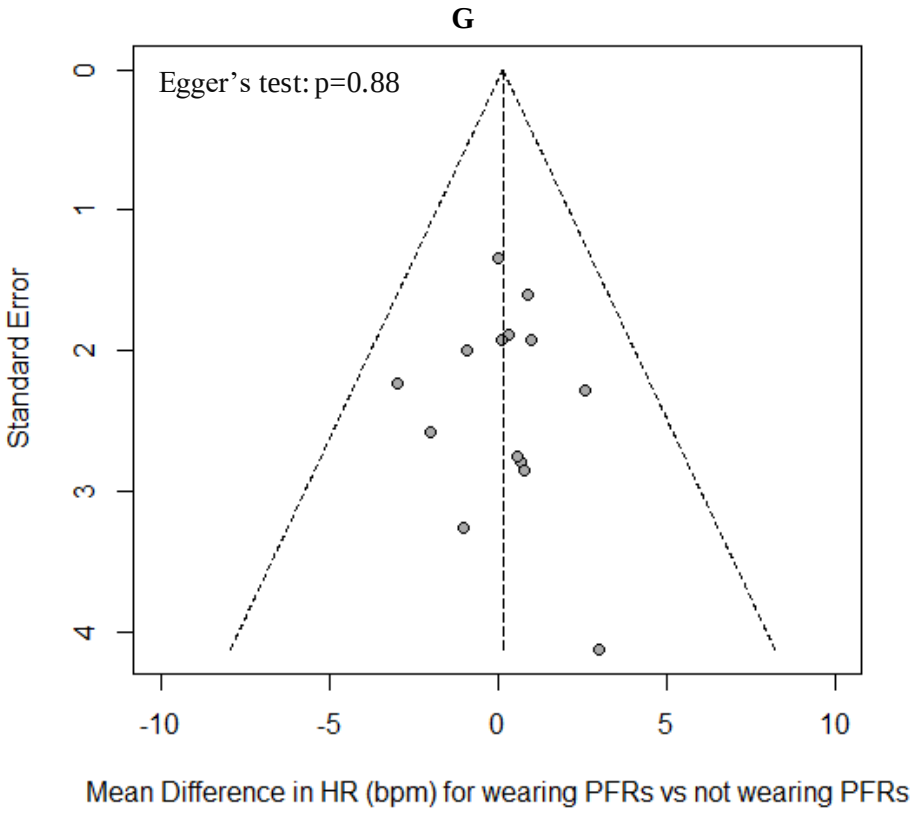


Figure S8. Begg funnel plots and Egger's test of HRV indices in our meta-analysis.

Table S1. The PICOS (participants, intervention, comparisons, outcomes, and study design) of the meta-analysis and systematic review.

P: Population	**I: Intervention**
Overall population Elderly Young adults	Wearing a particulate-filtering respirator
C: Comparison	**O: Outcomes**
Wearing particulate-filtering respirators versus not wearing	Blood Pressure (BP) Heart Rate Variability (HRV)
Study design: Randomized crossover study	

Table S2. Full search strategy for Scopus, PubMed, and Web of Science.

