SUPPLEMENTAL MATERIALS

Blood Pressure Responses During Exercise: Physiological Correlates and Clinical Implications

Matthew Nayor, MD, MPH[1,2,3]*, Priya Gajjar, MS[1]; Venkatesh L. Murthy, MD, PhD[4,5]; Patricia Miller, MS[6]; Raghava S. Velagaleti, MD, MPH[3,7]; Martin G. Larson, SD[3,6]; Ramachandran S. Vasan, MD[1,2,3,8,9]; Gregory D. Lewis, MD[10]*; Gary F. Mitchell, MD[11]*; Ravi V. Shah, MD[12]*

(1) Cardiovascular Medicine Section, Department of Medicine, Boston University School of Medicine, Boston, MA; (2) Preventive Medicine and Epidemiology Section, Department of Medicine, Boston University School of Medicine, Boston, MA; (3) Boston University's and National Heart, Lung, and Blood Institute's Framingham Heart Study, Framingham, MA; (4) Division of Cardiovascular Medicine, Department of Medicine, University of Michigan, Ann Arbor; (5) Frankel Cardiovascular Center, University of Michigan, Ann Arbor; (6) Department of Biostatistics, Boston University School of Public Health, Boston, MA; (7) Cardiology Section, Department of Medicine, Boston VA Healthcare System, West Roxbury, Massachusetts; (8) University of Texas School of Public Health San Antonio, and Departments of Medicine and Population Health Sciences, University of Texas Health Science Center, San Antonio, TX; (9) Department of Epidemiology, Boston University School of Public Health, and the Center for Computing and Data Sciences, Boston University, Boston, MA; (10) Cardiology Division and Pulmonary Critical Care Unit, Department of Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, MA; (11) Cardiovascular Engineering, Inc., Norwood, MA; (12) Vanderbilt Translational and Clinical Research Center, Cardiology Division, Vanderbilt University Medical Center, Nashville, TN

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Supplemental Methods

Equations used for predicted peak oxygen upate (VO$_2$) as defined by the Wasserman-Hansen equations are reproduced below[20].

Men
Ideal weight (kg) = 0.79 x Height (cm) – 60.7

If actual weight equals or exceeds ideal weight:
Peak VO$_2$ = 0.0337 X Height – 0.000165 X Age X Height – 1.963 + 0.006 X Weight (actual – ideal)

If actual weight is less than ideal weight:
Peak VO$_2$ = 0.0337 X Height – 0.000165 X Age X Height – 1.963 + 0.014 X Weight (actual – ideal)

Women
Ideal weight (kg) = 0.65 X Height (cm) -42.8
Peak VO$_2$ = 0.001 X Height X (14.783 – 0.11 X Age) + 0.006 X Weight (actual – ideal)

Table S1A. Characteristics by categories of peak O_2 pulse in women and men with CFPWV values below the median

Variable	Women (CFPWV <7.2 m/s)			Men (CFPWV <7.9 m/s)		
	Peak O_2 pulse <9.5 ml/beat (N=349)	Peak O_2 pulse ≥9.5 ml/beat (N=397)	P-value	Peak O_2 pulse <15.0 ml/beat (N=286)	Peak O_2 pulse ≥15.0 ml/beat (N=393)	P-value
Age, years	51 ± 8	48 ± 8	<0.001	51 ± 9	49 ± 8	0.002
Body mass index, kg/m^2	25.0 ± 4.5	27.2 ± 5.8	<0.001	27.1 ± 4.1	28.8 ± 4.5	<0.001
Total Cholesterol, (mg/dl)	195.0 ± 34.0	185.4 ± 32.6	<0.001	184.5 ± 34.5	185.3 ± 34.0	0.76
HDL Cholesterol, (mg/dl)	69.4 ± 18.2	68.6 ± 17.3	0.55	51.5 ± 14.9	52.0 ± 14.6	0.68
Treated for Diabetes, N (%)	3 (0.9)	8 (2.0)	0.32	7 (2.4)	3 (0.8)	0.14
Current Smoker, N (%)	24 (6.9)	28 (7.1)	1.00	23 (8.0)	16 (4.1)	0.04
Prevalent cardiovascular disease, N (%)	8 (2.3)	8 (2.0)	0.99	7 (2.4)	10 (2.5)	1.00
Hypertension treatment, N (%)	25 (7.2)	38 (9.6)	0.29	46 (16.1)	45 (11.5)	0.10
Resting Heart Rate, beats/min	75 ± 12	70 ± 11	<0.001	70 ± 11	65 ± 10	<0.001
Physical Activity Index	32.5 ± 3.9	33.8 ± 4.0	<0.001	35.3 ± 7.1	34.9 ± 6.4	0.53
Resting systolic blood pressure, mm Hg	109 ± 11	110 ± 11	0.30	117 ± 11	117 ± 11	0.31
Peak Systolic blood pressure mm Hg	160 ± 20	169 ± 21	<0.001	182 ± 22	191 ± 22	<0.001
CFPWV, m/s	6.4 ± 0.5	6.3 ± 0.6	0.06	7.0 ± 0.6	6.9 ± 0.6	0.01
Peak O_2 pulse, mL/beat	8.1 ± 1.0	11.6 ± 1.6	<0.001	13.0 ± 1.6	18.1 ± 2.3	<0.001
Peak VO_2, ml/kg/min	19.8 ± 4.1	25.6 ± 6.4	<0.001	25.1 ± 4.7	31.5 ± 6.8	<0.001
Peak workload, watts	120 ± 20	168 ± 34	<0.001	197 ± 35	261 ± 43	<0.001
Peak RER	1.23 ± 0.09	1.20 ± 0.08	<0.001	1.28 ± 0.10	1.24 ± 0.08	<0.001

