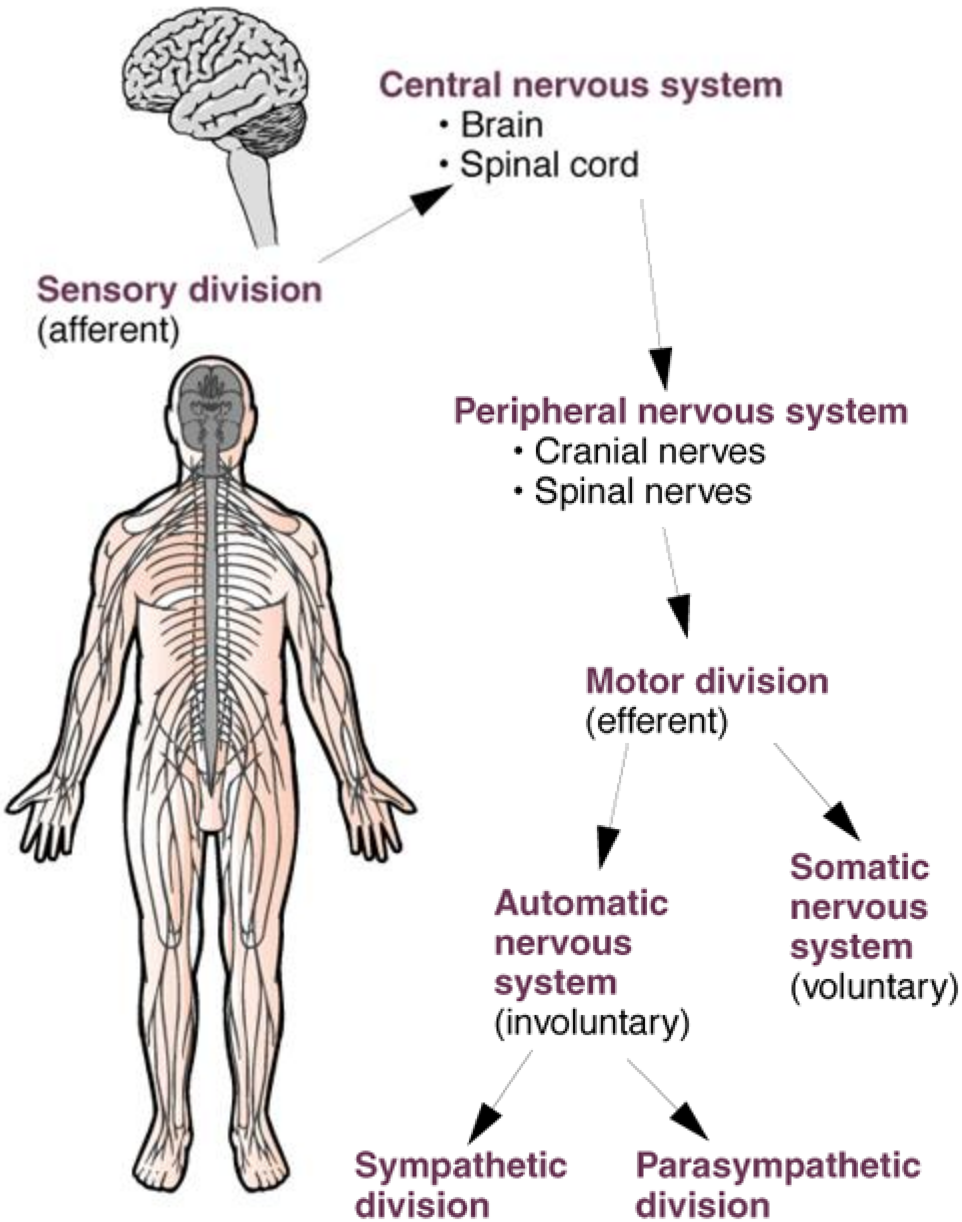
AJUSTES CARDIOR-RESPIRATÓRIOS AO EXERCÍCIO FÍSICO: ASPECTOS CLÍNICOS

Sistema Nervoso



FUNÇÕES

1) O **sistema cardiovascular** proporciona aos tecidos uma corrente contínua de oxigênio e nutrientes;

2) É responsavel também pela remoção dos co-produtos do metabolismo;

3) Regulação homeostática do organismo por distribuição de hormônios.

