Online Supplement

The Effects of Home Particulate Air Filtration on Blood Pressure: A Systematic Review

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Search Strategy

Studies were searched through July 23, 2019.

Search terms were as follows for each of the respective databases:

Cochrane Central Register of Controlled Trials:
("air filters" OR "air filtration" OR "air filter" OR "air conditioning" OR "electret" OR "high efficiency particular air" OR "hepa" OR "air cleaner" OR "micropore filter*" OR "millipore filt*") in All Text AND (("blood pressure" OR "blood pressure determination" OR "arterial pressure") OR ("blood pressure" OR "diastolic pressure" OR "systolic pressure")) in All Text - (Word variations have been searched)

Embase and Inspec:
TOPIC: ((blood or diastolic or systolic or arterial) NEAR (pressure)) AND TOPIC: ("air filter*" OR "micropore filter*" OR "millipore filter*" OR "air filtration" OR "micropore filtration" OR "millipore filtration" OR "air condition*" OR Electret OR "High Efficiency Particulate Air" OR HEPA)

WebOfScience:
TS=("air filter*" OR "micropore filter*" OR "millipore filter*" OR "air filtration" OR "micropore filtration" OR "millipore filtration" OR "air condition*" OR "Electret" OR "High Efficiency Particulate Air" OR "HEPA") AND TS=(("blood" OR "diastolic" OR "systolic" OR "arterial") NEAR "pressure")

PubMed:
(("Air Filters"[MeSH Terms] OR "air filters"[tiab] OR "air filtration"[tiab] OR "air filter"[tiab] OR "Air Conditioning"[Mesh] OR "Air Conditioning"[tiab] OR Electret[tiab] OR "High Efficiency Particulate Air "[tiab] OR HEPA[tiab] OR "air cleaner"[tiab] OR "Ventilation/instrumentation"[MESH] OR "Ventilation/methods"[MESH] OR "Micropore Filters"[MESH] OR "Micropore Filters"[tiab] OR "Micropore Filter"[tiab] OR "Millipore Filters"[tiab] OR "Millipore Filter"[tiab]) AND ((("blood pressure"[MeSH Terms] OR "blood pressure determination"[MeSH Terms] OR "arterial pressure"[MeSH Terms]) OR "Blood Pressure"[tiab]) OR "Diastolic Pressure"[tiab]) OR "Systolic Pressure"[tiab])) NOT ("animals"[MeSH Terms] NOT "humans"[MeSH Terms])

Table S1. Supplemental Table #1: BP Measurement Methods

Study ID	Measurement Technique	Position (Seated, Supine, Ambulatory)	Measurements Per Sitting	Measurements Per Intervention (Continuous vs Endpoint)	Primary vs Secondary Outcome	Device Used (if specified)	Consistent with AHA Guidelines[34]
Brauner et al, 2008	Not specified	Not specified	Not specified	Endpoint only (48h)	Secondary	Not specified	Not specified
Chen et al, 2015	Manual	Five-minute resting seated	3 readings (2 minute intervals between readings) SBP and DBP recorded as the mean of the second and third measurements	Endpoint only (48h)	Secondary	Mercury sphyngomanometer	Yes
Chuang et al, 2017	Automatic	Ambulatory	1 reading	Continuous (hourly) for 12 x 24h home visits	Primary	DynaPulse model 5000A; Pulse Metric, San Diego, CA	No AHA guidelines recommend a frequency of one reading every 15-30 minutes
Cui et al, 2018	Automatic (Oscillometry)	Five-minute resting, supine	1 reading	Endpoint only (0h, 48h)	Secondary	VICORDER® cardiovascular and peripheral vascular testing instrument, SMT Medical, Würzburg, Germany[35]	Yes
Karottki et al, 2013	Manual	Resting seated	1 reading	Days 0, 2, 7, 14	Secondary	WelchAllyn DuraShock DS54 manometer	No AHA guidelines recommend recording the

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							average of two separate BP measurements, with the first measurement discarded
Li et al, 2017	Not specified	Resting seated	3 readings (2 minute intervals between readings) SBP and DBP recorded as the mean of the second and third measurements	Enrollment and endpoint only (9d)	Secondary	Mercury sphyngomanometer	Yes
Lin et al, 2011	Automatic	Ambulatory	1 reading	Continuous Hourly (7AM-11PM) for 48h	Primary	DynaPulse model 5000A; Pulse Metric, San Diego, CA	No AHA guidelines recommend monitoring patients for 24 consecutive hours at a frequency of every 15-30 minutes
Morishita et al, 2018	Automatic	Five-minute resting seated	6 readings of brachial BP The mean of the last 5 of 6	Endpoint only (3d)	Primary (SBP)	BpTRUE BPM-100 Monitor	Yes