Timeline: ~ 03. January. 2022	Total articles
Scopus	
((TITLE-ABS-KEY (mask*) OR TITLE-ABS-KEY (facemask*) OR TITLE-ABS-KEY ("face mask*") OR TITLE-ABS-KEY ("particulate-filtering respirator*") OR TITLE-ABS-KEY ("N95 Respirators") OR TITLE-ABS-KEY (respirator*) OR TITLE-ABS-KEY ("respiratory protective device") OR TITLE-ABS-KEY ("filtering face piece respirator") OR TITLE-ABS-KEY ("respirator air-purifying") OR TITLE-ABS-KEY ("disposable particulate respirator") OR TITLE-ABS-KEY (n95) OR TITLE-ABS-KEY (n99))) AND ((TITLE-ABS-KEY ("Randomized crossover") OR TITLE-ABS-KEY ("Randomized crossover trials") OR TITLE-ABS-KEY ("RCT*") OR TITLE-ABS-KEY ("Randomized Double-Blind Crossover Trial") OR TITLE-ABS-KEY ("Randomized Single-Blind Crossover Trial") OR TITLE-ABS-KEY (crossover))) AND ((TITLE-ABS-KEY (cardiovascular) OR TITLE-ABS-KEY (cardiopulmonary) OR TITLE-ABS-KEY ("blood pressure") OR TITLE-ABS-KEY (sbp) OR TITLE-ABS-KEY (dbp) OR TITLE-ABS-KEY ("systolic blood pressure") OR TITLE-ABS-KEY ("diastolic blood pressure") OR TITLE-ABS-KEY ("arterial pressure") OR TITLE-ABS-KEY ("aortic blood pressure") OR TITLE-ABS-KEY (hrv) OR TITLE-ABS-KEY ("heart rate variability"))) AND ((TITLE-ABS-KEY ("air pollution") OR TITLE-ABS-KEY ("particulate matter") OR TITLE-ABS-KEY ("Ultrafine Particle*") OR TITLE-ABS-KEY (pm2.5) OR TITLE-ABS-KEY (pm10) OR TITLE-ABS-KEY (ufp) OR TITLE-ABS-KEY ("PM") OR TITLE-ABS-KEY ("air pollutant*"))	196
Web of Science	
(TS=(mask*) OR TS=(facemask*) OR TS=("face mask*") OR TS=("particulate-filtering respirator*") OR TS=("N95 Respirators") OR TS=(respirator*) OR TS=("respiratory protective device") OR TS=("filtering face piece respirator") OR TS=("respirator air-purifying") OR TS=("disposable particulate respirator") OR TS=(N95) OR TS=(N99)) AND (TS=("Randomized crossover") OR TS=("Randomized crossover trials") OR TS=("Randomized crossover") OR TS=("Randomized crossover trials") OR TS=("RCT*") OR TS=("Randomized Double-Blind Crossover Trial") OR TS=("Randomized Single-Blind Crossover Trial") OR TS=(crossover)) AND (TS=(cardiovascular) OR TS=(cardiopulmonary) OR TS=("blood pressure") OR TS=(SBP) OR TS=(DBP) OR TS=("systolic blood pressure") OR TS=("diastolic blood pressure") OR TS=("arterial pressure") OR TS=("aortic blood pressure") OR TS=(HRV) OR TS=("heart rate variability")) AND (TS=("air pollution") OR TS=("particulate matter") OR TS=("Ultrafine Particle*") OR TS=(PM2.5) OR TS=(PM10) OR TS=(UFP) OR TS=(PM) OR TS=("Air pollutant*")) AND LANGUAGE: (English)	254
PubMed	
((((((((((((((Mask*[Title/Abstract]) OR (Masks[MeSH Terms])) OR (Facemask*[Title/Abstract])) OR ("face mask*"[Title/Abstract])) OR ("particulate-filtering respirator*"[Title/Abstract])) OR ("N95 Respirators"[Title/Abstract])) OR (Respirator*[Title/Abstract])) OR ("respiratory protective device"[Title/Abstract])) OR ("filtering face piece respirator"[Title/Abstract])) OR ("respirator air-purifying"[Title/Abstract])) OR ("disposable particulate respirator"[Title/Abstract])) OR (N95[Title/Abstract])) OR (N99[Title/Abstract])) AND ((((((("Randomized crossover"[Title/Abstract]) OR ("Randomized crossover trials"[Title/Abstract])) OR (RCT[Title/Abstract])) OR ("Randomized Double-Blind Crossover Trial"[Title/Abstract])) OR ("Randomized Single-Blind Crossover Trial"[Title/Abstract])) OR (crossover[MeSH Terms]))) AND ((((((((((cardiovascular[Title/Abstract]) OR (cardiopulmonary[Title/Abstract])) OR ("blood pressure"[Title/Abstract])) OR ("blood pressure"[MeSH Terms])) OR (SBP[Title/Abstract])) OR (DBP[Title/Abstract])) OR ("systolic blood pressure"[Title/Abstract])) OR ("diastolic blood pressure"[Title/Abstract])) OR ("arterial pressure"[Title/Abstract])) OR ("aortic blood pressure"[Title/Abstract])) OR (HRV[Title/Abstract])) OR ("heart rate variability"[Title/Abstract]))) AND ((((((((("air pollution"[MeSH Terms]) OR ("particulate matter"[MeSH Terms])) OR ("air pollution"[Title/Abstract])) OR ("particulate matter"[Title/Abstract])) OR (PM2.5[Title/Abstract])) OR (PM10[Title/Abstract])) OR ("PM"[Title/Abstract])) OR ("UFP"[Title/Abstract])) OR ("Ultrafine Particle*"[Title/Abstract])) OR ("air pollutant*"[Title/Abstract]))	77

Table S3. Particulate matter air pollution levels (μg/m^3) during the intervention periods in the included studies.

