

SUPPLEMENTARY ONLINE-ONLY CONTENT

Sitting Less and Moving More: Implications for Hypertension

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Short title: Sitting Less, Moving More & Hypertension

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Supplementary Table S1. Summary of acute studies examining the cardiovascular (blood pressure) responses to prolonged sitting and sitting interrupted with physical activity bouts.

a) Normotensive healthy populations

Reference	Population/setting	BP measure	Intervention	BP results
Bhammer (2017) ¹	10 (5 men, 5 women) Age: 32 ± 5 years BMI: 30 ± 5 kg/m ² Insufficiently active	ABPM	1. Sitting (SIT)—9 h 2. 30-min moderate-intensity walking at midday (8.5 h sitting) 3. Sitting + moderate-intensity walking bouts (MOD)—(21 x 2 min bouts of walking at 20 min intervals—total 42 min walking) 3. Sitting + vigorous-intensity walking bouts (VIG)—(8 x 2 min bouts of walking at 60 min intervals—total 16 min walking)	Results for n = 6 (4 men, 2 women) due to excluded data (missing/caffeine) <i>MOD vs. SIT</i> <i>Evening BP outside laboratory</i> – ↓ SBP by 6 mmHg – ↓ DBP by 5 mmHg – ↓ MAP by 6 mmHg No other trial periods or BP results were statistically significant between any conditions.
Champion (2018) ²	24 (12 men, 12 women) Age: ~37 ± 10 years BMI: ~25 ± 5 kg/m ² Physically active	O - hourly	1. Sitting (SIT)—6.5 h 2. Sitting + light-intensity walking bouts (LW)—6.5 h (6 x 20 min bouts of light walking at 60 min intervals—total 2 h light walking)	<i>LW vs. SIT</i> – ↓ SBP by 4 mmHg – ↓ DBP by 3 mmHg – ↓ MAP by 4 mmHg
Bailey (2015) ³	10 (7 men, 3 women) Age: 24 ± 3 years BMI: 27 ± 4 kg/m ² Activity level—not reported	O - hourly	1. Sitting (SIT)—5 h 2. Sitting + standing bouts (LW)—5 h (14 x 2 min bouts of standing at 20 min intervals—total 28 min light walking) 3. Sitting + light-intensity walking bouts (LW)—5 h (14 x 2 min bouts of light walking at 20 min intervals—total 28 min light walking)	No statistically significant effects on BP.
Padilla (2009) ⁴	8 healthy men Age: 24 ± 2 years (SE) BMI: 24 ± 1 kg/m ² Physically active	O and A -hourly (brachial and popliteal)	1. Sitting (SIT)—3 h 2. Supine control (lying down)—3 h	<i>SIT vs. LYING DOWN</i> – ↑ SBP (magnitude not detailed) – ↑ DBP (magnitude not detailed)
Shvartz (1983) ⁵	8 healthy men Age range: 19–30 years BMI: ~25 kg/m ² (data not specifically reported)	O - hourly	5 h sitting period with initial 30 min and 20 min in supine and standing positions, respectively.	Responses during 5 h sitting – ↑ TPR by 5% – ↑ DBP by 9 mmHg (1 h vs. 5 h) – ↑ mean arterial BP (7.3 mmHg)

	Activity level—not reported			<ul style="list-style-type: none"> - ↓ calf BF by 13% - ↑ calf pooling by 17% - Non-significant changes in SBP, thigh BF, cardiac output, stroke volume, and heart rate
Younger (2016) ⁶	10 (6 men, 4 women) Age: 22 ± 1 years (SE) BMI: 25 ± 2 kg/m ² Physically active	A - hourly	1. Sitting (SIT)—5 h 2. 30-min MVPA (cycling) + 5 h sitting	<ul style="list-style-type: none"> - ↓ Mean arterial pressure by 5% over 5 h MVPA vs. SIT - ↑ Heart rate in hours 1 and 2 - No significant differences for SBP, or DBP

b) Pre-hypertensive and hypertensive populations

Reference	Population/setting	BP measure	Intervention	BP results
Zeigler (2015) ⁷	9 (4 men, 6 women) Age: 43 ± 13 years BMI: 27 ± 6 kg/m ² Insufficiently active desk workers. All participants pre-hypertensive	ABPM	1. Sitting (SIT)—8 h (simulated office) 2. Sitting + accumulated walking bouts @ 1.6 km/h (total 2.5 h)—8 h (2 x 10, 2 x 15, 2 x 20, 2 x 30 at ~hourly time points).	<i>Work hours (9-4pm)</i> <ul style="list-style-type: none"> - ↓ SBP by 3 mmHg - ↓ DBP by 3 mmHg <i>Post work hours (4-10pm)</i> <ul style="list-style-type: none"> - ↓ SBP by 4 mmHg - ↓ DBP by 4 mmHg
Zeigler (2016) ⁸	9 (2 men, 7 women) Age: 30 ± 15 years BMI: 29 ± 3 kg/m ² Insufficiently active 7 participants pre-hypertensive	ABPM	1. Sitting (SIT)—8 h 2. Sitting + accumulated standing bouts (total 2.5 h) STAND—8 h (2 x 10, 2 x 15, 2 x 20, 2 x 30 at ~hourly time points) 3. Sitting + accumulated walking bouts @ 1.6 km/h (total 2.5 h) WALK 4. Sitting + accumulated cycling bouts @ ~20 watts and same cadence as 3.) (total 2.5 h) CYCLE	<i>Work hours (8-4pm)</i> <i>STAND vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 3 mmHg - ↑ DBP by 2 mmHg <i>WALK vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 3 mmHg <i>CYCLE vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 5 mmHg - ↓ DBP by 1 mmHg <i>Post work hours (4-7pm)</i> <i>STAND vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 6 mmHg - ↓ DBP by 4 mmHg <i>WALK vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 4 mmHg <i>CYCLE vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 13 mmHg - ↓ DBP by 7 mmHg
Larsen (2014) ⁹	19 (11 men, 8 women) Age: 54 ± 5 years BMI: 31 ± 4 kg/m ² Sedentary occupation Insufficiently active 52% pre-hypertensive or hypertensive	O - hourly	1. Sitting (SIT)—5 h 2. Sitting + light-intensity walking bouts (LW)—5 h (14 x 2 min bouts of light walking at 20 min intervals—total 28 min light walking)	<i>LW vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 3 mmHg - ↓ DBP by 3 mmHg <i>MW vs. SIT</i> <ul style="list-style-type: none"> - ↓ SBP by 2 mmHg - ↓ DBP by 2 mmHg <i>MW vs. LW</i>