Componentes do Sistema Cardiovascular

- ✓ CORAÇÃO
- ✓ SANGUE
- ✓ SISTEMA VASCULAR

CONTROLE DO CORAÇÃO PELO SISTEMA NERVOSO AUTÔNOMO

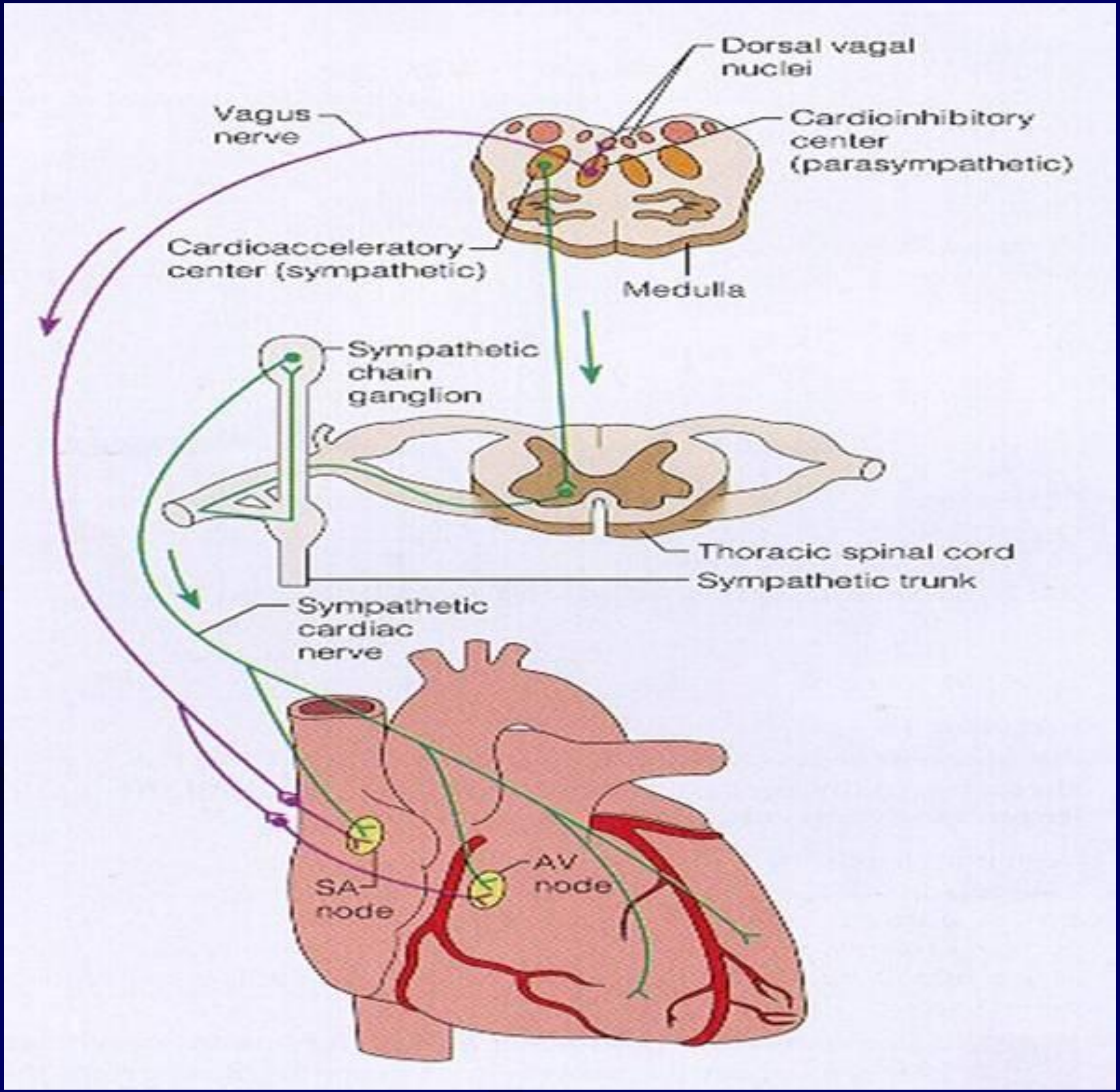
Regulação Extrínseca

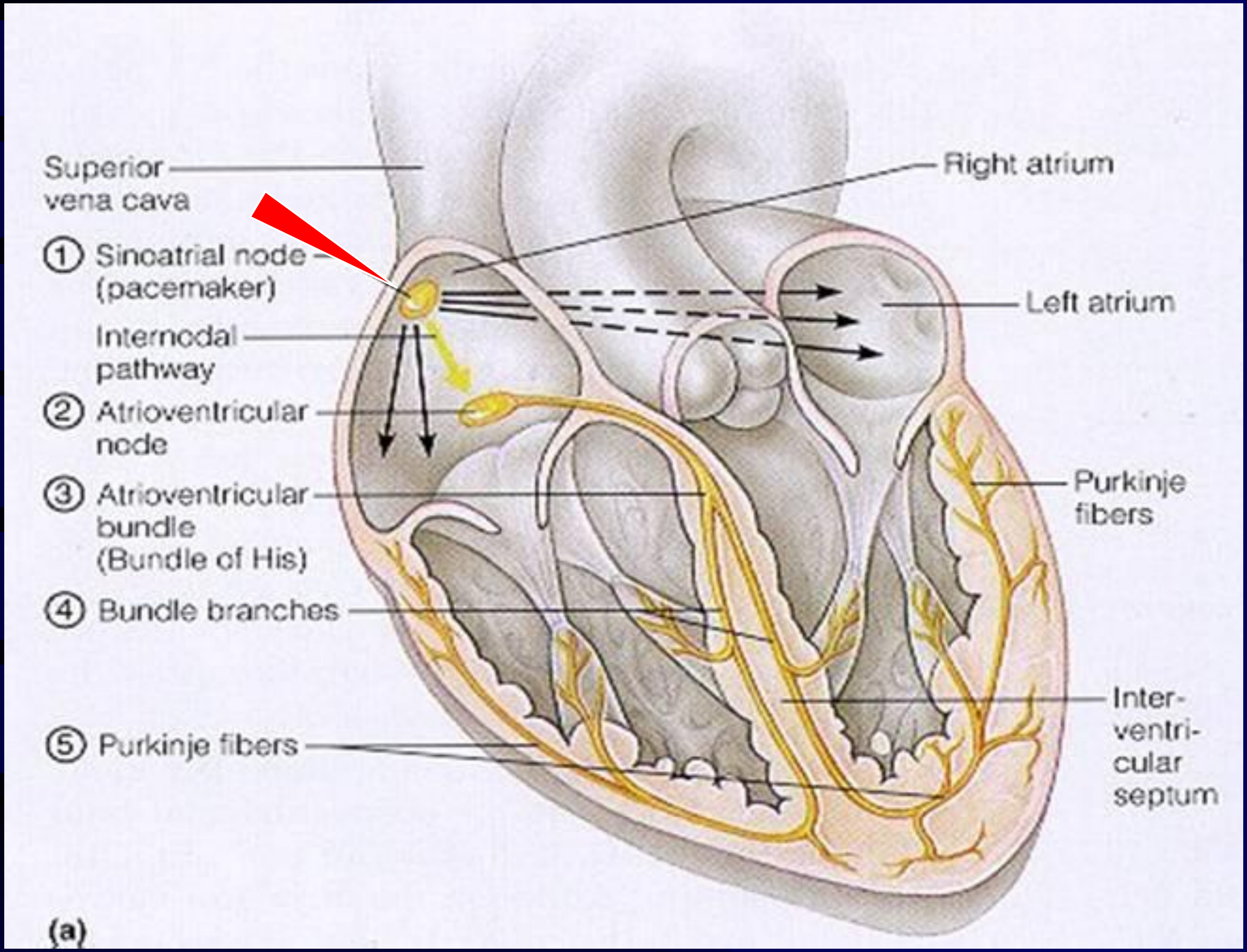
- *Centros neurais*

SNS (noradrenalina e adrenalina)
Efeitos:Taquicardia e Força de contração

SNPS (acetilcolina)
Efeitos: Bradicardia e Força de contração

Regulação Intrínseca
Distensão da câmara cardíaca (volume de sangue que chega ao coração).

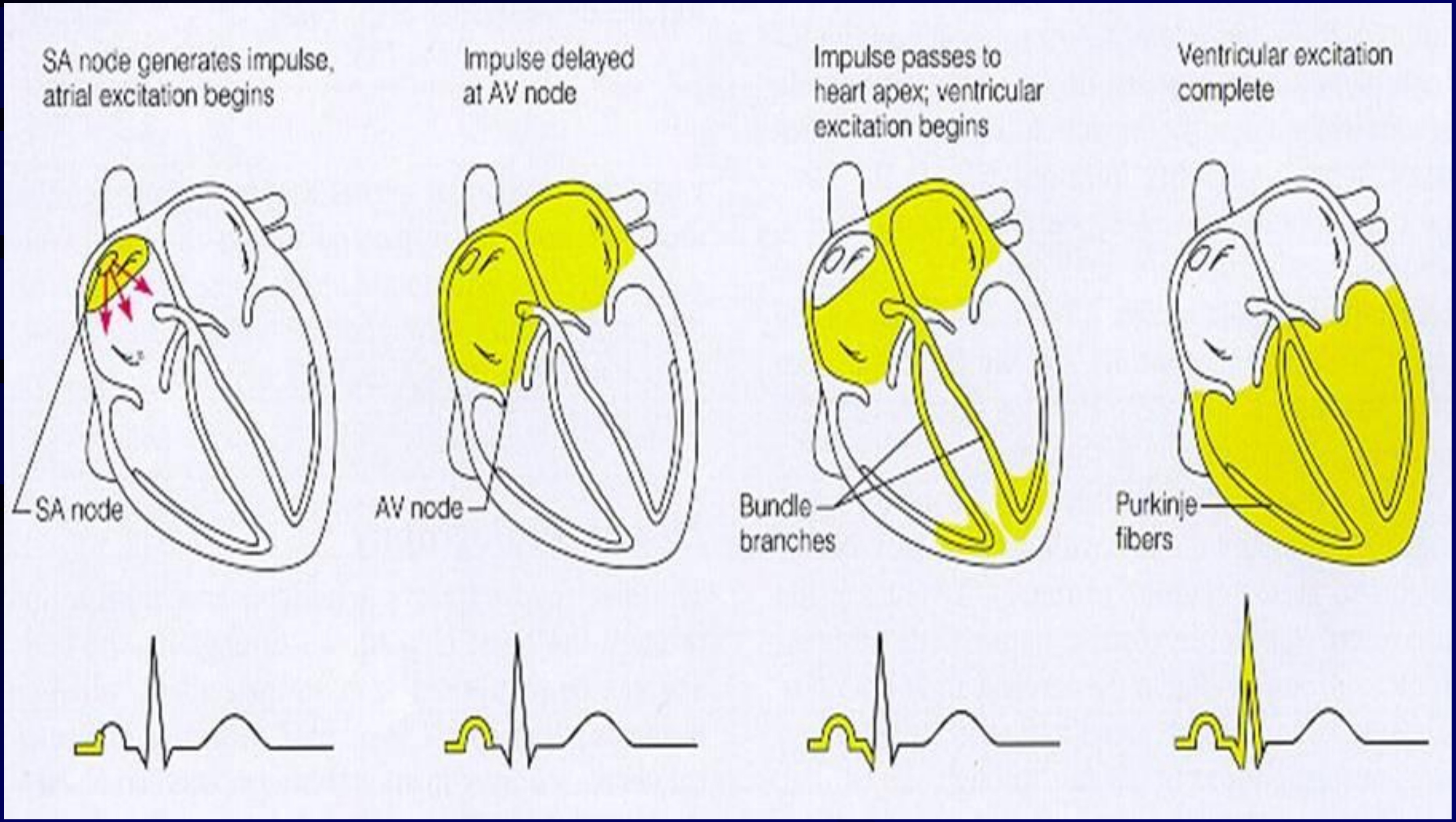




Fibra Nodal:
Auto-geração de potenciais de ação (*cronotropismo cardíaco*)

Nodo Sino-atrial (marca-passo normal-110 bpm): 3mm x 1cm na parede átrio D sob o tônus simpático e parassimpático (± 70 bat/min).

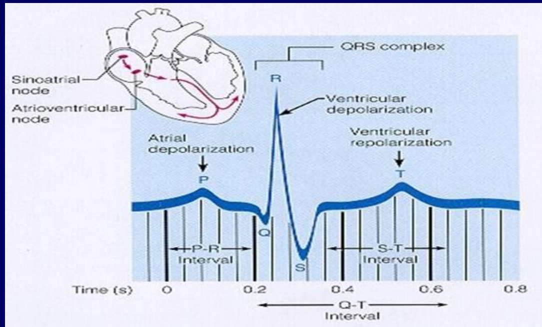
ATIVIDADE ELÉTRICA DO CORAÇÃO



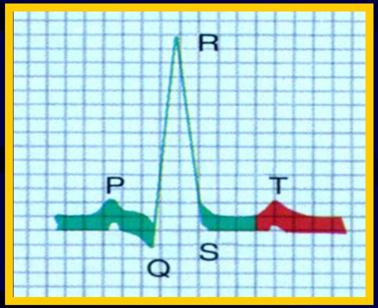
ELETROCARDIOGRAMA

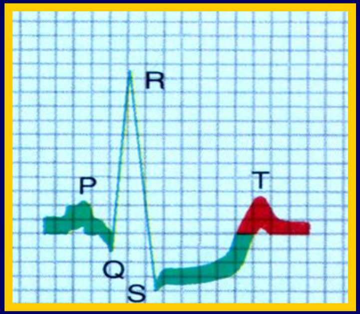
O registro gráfico da atividade elétrica do coração é denominado eletrocardiograma (ECG);

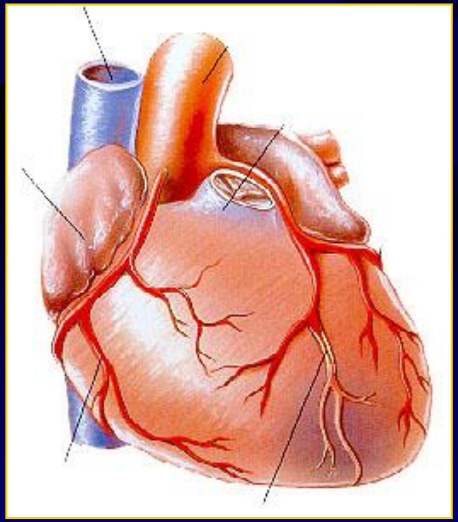
O ECG permite a monitorar a FC, e evidenciar anormalidades da função cardíaca (ritmo e condução cardíaca, e fornecimento de O2).