Study	Interventions	$PM_{2.5}$: Ave ± SD (Min-Max)	PM_{10}: Ave ± SD (Min-Max)
(7)‡	First 48-h intervention period	71.0	134.0
	Second 48-h intervention period	56.8	105.6
(8)	Pre-intervention period	23.6 ± 3.5	-
	Post-intervention period	18.8 ± 5.4	-
	Combination of pre- and post-intervention period	21.2 ± 5.1	-
	Intervention period	15.9 ± 5.5	-
(2)	Without PFR	9.3 ± 7.8	-
	With PFR	9.2 ± 7.6	-
(3)*	Without FPR	79.6 (60.6 – 95.1)	205 (165-235)
	With PFR	72.9 (56.5 – 79.7)	176 (142-200)
(5)⁎	Outdoor	74.2 ± 38.3	-
	Indoor	85.2 ± 43.6	-
(4)	Without PFR	89 (25 – 170)	92 (70-117)
	With PFR	61 (20 – 88)	103 (83-180)
(6)	Without PFR	86 ± 61 (52 – 120)	-
	With PFR	140 ± 113 (77 – 203)	-
(1)	Without PFR	-	-
	With PFR	-	-

‡ In this study, indoor particulate matter concentrations have been reported at first (half of participants wore PFR and the others did not wear PFR) and second (half of participants wore PFR and the others did not wear PFR) intervention periods.

*Median (percentile 25-percentile 75).

⁎ Considering the particulate-filtration efficiency of the respirator and the proportion of wearing time, the estimated time-weighted exposure levels of PM2.5 for subjects wearing respirators were 7.1 μg/m^3 outdoors and 19.3 μg/m^3 indoors on average.

Table S4. Details regarding BP measurement protocol.

Study	BP measurement device	BP measurement (Ambulatory *vs* Seated)	Where was BP measurement device installed?	How often was BP measurement repeated during the study period?	Number of BP measurements (included to analyses)	Which study has considered BP as the primary outcome?
(1)	Automated blood pressure cuff and monitor: Oscar 2, SunTech Medical, Inc., NY, USA	Ambulatory	NR	Every 15 min	NR (Computed based on the duration of intervention and control periods: 38 measurements per each participant).	NR (not reported)
(7)	NR	Ambulatory	Left upper-arm	Every 30 min during the day (8:00–22:00) Every hour during the night (22:00–7:00)	NR (Computed based on the duration of intervention and control periods: 56 measurements per each participants for the day and 36 measurements per each participants for the night).	*
(8)	automatic sphygmomanometer (HEM-780; Omron, Kyoto, Japan)	Seated	At the arm	Every 10 min	two measurements of BP were obtained with a 10-minute interval.	NR
(2)	Ambulatory blood pressure monitoring: OSCAR-2 BP monitor with SphygmoCorinside and the XCEL PWA system (Atcor Medical, Sydney)	Seated	NR	Every 10 min	Average of 9 readings per participant each visit (4 visits out of 5 visits)	*
(3)	A portable device: Mobile-O-GEAPH NG Vers.20; Hypertension Management Software Inc. Germany	Ambulatory	Over the left brachial artery	Every 15 min	NR (Computed based on the duration of intervention and control periods: 32 measurements per each participant).	NR
(5)	A portable, noninvasive, automated ambulatory BP monitoring and recording	Ambulatory	Over the left brachial artery	Every 15 min (6:00–22:00) and every 30 min (22:00–6:00)	At least 60 measurements (out of the total 80	NR

Study	BP measurement device	BP measurement (Ambulatory *vs* Seated)	Where was BP measurement device installed?	How often was BP measurement repeated during the study period?	Number of BP measurements (included to analyses)	Which study has considered BP as the primary outcome?
	instrument (Model 90217, Spacelabs, UK)				measurements) were considered effective monitoring of the BP.	
(6)	An automatic blood pressure monitor (Model 90217, Spacelabs, UK)	Ambulatory	At the left brachial artery	Every 15 minutes during the 2-hour walking Every 30 minutes for the rest of the daytime (07:00 to 22:00) Every hour overnight (22:00 – 07:00)	NR (Computed based on the duration of intervention and control periods: 16, 30 and 18 measurements per each participant during 2-hour walking, the rest of the daytime and overnight, respectively).	NR
(4)	An automatic blood pressure (model 90217 ultralite ambulatory blood pressure monitor; Spacelabs Healthcare Ltd.)	Ambulatory	NR	Every 15 min during the 2-hr walking Every 30 min during the day Every hour overnight (22:00 hours to 07:00 hours)	NR (Computed based on the duration of intervention and control periods: 16, 30 and 18 measurements per each participant during 2-hour walking, the rest of the daytime and overnight, respectively).	NR

* These studies have reported that BP as primary outcomes.