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			measurements was recorded				
Padro-Martinez et al, 2015	Automatic	Resting seated	Not specified; at least 1 reading on each arm	Endpoint only (21d)	Primary	Omron Automatic Blood Pressure Monitor Model #HEM-711ACN2, Omron Healthcare, Kyoto, Japan	Not specified AHA guidelines recommend recording the average of ≥2 readings; here, the # of readings per arm not specified.
Shao et al, 2017	Ambulatory	Ambulatory	1 reading	Continuous (every 30 minutes) at 13d	Primary (SBP)	MGY-ABP1; DM Software Inc, Beijing, China	Yes

Table S2. Supplemental Table 2: Risk of Bias Assessment

Study ID	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Blood Pressure Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Other Bias	Overall Risk of Bias
Brauner et al, 2008	Low risk: "Randomized order." Authors retrospectively analyzed effect of randomization order.	Unclear risk: Method of allocation assignment not specified.	Unclear risk: Method of blinding is not specified. Blinding status may have affected participant behavior such as window-opening, time spent indoors, cooking, etc.	Low risk: Blinding of outcome assessment occurred; unlikely that blinding was broken.	Low risk: No missing outcome data reported	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**
Chen et al, 2015	Unclear risk: randomized & double-blinded, but method of randomization/ blinding not described.	Unclear risk: Method of allocation assignment not specified.	Low risk: Method of blinding is not specified, but unlikely that blinding was broken. Authors declare that participants could not distinguish between active + sham filters.	Low risk: Blinding of outcome assessment occurred; unlikely that blinding was broken.	Low risk: No missing outcome data reported	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**
Chuang et al, 2017	Unclear risk: randomized & double-blinded, but method of randomization/ blinding not described.	Unclear risk: Method of allocation assignment not specified.	Unclear risk: Participants were possibly aware of their intervention assignments because “Filtrete and gauze control filters were not identical." This potentially led to behavior or tampering to reduce the observed effect of the filtration intervention. However, no tampering was detected.	Low risk: Blinding of outcome assessment occurred; unlikely that blinding was broken.	Low risk: No missing outcome data reported	Unclear risk	Low risk: Supported by consistency of in-group and between-group comparisons	**Low Risk**

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Cui et al, 2018	Low risk: "The order of true filtration and sham filtration was determined using cluster-randomization with individuals residing in the same dormitory room as a group."	Unclear risk: Method of allocation assignment not specified.	Low risk: "The true and sham filtration devices looked identical, the participants and research staff members that assessed health indicators were blinded to the order of true and sham filtration interventions."	Low risk: "The participants and research staff members that assessed health indicators were blinded to the order of true and sham filtration interventions." Unlikely that blinding was broken.	Low risk: Data from one participant excluded due to self-reported second-hand smoke exposure, which would have skewed results.	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**
Karottki et al, 2013	Low risk: "randomized order of exposure"	Unclear risk: Method of allocation assignment not specified.	Low risk: "The participants as well as the researcher measuring health outcomes were blinded to the exposure scenario." Effort was taken to ensure that active and sham filtration conditions were indistinguishable. "In the period with sham filtration, we used a dummy filter that conferred the same pressure drop and noise level."=	Low risk: Outcome assessment was identical for sham and active filtration conditions. "The participants as well as the researcher measuring health outcomes were blinded to the exposure scenario."	Low risk: Some subjects missing gender, age, BMI data. However, "results in terms of effect of air filtration as categorical variable were not sensitive to adjustment for the baseline measurement, window opening, age, gender, or BMI with very similar effect	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**

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Study ID	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Blood Pressure Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Other Bias	Overall Risk of Bias
					estimates with or without adjustment."			
Li et al, 2017	Low risk: "The 17 dormitories received alternate treatments in random order"	Unclear risk: Method of allocation assignment not specified.	Low risk: Double-blind crossover trial	Low risk: Outcome assessment was identical for control and active filtration conditions.	Low risk: No missing outcome data reported.	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**
Lin et al, 2011	Unclear risk: Since participants served as their own controls and received the control and intervention treatments in the same order, no random sequence generation occurred for assignment into groups. However, methods for	Low risk: Participants served as their own controls. All received control and intervention treatments in the same order, and no allocation assignment occurred.	Unclear risk: "The intervention and control periods were blinded to all participants." Blinding of personnel is not mentioned.	Low risk: Outcome assessment was identical for control and active filtration conditions.	Low risk: No missing outcome data reported.	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Unclear Risk**