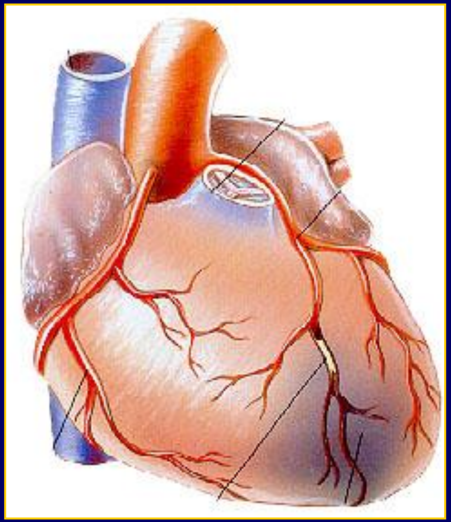


ISQUEMIA

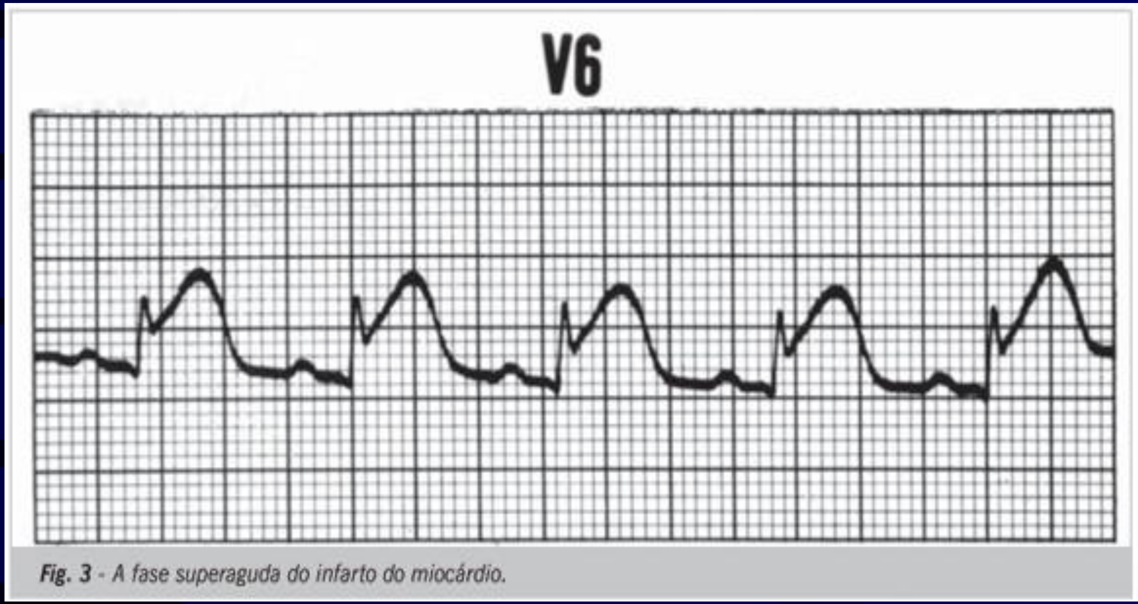








ELETROCARDIOGRAMA



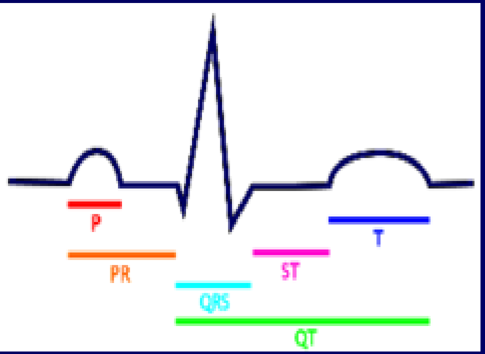
Fase superaguda do infarto do miocárdio.

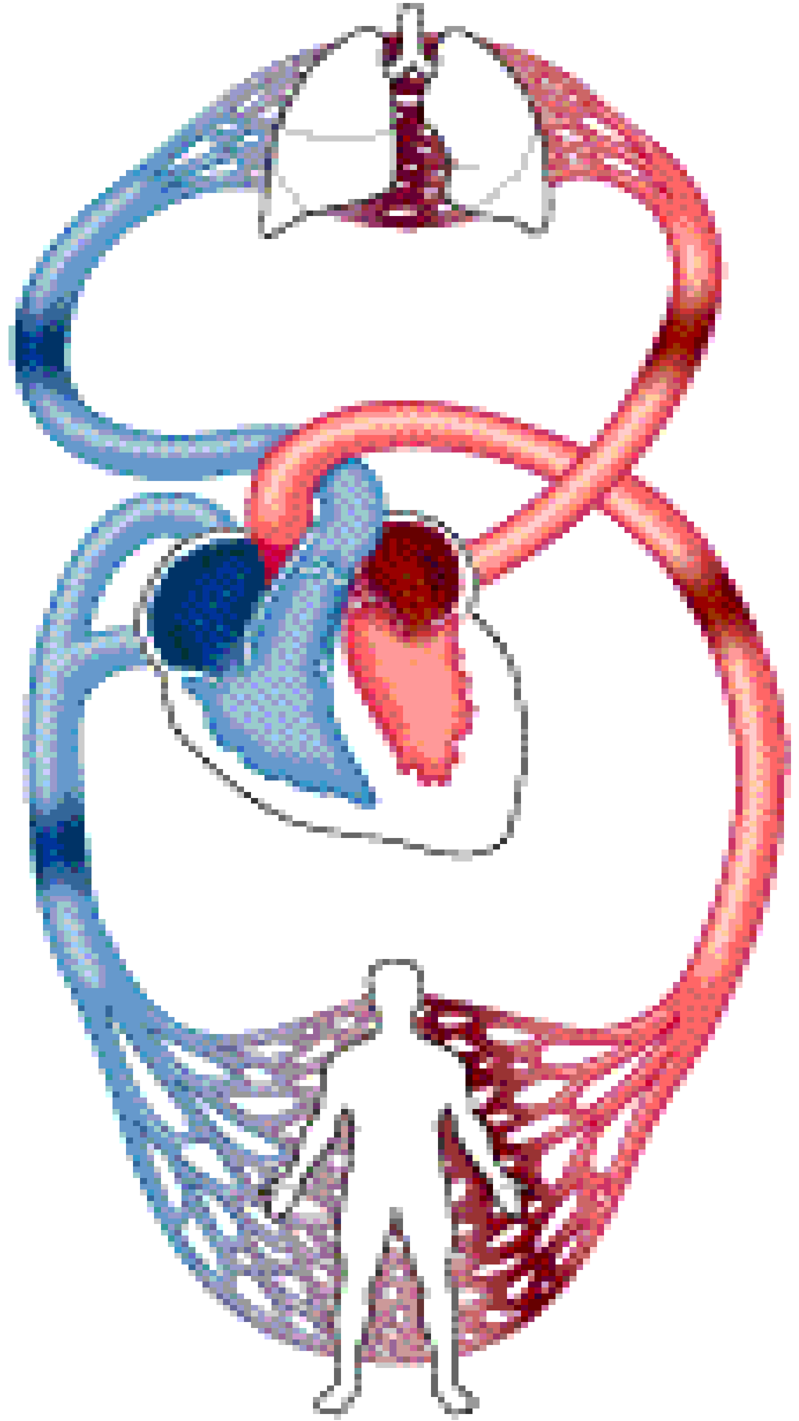
Onda P = despolarização atrial

Complexo QRS = despolarização ventricular

Onda T = repolarização ventricular

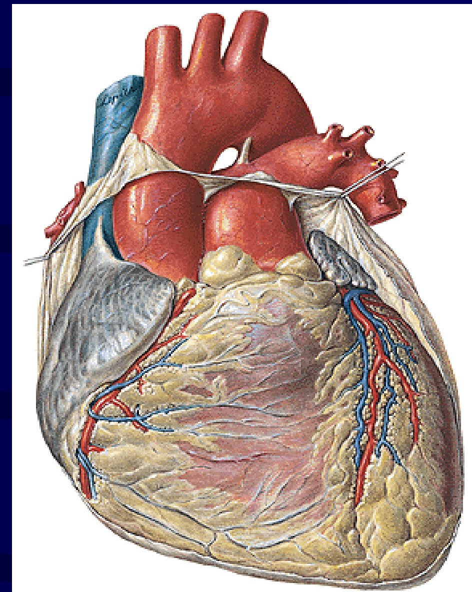
Onda Ta (não visível) = repolarização atrial





Pequena circulação
PULMONAR

Grande circulação
SISTÊMICA



VEIAS

ARTÉRIAS

ARTERÍOLAS

CAPILARES

VÊNULAS

Terminologias

****Ciclo Cardíaco** – O Ciclo da circulação sangüínea aliado aos eventos elétricos e mecânicos que ocorrem enquanto o sangue entra e é ejetado pelo coração *(em 1 min representa a FC).*

Volume Sistólico - volume de sangue ejetado em cada batimento pelos ventrículos.