Table S5. Details regarding HRV measurement protocol.

Study	HRV measurement device	How did the HRV indices monitor (Ambulatory or Seated)?
(1)	12-lead Holter monitor (BI9800, Biomedical Instruments Co. Ltd, Shenzhen, China)	Ambulatory
(7)	12-lead continuous electrographic Holter	Ambulatory
(2)	Continuous electrocardiogram monitoring using a Spacelabs evo Holter system	Seated
(3)	12-channel continuous Holter recorder (model MGY-H12; DM Software Inc., USA)	Ambulatory
(5)	12-lead continuous electrographic Holter monitor (Seer Light, GE Medical Systems)	Ambulatory
(4)	12-lead continuous electrocardiography (ECG) Holter recorder (Lifecard 12; Spacelabs Healthcare Ltd., Hertford, UK)	Ambulatory
(6)	12-lead continuous electrographic Holter monitor (Lifecard 12, Spacelabs, UK)	Ambulatory
(8)	Not reported	Ambulatory

Table S6. Comparing the findings of the participants wore respirators for 24 and 48 hour versus those wore respirators for 2 and 4 hour.

Health outcomes based on the time duration of wearing respirators (studies)	Heterogeneity				Test for overall effect		
	Tau^2	Chi^2	I^2	p-value	Overall effect size	Z	p-value
SBP-24 and 48 hour(4, 5, 7, 9)	0.00	6.80	0%	0.87	-0.71 (-2.17, 0.74)	0.96	0.34
SBP-2 and 4 hour(1-3)	0.00	0. 31	0%	0.86	-1.01 (-3.69, 1.67)	0.74	0.46
DBP-24 and 48 hour(4, 5, 7, 9)	0.00	3.17	0%	0.99	-0.41 (-1.39, 0.56)	0.83	0.41
DBP-2 and 4 hour(1-3)	0.00	0.63	0%	0.73	-0.83 (-2.82, 1.15)	0.82	0.41
HF-24 and 48 hour(5, 7, 9)	0.00	2.78	0%	0.95	36.46 (-3.95, 76.86)	1.77	0.08
HF-2 and 4 hour(1-3)	0.00	0.78	0%	0.68	56.55 (-51.58, 164.67)	1.02	0.31
LF-24 and 48 hour(5, 7, 9)	0.00	1.55	0%	0.99	52.16 (-23.94, 128.25)	1.34	0.18
LF-2 and 4 hour(1-3)	0.00	0.32	0%	0.85	-28.08 (-157.67, 101.51)	0.42	0.67
LF/HF-24 and 48 hour(5, 7, 9)	0.00	4.16	0%	0.84	-0.11 (-0.26, 0.03)	1.59	0.11
LF/HF-2 and 4 hour(2, 3)	0.00	0.88	0%	0.35	-0.42 (-0.94, 0.10)	1.59	0.11
SDNN-24 and 48 hour(5, 7, 9)	0.00	1.03	0%	1.00	6.09 (1.25, 10.94)	2.46	0.01
SDNN-2 and 4 hour(1-3)	0.00	0.89	0%	0.64	-0.44 (-5.74, 4.85)	0.16	0.87
pNN50-24 and 48 hour(5, 7, 9)	0.00	5.78	0%	0.67	1.10 (-0.50, 2.70)	1.35	0.18
pNN50-2 and 4 hour(1, 3)	0.00	0.10	0%	0.76	1.69 (-2.73, 6.10)	0.75	0.45
HR-24 and 48 hour(4, 5, 7, 9)	0.00	4.80	0%	0.94	0.16 (-1.06, 1.38)	0.26	0.80
HR-2 and 4 hour(1, 3)	0.00	0.47	0%	0.49	0.09 (-2.63, 2.80)	0.06	0.95

Table S7. Meta-analyses – excluding studies one-by-one.