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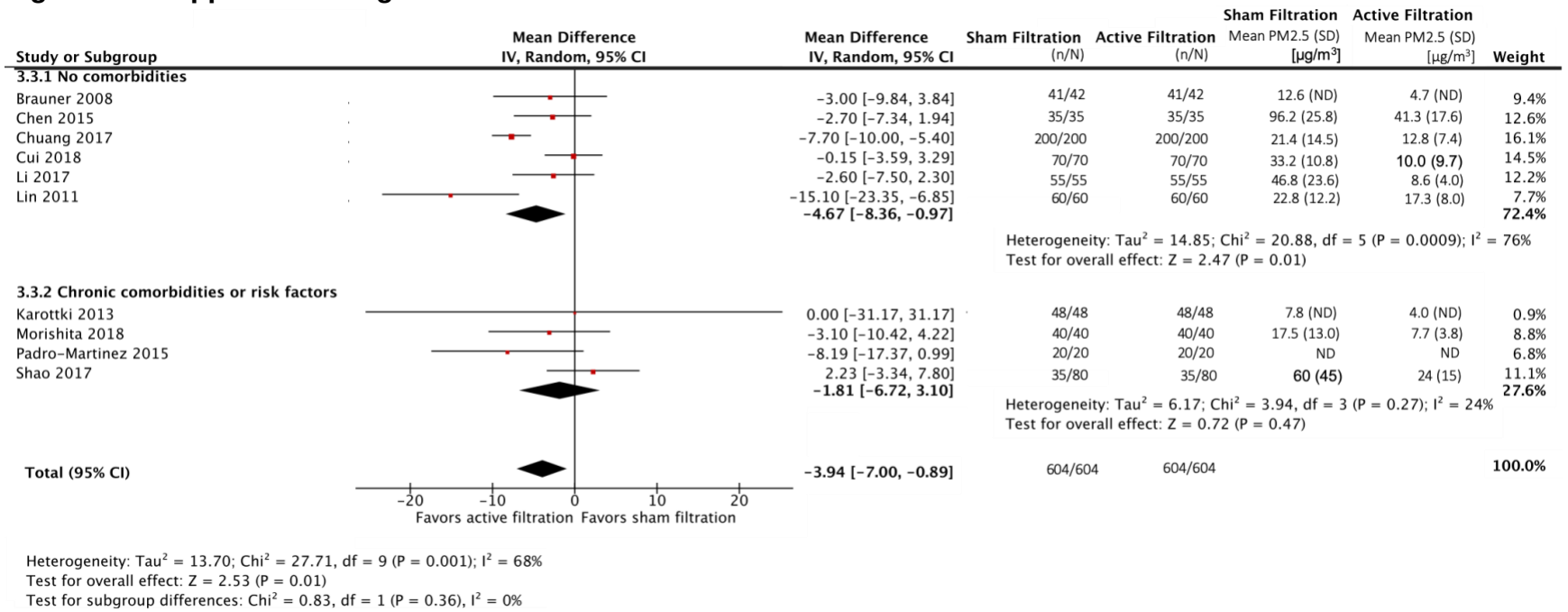
Study ID	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Blood Pressure Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Other Bias	Overall Risk of Bias
	determining visit order are not specified.							
Morishita et al, 2018	Low risk: "Computer-generated random order"	Unclear risk: Method of allocation assignment not specified.	Low risk: "Participants, health technicians, and the data analysists (S.D.A. and J.D.) were blinded to intervention ordering." One unblinded team member placed filters in participants' rooms.	Low risk: Outcome assessment was identical for control and active filtration conditions.	Low risk: Since participants served as their own controls, "Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups."	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**
Padro-Martinez et al, 2015	Low risk: "Pairs of participants were studied in parallel with one participant starting with HEPA and the other with sham filtration with assignment randomized."	Unclear risk: Method of allocation assignment not specified.	Low risk: "The study design was a randomized, double-blind crossover trial." Method of blinding is not specified, but authors declare that blinding could only be broken if participants tampered with the filtration devices. "While we found no evidence that any of the filters had been	Low risk: Outcome assessment was identical for control and active filtration conditions.	Low risk: No missing outcome data reported.	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Low Risk**