****Débito Cardíaco** (Q) - O volume de sangue bombeado pelo coração a cada minuto (VS x FC).

Diferença A-v O_2 - diferença do conteúdo de O_2 do sangue arterial e do sangue venoso.

Duplo produto – Taxa de sobrecarga ao miocárdio (PAS x FC).

Terminologias

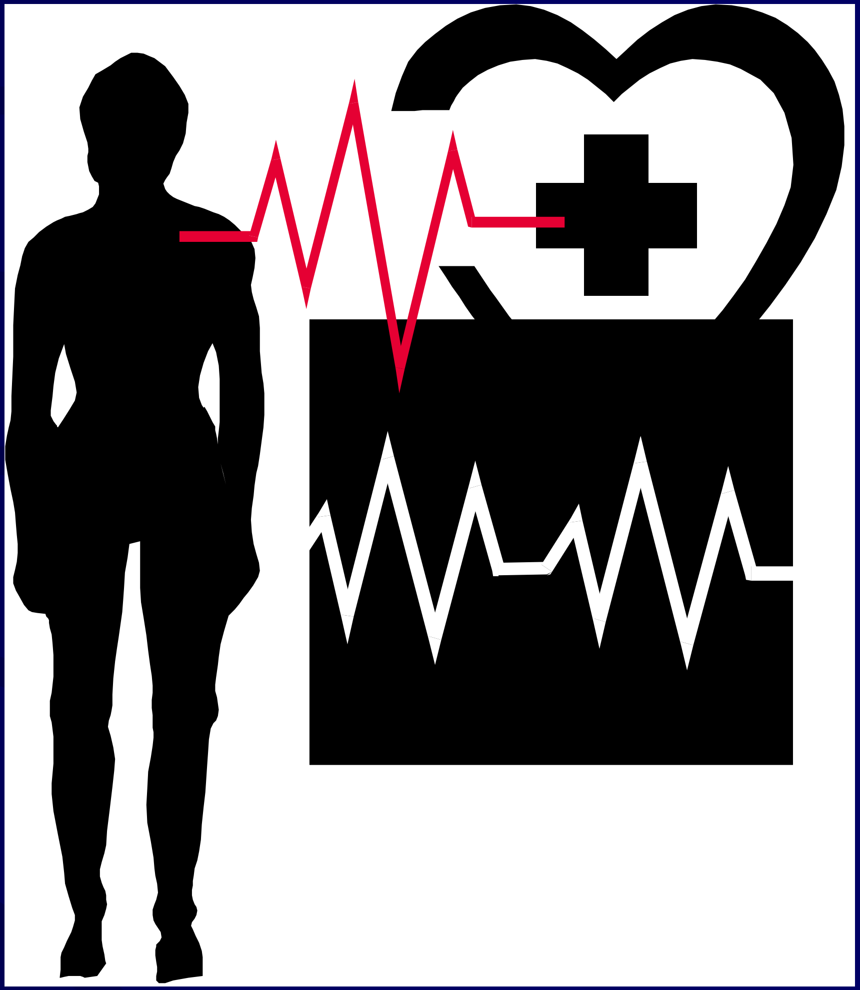
****Pré-carga** – *Volume de sangue (no final da diástole) presente no ventrículo do coração, após seu enchimento passivo e contração* ***atrial****. Uma redução do retorno venoso pode reduzir a pré-carga.*

****Pós-carga** – *É a resistência contrária a ejeção ventricular. A resistência ao fluxo sanguíneo na saída do ventrículo determina essa variável. A redução da RVPT pode reduzir a pós-carga.*

Frequência Cardíaca (FC)

- Número de vezes que ocorre o ciclo cardíaco durante 60 segundos.

- A FC é um dos indicadores para avaliação, prescrição e acompanhamento do treinamento aeróbio.



DIFERENTES NOMENCLATURAS
- FC -

- **FC basal**: menor número de bpm quando se está em repouso completo e não interrompido;
- **FC repouso**: número de bpm quando se está em repouso;
- **FC máxima**: maior número de contrações cardíacas por minuto;
- **FC reserva**: diferença entre a FCmáxima e a FCrepouso;
- **FC trabalho**: identificada para prescrição do exercício;

DIFERENTES NOMENCLATURAS

- FC -

- **FC limiar anaeróbio**: corresponde a FC na qual ocorre equilíbrio entre a produção e a remoção de lactato durante o exercício;
- **FC VO_2máx.**: FC na qual se atinge a maior captação de oxigênio;
- **FC recuperação**: número de bpm no pós-exercício.

O que significa a FCrep e o minuto “1” da recuperação (pós-exercício) da FC?

Heart rate recovery after exercise is related to the insulin resistance syndrome and heart rate variability in elderly men

Lars Lind, MD, PhD, and Bertil Andrén *Uppsala, Sweden*

Objective We investigated the associations between heart rate recovery after exercise (as a suggested measure of vagal activity), heart rate variability, and measurements of the insulin resistance syndrome.

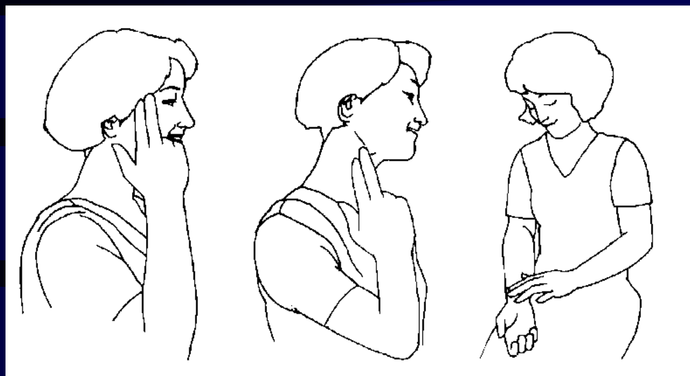
Material and Methods Seventy men aged 70 years were examined with a symptom-limited bicycle exercise test, a 24-hour heart rate variability test, and different measurements of different components of the insulin resistance syndrome.

Results Heart rate recovery after exercise (mean ± SD 20 ± 9 beats during the first minute) was related to both the SD of the R-R interval and the low frequency power at the heart rate variability analyses ($r = 0.39$, $P < .002$ for both). Furthermore, heart rate recovery after exercise was related to insulin sensitivity at the hyperinsulinemic eugleucemic clamp ($r = 0.28$, $P < .03$), and to high-density lipoprotein cholesterol and exercise capacity, and inversely to obesity and insulin and glucose levels 2 hours after an oral glucose load ($P < .05$ for all). Heart rate recovery after exercise was not related to left ventricular mass measured by means of echocardiography or to the number of ventricular premature complexes at a 24-hour Holter recording.

Conclusion Heart rate recovery 1 minute after exercise was related to measurements of 24-hour heart rate variability. Furthermore, heart rate recovery after exercise was related to several of the major components of the insulin resistance syndrome, thereby establishing a link between this syndrome and cardiac autonomic nervous activity. (Am Heart J 2002; 144:666-72.)

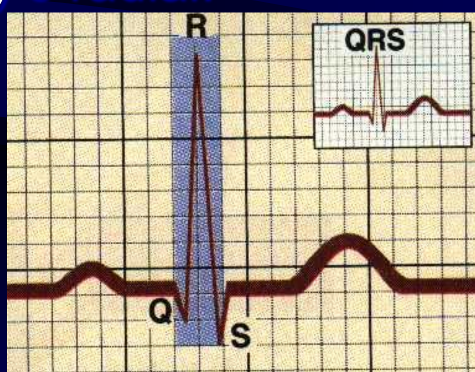
FORMAS DE MEDIÇÃO

As formas mais comuns de medição da freqüência cardíaca são:



Manual - apesar da simplicidade da sua utilização, esta forma de medição não apresenta resultados seguros.