Studies included	Health outcomes	Heterogeneity				Test for overall effect		
		Tau^2	Chi^2	I^2	p-value	Overall effect size	Z	p-value
(1-5, 7, 8)	SBP	0.00	4.64	0%	0.95	-0.67 (-2.02, 0.68)	0.97	0.33
(1-3, 5, 7-9)		0.00	6.60	0%	0.92	-0.95 (-2.40, 0.50)	1.29	0.20
(1-4, 7-9)		0.00	6.96	0%	0.94	-0.69 (-2.03, 0.64)	1.02	0.31
(1, 2, 4, 5, 7-9)		0.00	7.14	0%	0.93	-0.76 (-2.09, 0.57)	1.12	0.26
(1, 3-5, 7-9)		0.00	7.06	0%	0.93	-0.84 (-2.17, 0.49)	1.23	0.22
(1-5, 7, 9)		0.00	4.50	0%	0.97	-0.50 (-1.83, 0.82)	0.75	0.45
(2-5, 7-9)		0.00	6.88	0%	0.94	-0.69 (-2.01, 0.64)	1.01	0.31
(1-5, 8, 9)		0.00	5.56	0%	0.94	-1.28 (-2.81, 0.24)	1.65	0.10
(1-5, 7, 8)	DBP	0.00	2.75	0%	0.99	-0.63 (-1.57, 0.31)	1.31	0.19
(1-3, 5, 7-9)		0.00	3.21	0%	1.00	-0.40 (-1.45, 0.66)	0.74	0.46
(1-4, 7-9)		0.00	3.89	0%	1.00	-0.46 (-1.38, 0.46)	0.98	0.33
(1, 2, 4, 5, 7-9)		0.00	3.89	0%	1.00	-0.52 (-1.43, 0.38)	1.13	0.26
(1, 3-5, 7-9)		0.00	3.94	0%	1.00	-0.49 (-1.40, 0.41)	1.07	0.29
(1-5, 7, 9)		0.00	3.29	0%	0.99	-0.38 (-1.30, 0.54)	0.80	0.42
(2-5, 7-9)		0.00	3.21	0%	1.00	-0.40 (-1.30, 0.51)	0.86	0.39
(1-5, 8, 9)		0.00	3.05	0%	1.00	-0.68 (-1.64, 0.28)	1.39	0.17
(3, 4, 7, 8)	MAP	0.00	2.86	0%	0.94	-1.06 (-2.24, 0.11)	1.77	0.08
(3, 7-9)		**0.00**	**3.03**	**0%**	**0.98**	**-1.46 (-2.77, -0.14)**	**2.17**	**0.03**
(4, 7-9)		0.00	3.01	0%	0.99	-0.82 (-1.99, 0.34)	1.38	0.17
(3, 4, 7, 9)		0.00	2.99	0%	0.96	-0.85 (-1.99, 0.29)	1.46	0.14
(3, 4, 8, 9)		**0.00**	**3.73**	**0%**	**0.93**	**-1.22 (-2.44, 0.00)**	**1.96**	**0.05**
(1-3, 5, 7, 8)	HF	0.00	3.64	0%	0.93	39.67 (-6.50, 85.83)	1.68	0.09
(1-3, 7-9)		0.00	3.22	0%	0.98	36.27 (-2.36, 74.89)	1.84	0.07
(1, 2, 5, 7-9)		0.00	3.04	0%	0.98	35.52 (-2.36, 74.89)	1.80	0.07
(1, 3, 5, 7-9)		**0.00**	**3.47**	**0%**	**0.97**	**38.58 (0.70, 76.46)**	**2.00**	**0.05**
(1-3, 5, 8, 9)		0.00	1.26	0%	0.94	47.49 (-6.58, 101.56)	1.72	0.09
(2, 3, 5, 7-9)		**0.00**	**3.60**	**0%**	**0.96**	**40.45 (1.10, 79.80)**	**2.01**	**0.04**
(1-3, 5, 7)	LF	0.00	2.17	0%	0.99	18.94 (-52.34, 90.22)	0.52	0.60
(1-3, 7, 9)		0.00	2.93	0%	0.98	30.37 (-36.59, 97.33)	0.89	0.37
(1, 2, 5, 7, 9)		0.00	2.96	0%	0.98	31.55 (-36.42, 99.52)	0.91	0.36
(1, 3, 5, 7, 9)		0.00	2.91	0%	0.98	31.81 (-33.85, 97.46)	0.95	0.34
(1-3, 5, 9)		0.00	1.81	0%	0.87	23.96 (-74.01, 121.93)	0.48	0.63
(2, 3, 5, 7, 9)		0.00	1.62	0%	1.00	50.17 (-22.63, 122.96)	1.35	0.18
(2, 3, 5, 7)	LF/HF	**0.00**	**5.41**	**0%**	**0.71**	**-0.15 (-0.29, -0.01)**	**2.13**	**0.03**
(2, 3, 5, 7, 9)		0.00	5.82	0%	0.76	-0.20 (-0.43, 0.03)	1.72	0.09
(2, 5, 7, 9)		0.00	4.22	0%	0.90	-0.12 (-0.26, 0.02)	1.67	0.09
(3, 5, 7, 9)		0.00	6.26	0%	0.71	-0.13 (-0.27, 0.01)	1.88	0.06
(2, 3, 5, 9)		0.00	2.95	0%	0.57	-0.11 (-0.27, 0.04)	1.41	0.16
(1-3, 5, 7)	SDNN	0.00	4.26	0%	0.89	2.36 (-1.72, 6.44)	1.13	0.26
(1-3, 7, 9)		0.00	5.10	0%	0.88	3.07 (-0.56, 6.71)	1.66	0.10
(1, 2, 5, 7, 9)		0.00	5.03	0%	0.89	3.37 (-0.59, 7.32)	1.67	0.10
(1, 3, 5, 7, 9)		0.00	5.11	0%	0.88	3.14 (-0.51, 6.80)	1.68	0.09
(1-3, 5, 9)		0.00	2.94	0%	0.71	1.72 (-2.50, 5.93)	0.80	0.42
(2, 3, 5, 7, 9)		**0.00**	**1.81**	**0%**	**1.00**	**4.91 (0.84, 8.97)**	**2.37**	**0.02**
(1, 3, 5, 7)	rMSSD	0.00	3.62	0%	0.89	1.28 (-0.88, 3.44)	1.16	0.25
(1, 3, 7, 9)		0.00	3.38	0%	0.95	1.34 (-0.67, 3.34)	1.31	0.19
(1, 5, 7, 9)		0.00	3.73	0%	0.93	1.40 (-0.62, 3.42)	1.36	0.17
(1, 3, 5, 9)		0.00	1.71	0%	0.79	2.14 (-1.03, 5.32)	1.32	0.19
(3, 5, 7, 9)		0.00	2.81	0%	0.97	1.75 (-0.24, 3.74)	1.72	0.09
(1, 3, 5, 7)	pNN50	**0.00**	**3.13**	**0%**	**0.93**	**1.85 (0.07, 3.64)**	**2.04**	**0.04**