Median CFPWV was 7.2 m/s in women and 7.9 m/s in men
Median peak O_2 pulse was 9.5 ml/beat in women and 15.0 ml/beat in men

Table S1B. Characteristics by categories of peak O_2 pulse in women and men with CFPWV values above the median

Variable	Women (CFPWV ≥7.2 m/s)			Men (CFPWV ≥7.9 m/s)		
	Peak O_2 pulse <9.5 ml/beat (N=397)	Peak O_2 pulse ≥9.5 ml/beat (N=350)	P-value	Peak O_2 pulse <15.0 ml/beat (N=396)	Peak O_2 pulse ≥15.0 ml/beat (N=290)	P-value
Age, years	59 ± 7	55 ± 7	<0.001	59 ± 9	57 ± 7	0.001
Body mass index, kg/m^2	26.1 ± 4.8	30.4 ± 6.0	<0.001	29.2 ± 4.4	31.3 ± 5.0	<0.001
Total Cholesterol, (mg/dl)	204.9 ± 35.9	199.6 ± 35.9	0.047	183.5 ± 38.9	184.5 ± 35.7	0.73
HDL Cholesterol, (mg/dl)	70.1 ± 21.1	64.5 ± 19.5	<0.001	50.8 ± 16.0	48.4 ± 13.3	0.03
Treated for Diabetes, N (%)	19 (4.8)	25 (7.1)	0.23	46 (11.6)	34 (11.7)	1.00
Current Smoker, N (%)	23 (5.8)	9 (2.6)	0.047	28 (7.1)	13 (4.5)	0.21
Prevalent cardiovascular disease, N (%)	7 (1.8)	14 (4.0)	0.10	38 (9.6)	12 (4.1)	0.01
Hypertension treatment, N (%)	102 (25.7)	91 (26.0)	0.99	152 (38.4)	100 (34.5)	0.33
Resting Heart Rate, beats/min	77 ± 12	74 ± 11	<0.001	74 ± 12	69 ± 111	<0.001
Physical Activity Index	32.8 ± 4.2	33.0 ± 4.2	0.44	35.2 ± 6.6	35.2 ± 6.4	0.98
Resting systolic blood pressure, mm Hg	123 ± 15	122 ± 13	0.36	129 ± 13	127 ± 12	0.07
Peak Systolic blood pressure mm Hg	175 ± 23	184 ± 22	<0.001	193 ± 24	197 ± 23	0.017
CFPWV, m/s	8.8 ± 1.9	8.4 ± 1.4	0.006	9.9 ± 2.2	9.4 ± 1.6	<0.001
Peak O_2 pulse, mL/beat	7.9 ± 1.0	11.1 ± 1.4	<0.001	12.7 ± 1.7	17.5 ± 2.1	<0.001
Peak VO_2, ml/kg/min	17.9 ± 3.7	20.7 ± 5.6	<0.001	21.5 ± 4.4	25.9 ± 6.1	<0.001
Peak workload, watts	110 ± 19	144 ± 28	<0.001	172 ± 39	226 ± 43	<0.001
Peak RER	1.23 ± 0.09	1.20 ± 0.08	<0.001	1.24 ± 0.10	1.21 ± 0.08	<0.001

Median CFPWV was 7.2 m/s in women and 7.9 m/s in men.