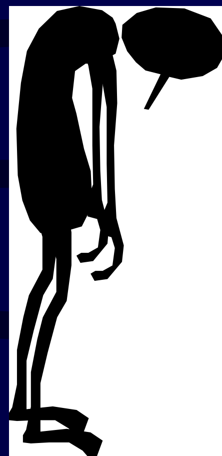
Tomada da freqüência do pulso nas artérias temporal, carótida (limitação) e radial.



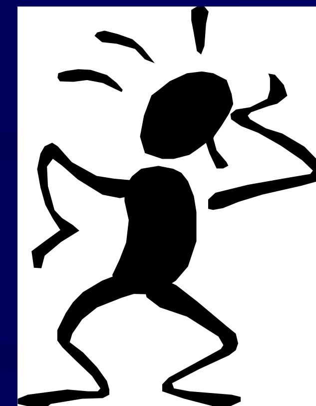
Eletrocardiograma - um aparelho detecta e registra graficamente os impulso elétricos gerados pelo coração.

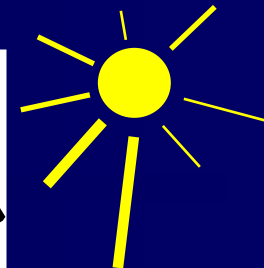
Monitor de freqüência cardíaca - uma cinta torácica com dois eletrodos registram as mudanças elétricas no coração, transmitindo-as através de um campo eletromagnético para um monitor de pulso.

ALGUNS FATORES QUE ALTERAM A FC



FADIGA

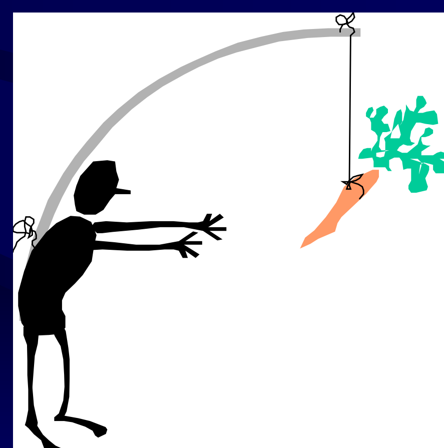




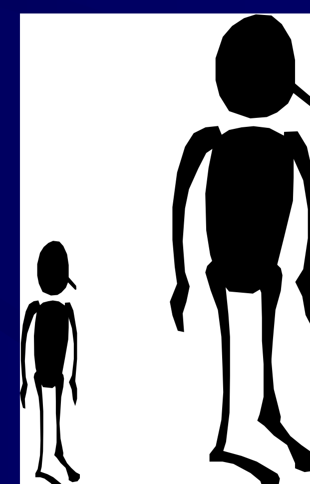
+ C°

CALOR

POSIÇÃO



MOTIVAÇÕES



IDADE

Relação VO_2 x FC

Notem o comportamento da FC para uma mesma quantidade de VO_2 após período de treinamento

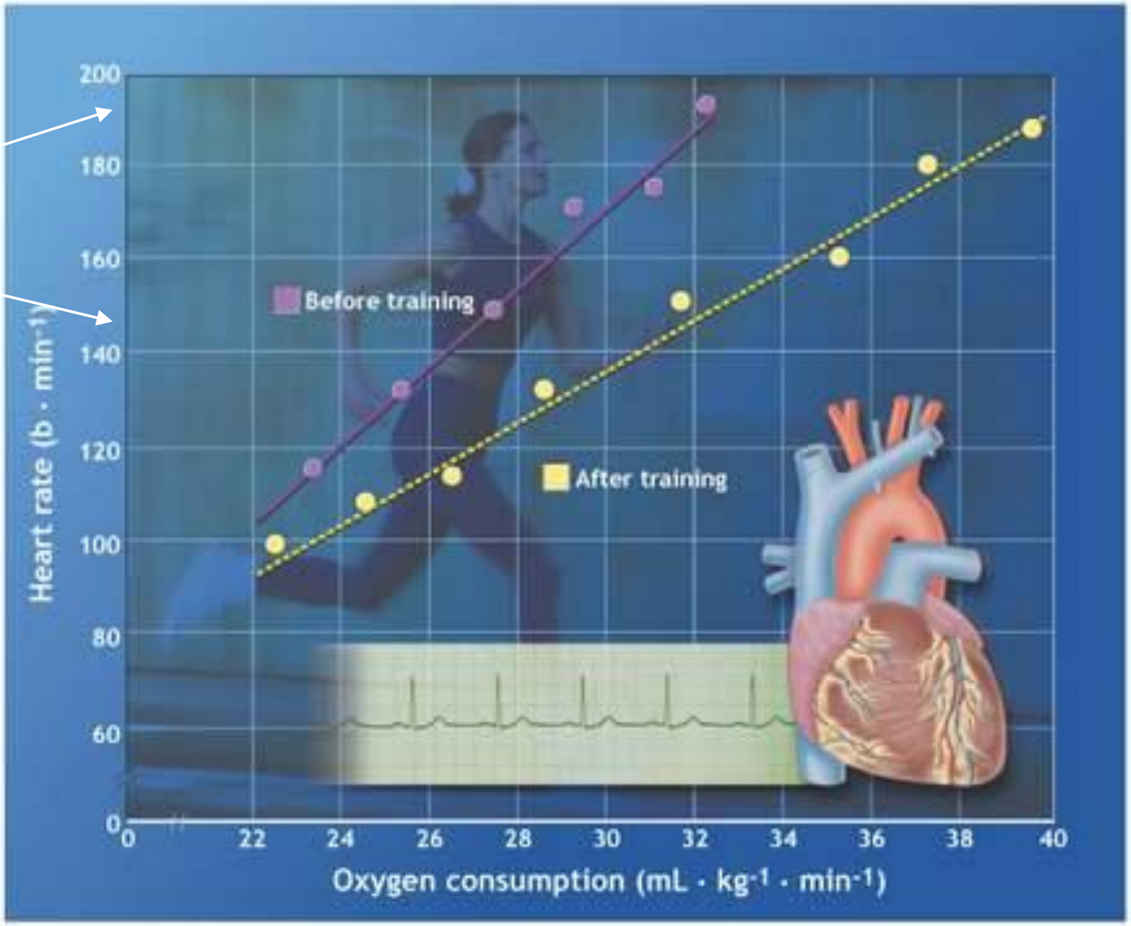
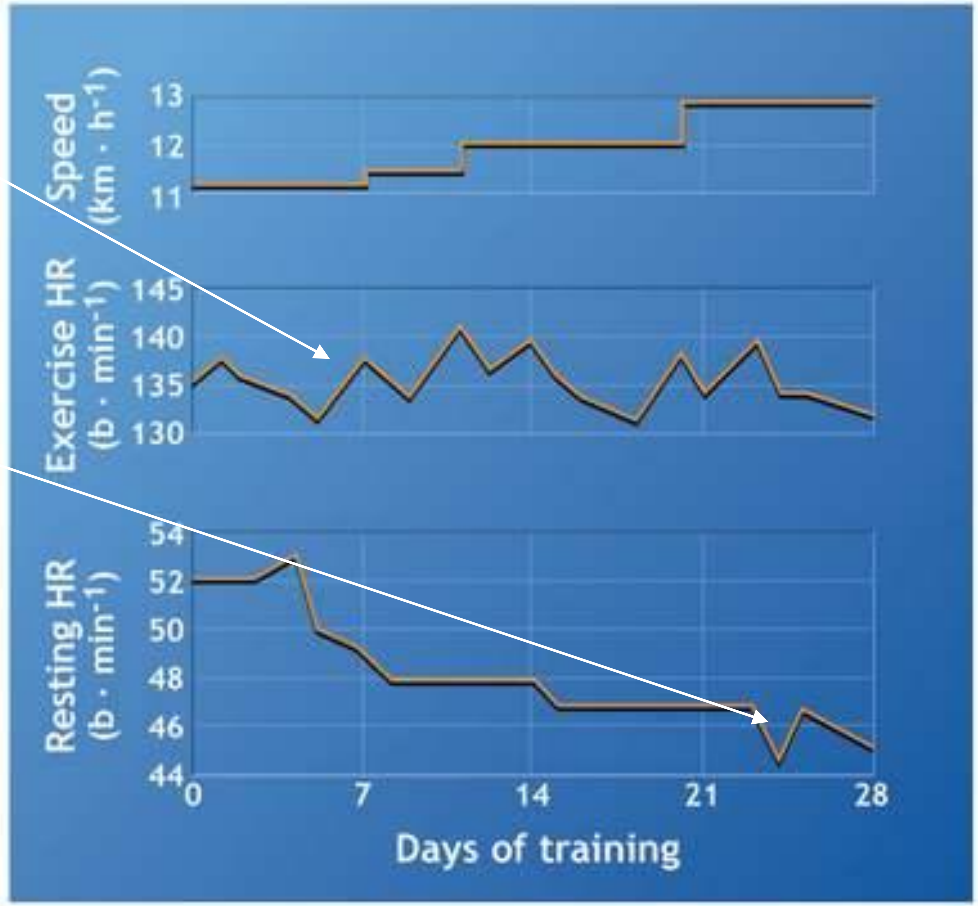


Figure 21.17. Improvements in heart rate response with aerobic training in relation to oxygen consumption. A significant reduction in exercise heart rate with training usually reflects an enhanced stroke volume.