Studies included	Health outcomes	Heterogeneity				Test for overall effect		
		Tau^2	Chi^2	I^2	p-value	Overall effect size	Z	p-value
(1, 3, 7, 9)		0.00	5.26	0%	0.81	1.00 (-0.56, 2.56)	1.26	0.21
(1, 5, 7, 9)		0.00	5.78	0%	0.76	1.09 (-0.45, 2.64)	1.39	0.17
(1, 3, 5, 9)		0.00	2.76	0%	0.60	0.60 (-1.58, 2.79)	0.54	0.59
(3, 5, 7, 9)		0.00	5.93	0%	0.75	1.18 (-0.37, 2.73)	1.49	0.14
(1, 3, 4, 7, 8)	HR	0.00	1.68	0%	1.00	0.49 (-0.73, 1.71)	0.79	0.43
(1, 3, 7-9)		0.00	5.01	0%	0.93	0.05 (-1.29, 1.39)	0.07	0.94
(1, 4, 7-9)		0.00	4.97	0%	0.96	0.24 (-0.92, 1.40)	0.40	0.69
(1, 3, 4, 7, 9)		0.00	5.13	0%	0.88	0.07 (-1.12, 1.26)	0.11	0.91
(3, 4, 7-9)		0.00	5.05	0%	0.96	0.07 (-1.10, 1.23)	0.11	0.91
(1, 3, 4, 8, 9)		0.00	3.99	0%	0.95	-0.07 (-1.34, 1.21)	0.10	0.92

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