Median peak O_2 pulse was 9.5 ml/beat in women and 15.0 ml/beat in men

Table S2. Multivariable models for prediction of peak SBP

Variable	All participants (N=2858)		Men (N=1365)		Women (N=1493)	
	Est. beta±SE	P-value	Est. beta±SE	P-value	Est. beta±SE	P-value
Age	-0.20±0.05	<0.0001	-0.39±0.07	<0.0001	0.00±0.06	1.00
Sex	1.96±1.06	0.06	--	--	--	--
Rest SBP	0.81±0.02	<0.0001	0.80±0.04	<0.0001	0.82±0.03	<0.0001
Hypertension treatment	-3.76±0.91	<0.0001	-3.23±1.29	0.01	-3.82±1.28	0.003
Transformed CFPWV	0.11±0.02	<0.0001	0.08±0.03	0.007	0.14±0.02	<0.0001
Log(peak O2 pulse)	21.1±1.6	<0.0001	19.0±2.6	<0.0001	22.5±2.1	<0.0001

Model adjusted R-squared values are 0.47 in all participants, 0.31 in men, and 0.45 in women.
Regression coefficients represent the change in peak SBP for a 1-unit higher value of each independent variable.

Table S3. Cross-sectional associations of a 1-SD higher blood pressure measure with a 1-SD higher value for arterial stiffness measures with additional covariate adjustment

BP measure	Arterial stiffness measures	Women (N=1492) $Est.\,\beta \pm SE$	P-value	Men (N=1365) $Est.\,\beta \pm SE$	P-value
Freewheel SBP	Carotid-femoral pulse wave velocity	0.06 ± 0.02	0.0002	0.06 ± 0.02	0.0007
Freewheel SBP	Peak O2 pulse	-0.04 ± 0.01	0.008	-0.05 ± 0.01	0.002
Freewheel SBP	Augmentation Index	0.01 ± 0.01	0.26	0.02 ± 0.01	0.17
Freewheel SBP	Characteristic Impedance	0.06 ± 0.01	<0.0001	0.04 ± 0.01	0.008
Freewheel SBP	Forward wave amplitude	0.07 ± 0.01	<0.0001	0.05 ± 0.01	0.0008
SBP at 75 watts	Carotid-femoral pulse wave velocity	0.12 ± 0.02	<0.0001	0.12 ± 0.02	<0.0001
SBP at 75 watts	Peak O2 pulse	-0.22 ± 0.02	<0.0001	-0.20 ± 0.02	<0.0001
SBP at 75 watts	Augmentation Index	0.03 ± 0.02	0.08	0.0 ± 0.02	0.82
SBP at 75 watts	Characteristic Impedance	0.12 ± 0.02	<0.0001	0.11 ± 0.02	<0.0001
SBP at 75 watts	Forward wave amplitude	0.11 ± 0.02	<0.0001	0.10 ± 0.02	<0.0001
Peak SBP	Carotid-femoral pulse wave velocity	0.11 ± 0.03	<0.0001	0.03 ± 0.03	0.36
Peak SBP	Peak O2 pulse	0.16 ± 0.02	<0.0001	0.13 ± 0.02	<0.0001
Peak SBP	Augmentation Index	0.01 ± 0.02	0.51	0.00 ± 0.02	0.97
Peak SBP	Characteristic Impedance	0.04 ± 0.02	0.10	0.03 ± 0.02	0.16
Peak SBP	Forward wave amplitude	0.13 ± 0.02	<0.0001	0.08 ± 0.02	0.0007
Peak DBP	Carotid-femoral pulse wave velocity	0.12 ± 0.03	<0.0001	0.10 ± 0.03	0.0001
Peak DBP	Peak O2 pulse	-0.12 ± 0.02	<0.0001	-0.17 ± 0.02	<0.0001
Peak DBP	Augmentation Index	0.05 ± 0.02	0.01	0.07 ± 0.02	0.002
Peak DBP	Characteristic Impedance	0.02 ± 0.02	0.38	-0.01 ± 0.02	0.79
Peak DBP	Forward wave amplitude	0.05 ± 0.02	0.02	0.0 ± 0.02	0.995
SBP/W slope	Carotid-femoral pulse wave velocity	0.20 ± 0.03	<0.0001	0.15 ± 0.03	<0.0001
SBP/W slope	Peak O2 pulse	-0.31 ± 0.02	<0.0001	-0.37 ± 0.03	<0.0001
SBP/W slope	Augmentation Index	0.05 ± 0.03	0.048	0.03 ± 0.03	0.24
SBP/W slope	Characteristic Impedance	0.17 ± 0.03	<0.0001	0.19 ± 0.03	<0.0001
SBP/W slope	Forward wave amplitude	0.19 ± 0.03	<0.0001	0.13 ± 0.03	<0.0001