Aprimoramento fisiológico...

Notem a redução da FC de repouso ao longo de 28 dias de treinamento e consequente redução do Custo da FC



unfig 15.1. The concept and computations developed by Karvonen for establishing effective training intensity threshold using HR significantly impacted the study of exercise training.

FATORES QUE REGULAM O DÉBITO CARDÍACO

Débito cardíaco DC = **Frequência Cardíaca FC** X **Volume de Ejeção VE**

Nervos parassimpáticos

Nervos simpáticos

Força de contração

Volume diastólico final

Pressão arterial média

Frank-Starling

Observe:
Variáveis que estimulam o débito cardíaco = setas contínuas
Variáveis que reduzem o débito cardíaco = setas tracejadas

DÉBITO CARDÍACO

Q (L/min) = VE (ml) x FC (b/min)

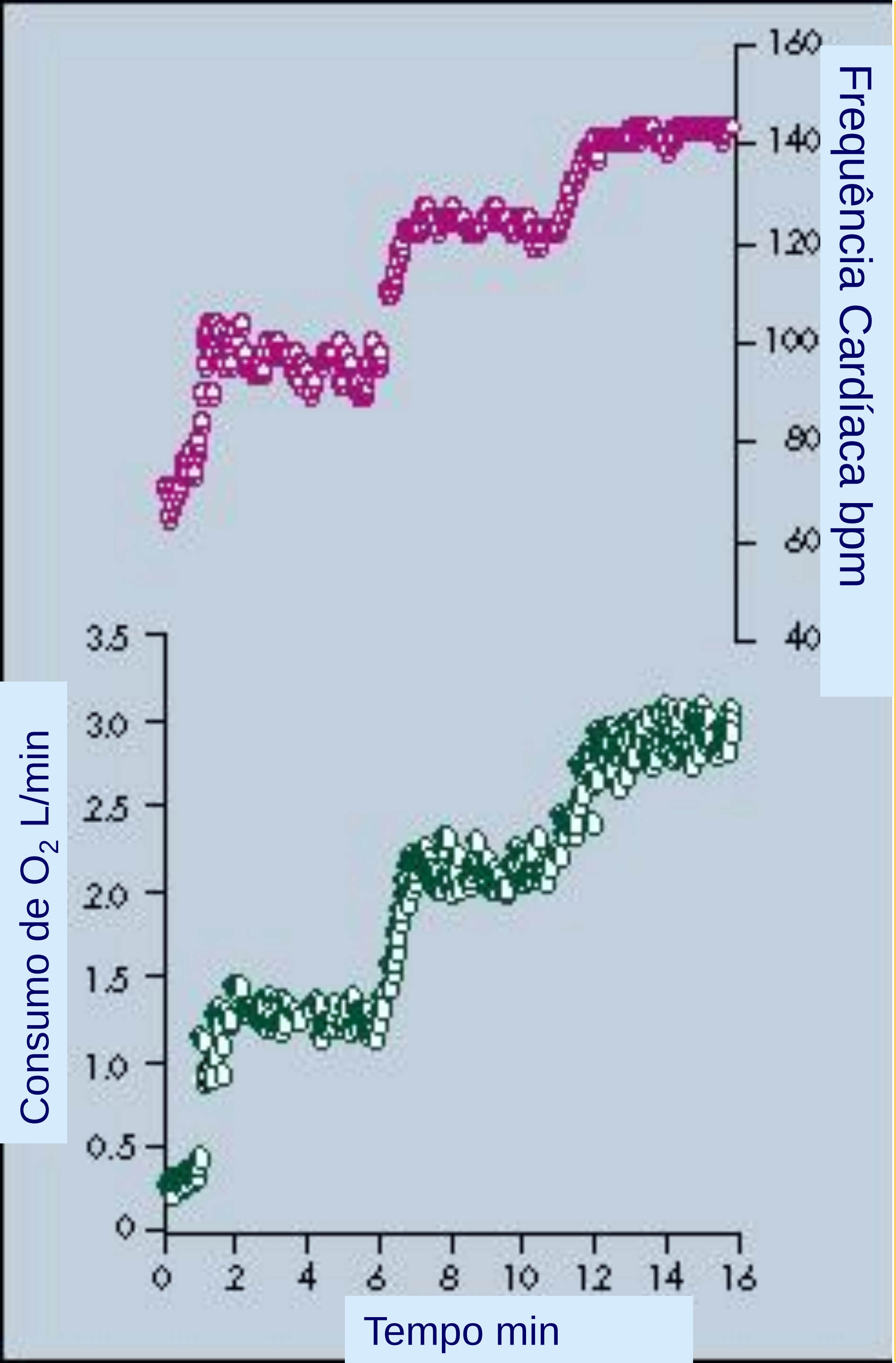
Exemplo:

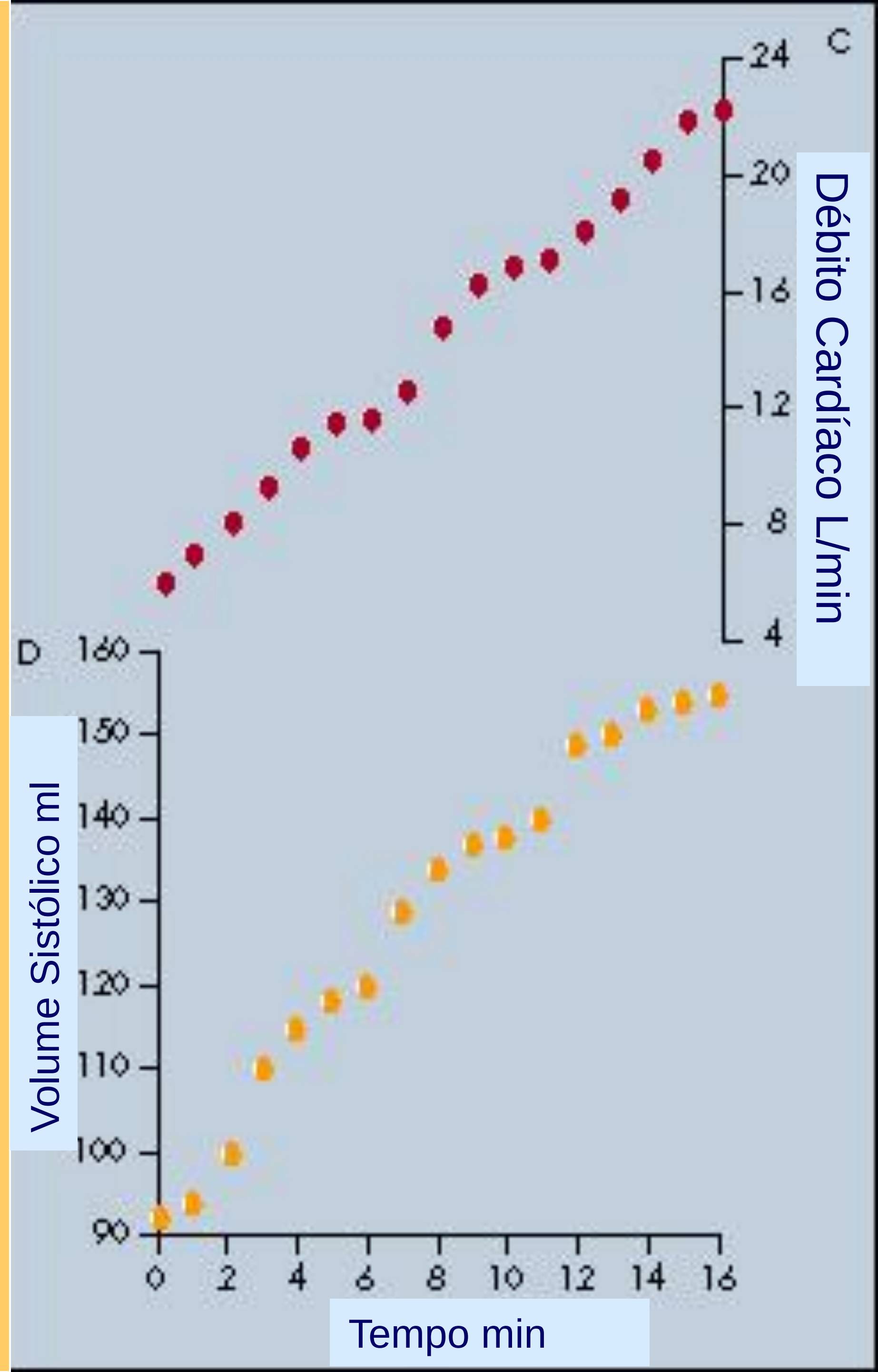
Repouso		
	DC =	FC x VE
Destreinados	5.000 =	70bpm x 71ml
Treinados	5.000 =	50bpm x 100ml