Table S2. Supplemental Table 2: Risk of Bias Assessment

Study ID	Random Sequence Generation	Allocation Concealment	Blinding of Participants and Personnel	Blinding of Blood Pressure Outcome Assessment	Incomplete Outcome Data	Selective Reporting	Other Bias	Overall Risk of Bias
			tampered with, we cannot completely discount the possibility that some participants did not follow our instructions. Nevertheless, failure of blinding of participants to the filtration regime is of less concern in a study such as ours that has objective health attributes, blood biomarkers and blood pressure in our case, which are not under voluntary control of participants."					
Shao et al, 2017	Low risk: "The filtration units were randomly allocated."	Unclear risk: Method of allocation assignment not specified.	Unclear risk: Blinding of participants is not mentioned.	Low risk: Outcome assessment was identical for control and active filtration conditions.	Low risk: No missing outcome data reported.	Unclear risk	Low risk: Assessors had no concerns on the quality of reporting.	**Unclear Risk**

Figure S1: Supplemental Figure 1

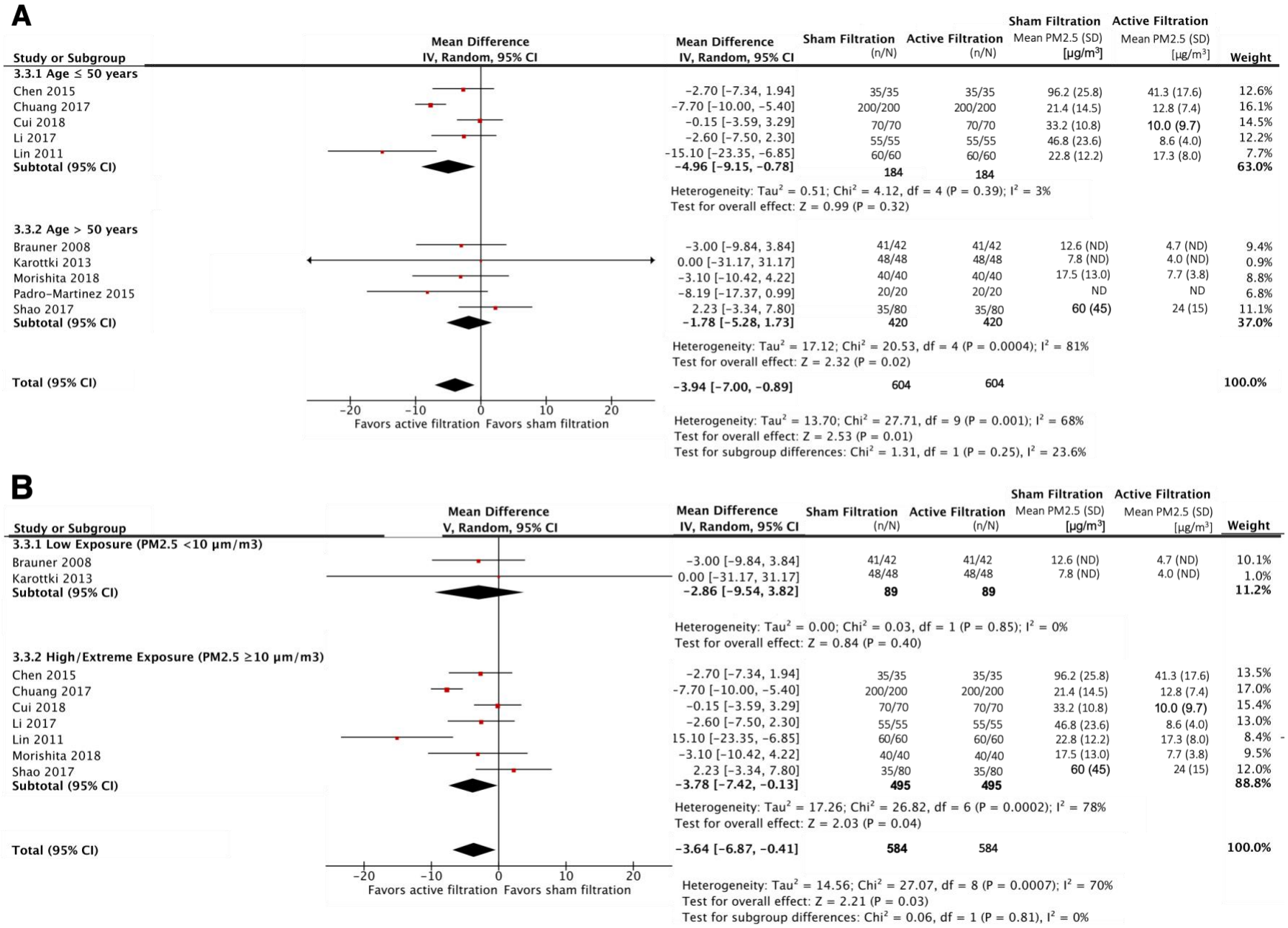


Heterogeneity: $Tau^2 = 13.70$; $Chi^2 = 27.71$, df = 9 (P = 0.001); $I^2 = 68\%$
Test for overall effect: Z = 2.53 (P = 0.01)
Test for subgroup differences: $Chi^2 = 0.83$, df = 1 (P = 0.36), $I^2 = 0\%$

Sensitivity analysis of air filtration effect on SBP restricted to studies enrolling subjects with chronic comorbidities (including patients taking vasoactive medications).