All variables shown were mean-centered and standardized for regression. Regression coefficients represent the change in BP measures (dependent variables) for a 1-SD higher value of the vascular stiffness measures or peak O_2 pulse. Models were adjusted for age, hypertension treatment, resting SBP, BMI, smoking, and menopause (women) and separate models were constructed for men and women. In models with peak DBP as the dependent variable, we substituted resting DBP for resting SBP as a covariate. 897 (60%) of women were post-menopausal. A Bonferroni-adjusted P-value threshold of 0.01 was used to determine statistical significance.

Table S4. Cross-sectional associations of a 1-SD higher blood pressure measure with a 1-SD higher value for vascular stiffness measures in the whole sample and in the subsample free of resting hypertension

	Women				Men			
	All Women (N=1492)		Non-hypertensives (N=953)		All Men (N=1365)		Non-hypertensives (N=556)	
Vascular stiffness measures	$Est.\beta \pm SE$	p-value	$Est.\beta \pm SE$	p-value	$Est.\beta \pm SE$	p-value	$Est.\beta \pm SE$	p-value
Freewheel SBP								
CFPWV	0.07 ± 0.02	<0.0001	0.05 ± 0.02	0.02	0.08 ± 0.02	<0.0001	0.06 ± 0.03	0.06
Peak O_2 pulse	-0.01 ± 0.01	0.27	-0.01 ± 0.02	0.47	-0.02 ± 0.01	0.10	-0.04 ± 0.03	0.12
Augmentation Index	0.01 ± 0.01	0.50	0.01 ± 0.02	0.51	0.01 ± 0.01	0.33	0.02 ± 0.03	0.41
Characteristic Impedance	0.04 ± 0.01	0.0009	0.03 ± 0.02	0.06	0.03 ± 0.01	0.03	0.01 ± 0.03	0.67
Forward wave amplitude	0.07 ± 0.01	<0.0001	0.08 ± 0.02	0.0001	0.05 ± 0.02	0.001	0.04 ± 0.03	0.11
SBP at 75 watts								
CFPWV	0.14 ± 0.02	<0.0001	0.11 ± 0.03	0.0001	0.14 ± 0.02	<0.0001	0.12 ± 0.04	0.003
Peak O_2 pulse	-0.16 ± 0.02	<0.0001	-0.20 ± 0.02	<0.0001	-0.17 ± 0.02	<0.0001	-0.19 ± 0.03	<0.0001
Augmentation Index	0.02 ± 0.02	0.29	0.02 ± 0.02	0.52	0.00 ± 0.02	0.97	0.02 ± 0.03	0.46
Characteristic Impedance	0.09 ± 0.02	<0.0001	0.10 ± 0.02	<0.0001	0.10 ± 0.02	<0.0001	0.12 ± 0.03	0.0003
Forward wave amplitude	0.11 ± 0.02	<0.0001	0.12 ± 0.03	<0.0001	0.10 ± 0.02	<0.0001	0.10 ± 0.03	0.002
Peak SBP								
CFPWV	0.13 ± 0.03	<0.0001	0.09 ± 0.03	0.005	0.05 ± 0.03	0.09	-0.04 ± 0.05	0.40
Peak O_2 pulse	0.20 ± 0.02	<0.0001	0.25 ± 0.03	<0.0001	0.16 ± 0.02	<0.0001	0.23 ± 0.04	<0.0001
Augmentation Index	-0.01 ± 0.02	0.78	-0.03 ± 0.03	0.27	-0.02 ± 0.02	0.41	0.00 ± 0.04	0.99
Characteristic Impedance	0.00 ± 0.02	0.92	-0.01 ± 0.03	0.77	0.02 ± 0.02	0.47	-0.04 ± 0.04	0.27
Forward wave amplitude	0.12 ± 0.02	<0.0001	0.15 ± 0.03	<0.0001	0.08 ± 0.02	0.002	0.07 ± 0.04	0.07
Peak DBP								
CFPWV	0.13 ± 0.03	<0.0001	0.10 ± 0.03	0.002	0.12 ± 0.03	<0.0001	0.10 ± 0.04	0.02
Peak O_2 pulse	-0.09 ± 0.02	<0.0001	-0.11 ± 0.03	0.0001	-0.13 ± 0.02	<0.0001	-0.14 ± 0.04	0.0002
Augmentation Index	0.05 ± 0.02	0.01	0.04 ± 0.03	0.14	0.06 ± 0.02	0.006	0.06 ± 0.04	0.09
Characteristic Impedance	0.01 ± 0.02	0.59	0.00 ± 0.03	0.95	-0.01 ± 0.02	0.64	0.05 ± 0.04	0.19
Forward wave amplitude	0.05 ± 0.02	0.01	0.03 ± 0.03	0.22	0 ± 0.02	0.94	0.04 ± 0.04	0.25
SBP/W slope								
CFPWV	0.23 ± 0.03	<0.0001	0.17 ± 0.04	<0.0001	0.19 ± 0.03	<0.0001	0.08 ± 0.05	0.12
Peak O_2 pulse	-0.22 ± 0.03	<0.0001	-0.23 ± 0.03	<0.0001	-0.3 ± 0.03	<0.0001	-0.3 ± 0.04	<0.0001
Augmentation Index	0.04 ± 0.03	0.18	0.01 ± 0.03	0.67	0.02 ± 0.03	0.45	0.03 ± 0.04	0.52
Characteristic Impedance	0.13 ± 0.03	<0.0001	0.13 ± 0.03	<0.0001	0.18 ± 0.03	<0.0001	0.16 ± 0.04	0.0001
Forward wave amplitude	0.18 ± 0.03	<0.0001	0.2 ± 0.03	<0.0001	0.13 ± 0.03	<0.0001	0.13 ± 0.04	0.003