VO_2

DC

Dif a-v O_2


Frequência Cardíaca bpm
160
140
120
100
80
60
40
Consumo de O2 L/min
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0 2 4 6 8 10 12 14 16
Tempo min


C
Débito Cardíaco L/min
24
20
16
12
8
4
D
Volume Sistólico ml
160
150
140
130
120
110
100
90
0 2 4 6 8 10 12 14 16
Tempo min

Estimativa da Vmáx pelo Custo de FC

Rev Andal Med Deporte. 2015;8(1):7–15

Revista Andaluza de
Medicina del Deporte

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Original

Máxima velocidade aeróbia calculada pelo custo da frequência cardíaca: relação com a performance

D.F. da Silva[a], R.C. Sotero[b], H.G. Simões[b] e F.A. Machado[a,*]

[a] Departamento de Educação Física, Universidade Estadual de Maringá, Maringá – PR, Brasil
[b] Departamento de Educação Física, Universidade Católica de Brasília, Brasília – DF, Brasil

Tabela 2
Valores médios ± desvio padrão (DP) da MVA obtida diretamente (V_{pico}) e indiretamente pelo CR (vVO_{2max}) e o CFC (vFC_{max}) com base nos métodos de Di Prampero[7] e Lacour et al.[11,12], para todos os participantes, G1 e G2

Variáveis	Di Prampero[7]	Lacour et al.[11,12]	V_{pico} ($km\,h^{-1}$)
30 a 49 anos (n = 21)			
vVO_{2max} ($km\,h^{-1}$)	15,1 ± 1,7†,*	15,5 ± 1,7†	14,9 ± 1,4†,*
vFC_{max} ($km\,h^{-1}$)	13,3 ± 1,5	14,9 ± 1,9†	
30 a 40 anos (n = 9)	Di Prampero[7]	Lacour et al.[11,12]	
vVO_{2max} ($km\,h^{-1}$)	15,3 ± 1,9†,*	15,7 ± 1,9†	14,9 ± 1,3*
vFC_{max} ($km\,h^{-1}$)	13,3 ± 1,5	14,6 ± 1,6†	
41 a 49 anos (n = 12)	Di Prampero[7]	Lacour et al.[11,12]	
vVO_{2max} ($km\,h^{-1}$)	15,0 ± 1,6†,*	15,4 ± 1,6†	14,9 ± 1,5†
vFC_{max} ($km\,h^{-1}$)	13,4 ± 1,6	15,1 ± 2,1†	

* Diferença significante ($p < 0{,}05$) para a vVO_{2max} proposta por Lacour et al.[7].
† Diferença significante ($p < 0{,}05$) para a vFC_{max} proposta por Moreno[16] seguindo o modelo proposto inicialmente por Di Prampero[7] para a variável VO_2.

Lacour et al.[11,12]:

$$vFC_{max} = (FC_{max} - FC_{rep}) \times CFC^{-1}$$

$$CFC = (FC_{vsub} - FC_{rep}) \times v^{-1}$$

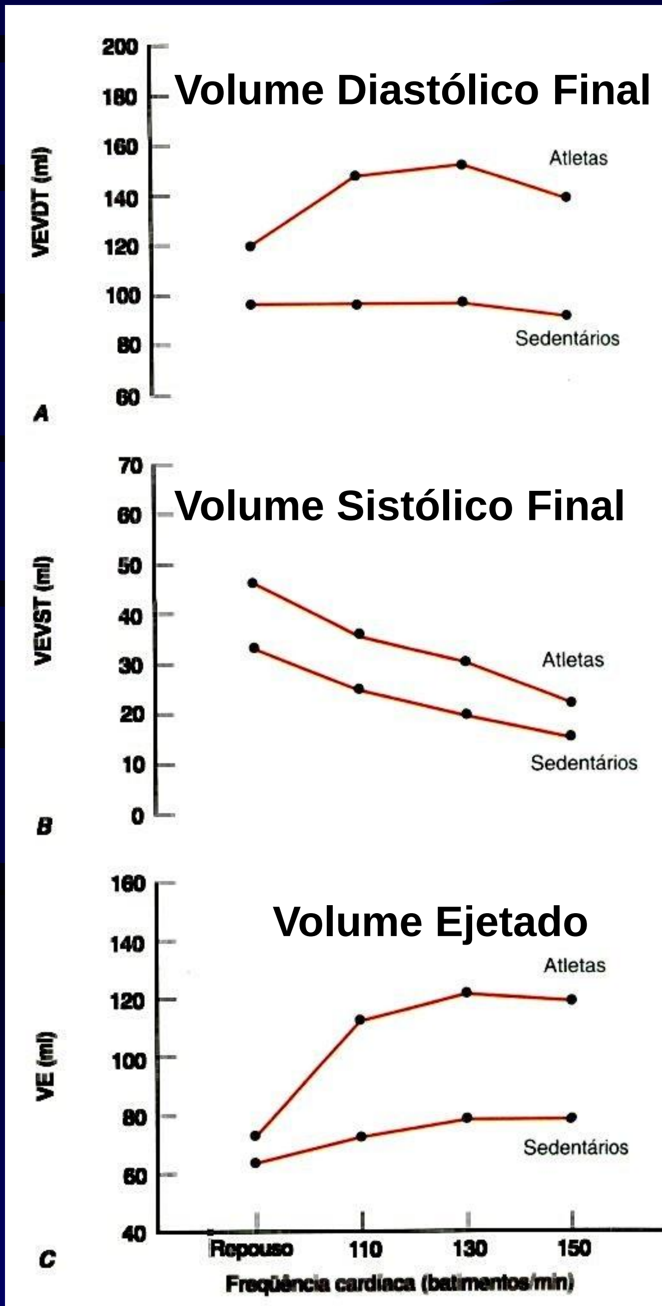
Na qual FC_{vsub} é a FC associada a uma velocidade submáxima referente a 75% do VO_{2max}[7], que correspondeu a 85,2 ± 3,9% da FC_{max} da amostra estudada.

Custo FC: (FCex – FCrep) / Vel ex.

Vmáx: (FCmáx – FCrep) / Custo FC

Volume Ejetado

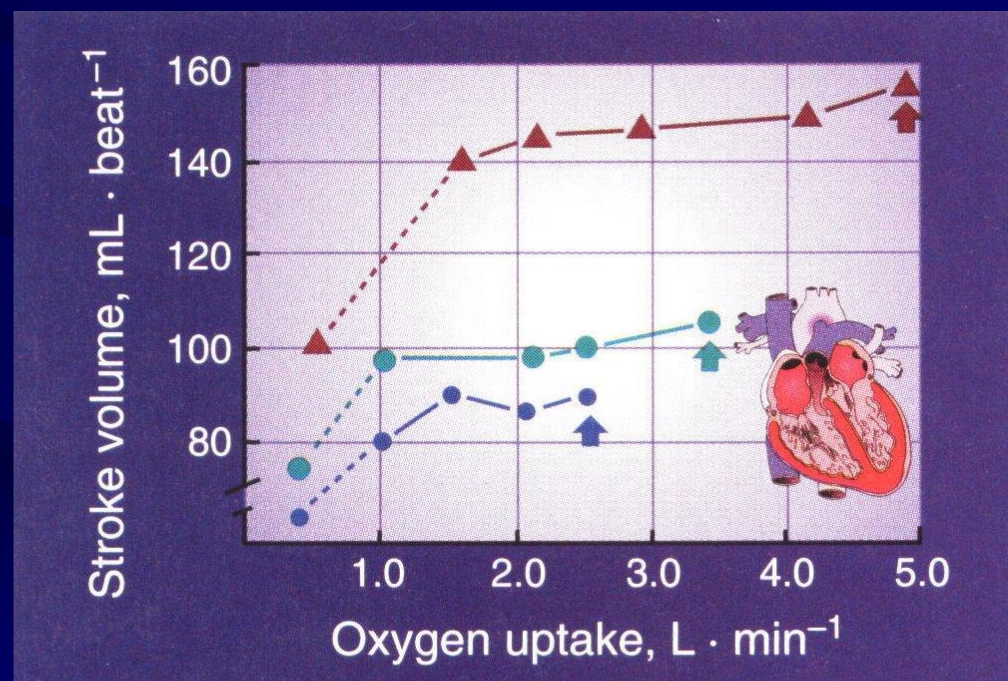
(Vej) (ml)



▲ Fundista

● Jovem (pré-T)

● Jovem (pós-T)