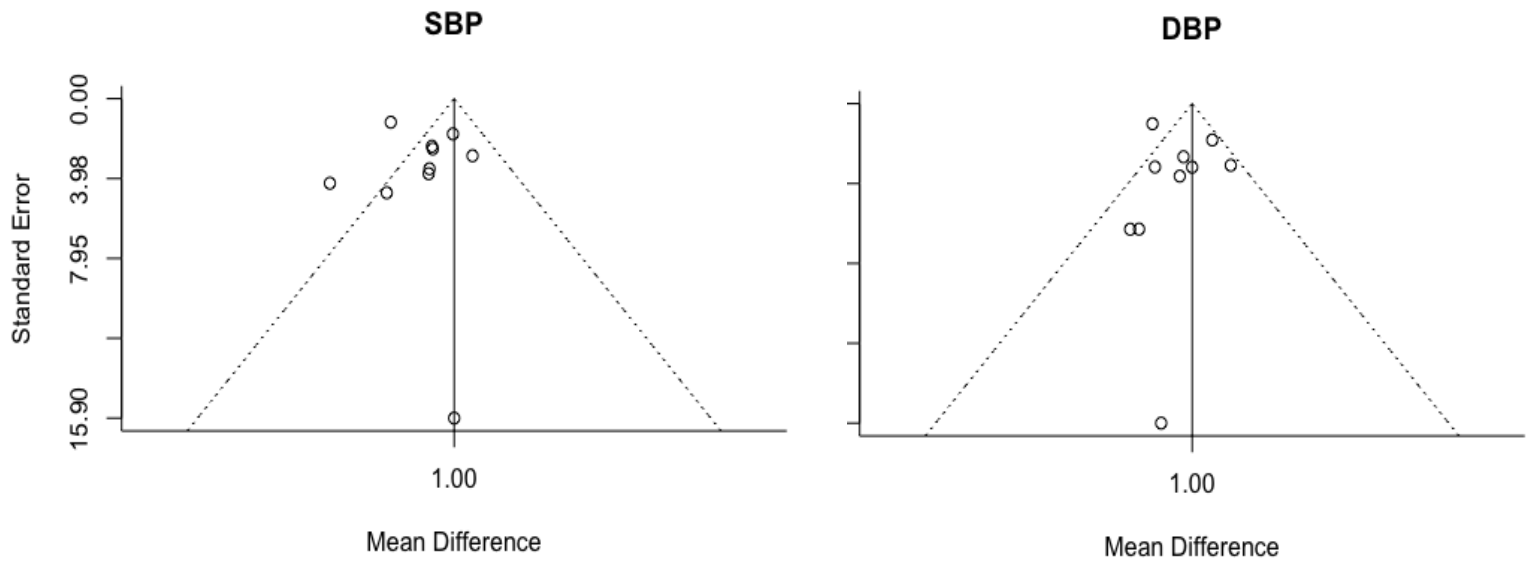
“Chronic comorbidities or risk factors” are defined as studies which did not exclude patients on the basis of having cardiopulmonary risk factors (including preexisting hypertension, hyperlipidemia, hemodynamic instability, metabolic syndrome), chronic medical conditions (including COPD, congestive heart failure, asthma) or taking vasoactive medications (including antihypertensives, vasodilators, and antiarrythmic medications).

Figure S2: Subgroup Analyses



Subgroup analyses were performed to assess the effect of air filtration on SBP with studies stratified by A) age and B) PM2.5 exposure levels. Studies were grouped by enrolling 1) subjects younger than 50 years or 2) subjects ages 50 and older. $PM_{2.5}$ exposure levels were grouped as 1) Low ($PM_{2.5}$>10 μg/m3) or 2) High/Extreme (< $PM_{2.5}$ ≥10 μg/m3), per the WHO air quality guidelines.

Figure S3: Funnel Plot Assessment of Publication Bias



Funnel Plots showing Mean Difference (MD) against the Standard Error (SE) for primary outcomes Systolic Blood Pressure (Egger test: -0.33, p = 0.74) and Diastolic Blood Pressure (Egger test: -0.45, p=0.65).