			3. Sitting + moderate intensity walking bouts (MW)—5 h (14 x 2 min bouts of moderate walking at 20 min intervals—total 28 min moderate walking)	– No significant differences
Dempsey (2016) ¹⁰	24 (14 men, 10 women) with type 2 diabetes Age: 62 ± 6 years BMI: 33 ± 3 kg/m ² Sedentary and insufficiently active 88% pre-hypertensive or hypertensive	O - hourly	1. Sitting (SIT)—7 h 2. Sitting + light-intensity walking bouts (LW)—7 h (12 x 3 min bouts of light walking at 30 min intervals—total 36 min light walking) 3. Sitting + simple resistance activity bouts (SRA)—7 h (12 x 3 min bouts (body-weight half squats, calf raises, gluteal contractions) at 30 min intervals—total 36 min)	<i>LW vs. SIT</i> – ↓ SBP by 14 mmHg – ↓ DBP by 8 mmHg <i>SRA vs. SIT</i> – ↓ SBP by 16 mmHg – ↓ DBP by 10 mmHg <i>SRA vs. LW</i> – ↓ SBP by 2 mmHg – ↓ DBP by 2 mmHg
Barone Gibbs (2017) ¹¹	25 (16 men, 9 women) Age: 42 ± 12 years BMI: 32 ± 5 kg/m ² Sedentary and insufficiently active Pre-to-Stage 1 hypertensive – none on antihypertensive medications.	O - hourly	1. Sitting (SIT)—8 h (2 x 3:40 h periods in am and pm) 2. Sitting + standing bouts (STAND)—8 h (8 x 30 min bouts of standing at 30 min intervals—total 4 h standing)	<i>STAND vs. SIT</i> – ↓ DBP by 1 mmHg – ↓ MAP by 1 mmHg – No significant difference in SBP

Data represent means ± SD or mean (range) for study described unless otherwise stated. ↑ increased significantly ($P < 0.05$); ↓ decreased significantly ($P < 0.05$); SBP, systolic blood pressure; DBP, diastolic blood pressure; ABPM, ambulatory BP measurement; O, oscillometric (automatic) office BP measurement; A, auscultatory (manual) office BP measurement. Note: Some information is adapted from Dempsey et al.¹² with permission.

Supplementary Table S2. Model results in relation to Figure 2.

Walking breaks vs. prolonged sitting (*Figure 2A*)

Participant phenotype and BP measure	Sitting condition: β coefficient for time	Walking condition: β coefficient for time	<i>P</i> (difference in slopes) ^a
Hypertensives (n=29)			
Systolic BP (mmHg/hr)	0.703*	-1.760***	<i>P</i> <0.001
Diastolic BP (mmHg/hr)	0.505*	-1.033***	<i>P</i> <0.001
Normotensives (n=33)			
Systolic BP (mmHg/hr)	0.447	-0.974***	<i>P</i> <0.001
Diastolic BP (mmHg/hr)	-0.022	-0.761***	<i>P</i> =0.002

Significant regression coefficient of BP on time, **P*<0.05; ***P*<0.01; ****P*<0.001.

^aLinear mixed effect model with random slopes (condition-by-time interaction). Models were adjusted for age, sex, BMI, treatment order, and baseline values. Walking breaks were 2-3 min every 20-30 min following baseline.

Simple resistance activity breaks vs. prolonged sitting (*Figure 2B*)

Participant phenotype and BP measure	Sitting condition β coefficient for time	SRA condition β coefficient for time	<i>P</i> (difference in slopes) ^a
Hypertensives (n=24)			
Systolic BP (mmHg/hr)	1.120***	-2.343***	<i>P</i> <0.001
Diastolic BP (mmHg/hr)	0.937***	-1.650***	<i>P</i> <0.001
Normotensives (n=19)			
Systolic BP (mmHg/hr)	0.947*	-1.813***	<i>P</i> <0.001
Diastolic BP (mmHg/hr)	0.723*	-0.901**	<i>P</i> <0.001

Significant regression coefficient of BP on time, **P*<0.05; ***P*<0.01; ****P*<0.001.

^aLinear mixed effect model with random slopes (condition-by-time interaction). Models were adjusted for age, sex, BMI, treatment order, and baseline values. SRA=simple resistance activity breaks (half-squats, calf raises, gluteal contractions and knee raises; 3 min every 30 min following baseline).

Note. Primary source datasets include pooled BP data from four separate experimental studies, including two published^{9, 10} and two unpublished^{13, 14}.