All variables shown were mean-centered and standardized for regression. Regression coefficients represent the change in BP measures (dependent variables) for a 1-SD higher value of the vascular stiffness measures or peak O_2 pulse. Models were adjusted

for age, hypertension treatment, and resting SBP and separate models were constructed for men and women. In models with peak DBP as the dependent variable, we substituted resting DBP for resting SBP as a covariate. A Bonferroni-adjusted P-value threshold of 0.01 was used to determine statistical significance.

Major Resources Table

In order to allow validation and replication of experiments, all essential research materials listed in the Methods should be included in the Major Resources Table below. Authors are encouraged to use public repositories for protocols, data, code, and other materials and provide persistent identifiers and/or links to repositories when available. Authors may add or delete rows as needed.

Animals (in vivo studies)

Species	Vendor or Source	Background Strain	Sex	Persistent ID / URL
N/A				

Genetically Modified Animals

	Species	Vendor or Source	Background Strain	Other Information	Persistent ID / URL
Parent - Male	N/A				
Parent - Female					

Antibodies

Target antigen	Vendor or Source	Catalog #	Working concentration	Lot # (preferred but not required)	Persistent ID / URL
N/A					

DNA/cDNA Clones

Clone Name	Sequence	Source / Repository	Persistent ID / URL
N/A			

Cultured Cells

Name	Vendor or Source	Sex (F, M, or unknown)	Persistent ID / URL
N/A			

Data & Code Availability

Description	Source / Repository	Persistent ID / URL
N/A		

Other

Description	Source / Repository	Persistent ID / URL

DOI [to be added]

ARRIVE GUIDELINES

The ARRIVE guidelines (https://arriveguidelines.org/) are a checklist of recommendations to improve the reporting of research involving animals. Key elements of the study design should be included below to better enable readers to scrutinize the research adequately, evaluate its methodological rigor, and reproduce the methods or findings.

Study Design

Groups	Sex	Age	Number (prior to experiment)	Number (after termination)	Littermates (Yes/No)	Other description
Group 1 (Control)						
Group 2						
Add more if needed						

Sample Size: Please explain how the sample size was decided Please provide details of any a *prior* sample size calculation, if done.

Inclusion Criteria

Exclusion Criteria

Randomization

Blinding