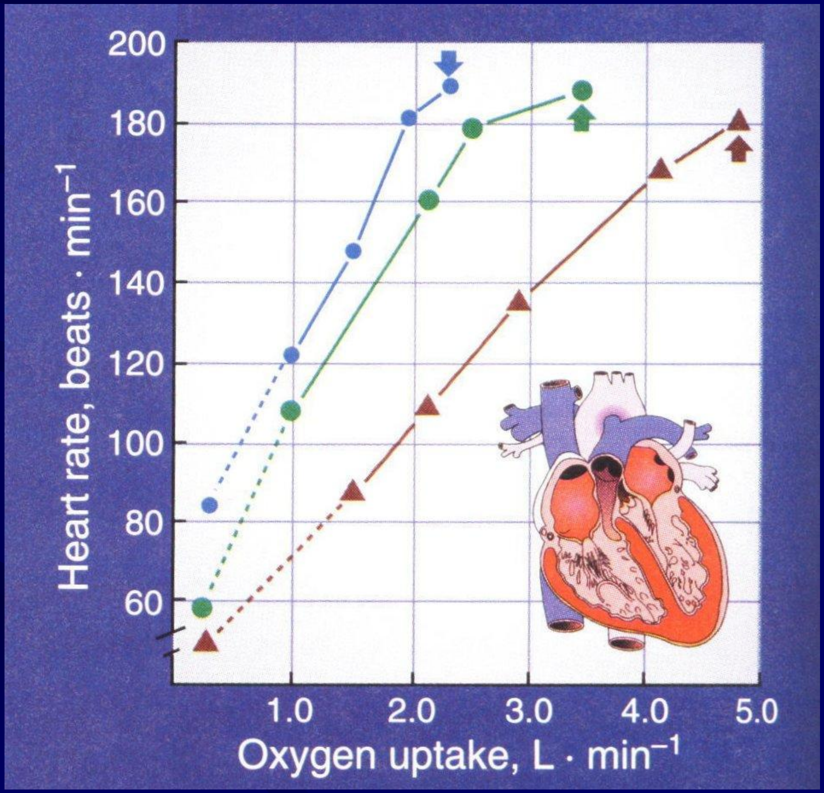
Frequência Cardíaca (FC)

(bpm)

Fundista

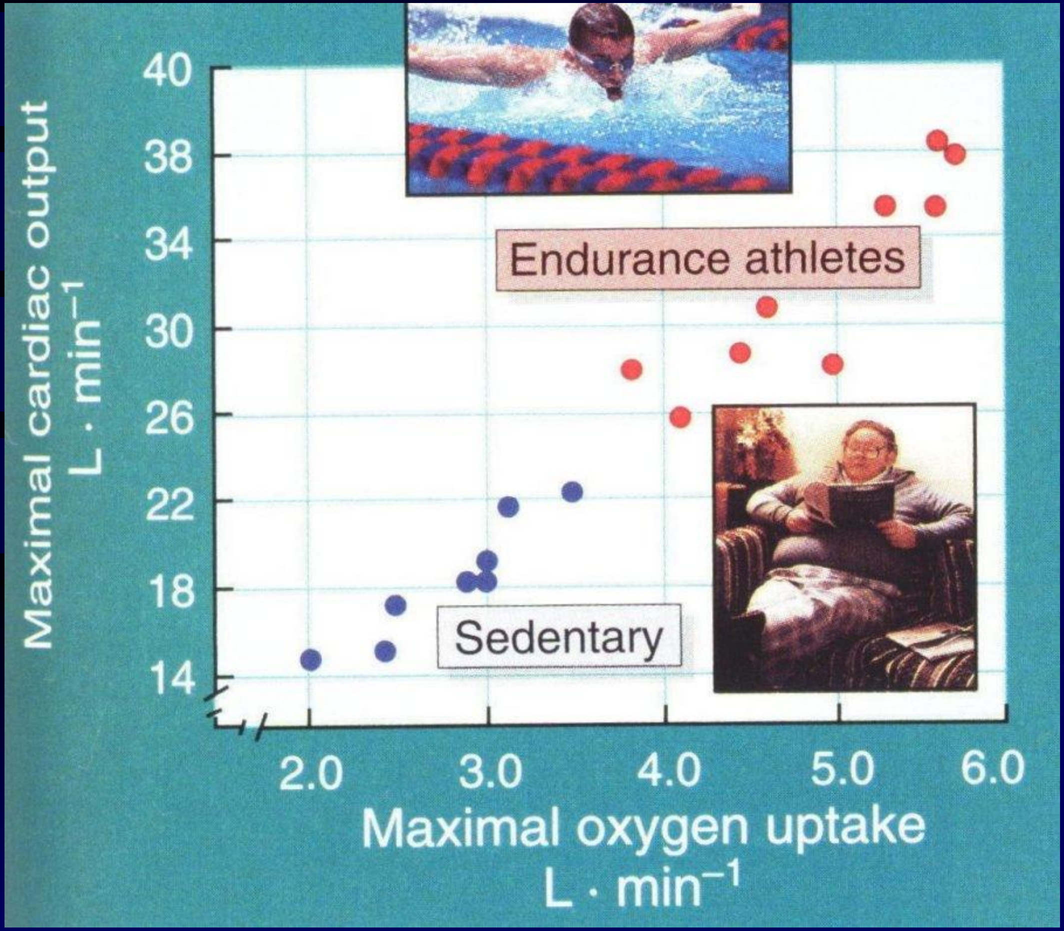
Jovem (pré-T)

Jovem (pós-T)



Débito Cardíaco Máximo* (DCmáx)

(l/min)



Ventilação (V_E)

- Volume de ar mobilizado pelos pulmões por um processo de fluxo, expresso em Litros/minuto.

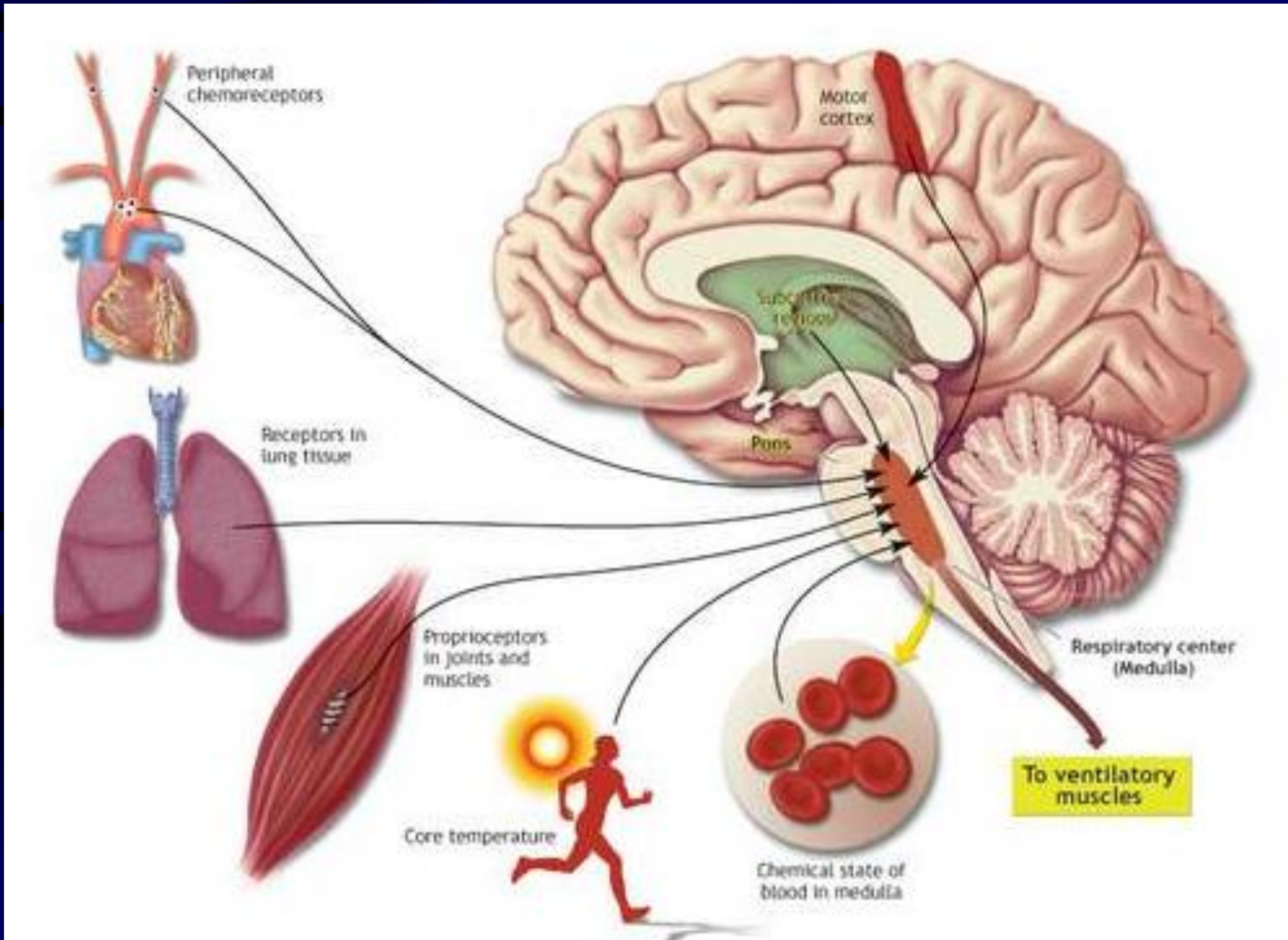
- Depende da profundidade a da freqüência da respiração;

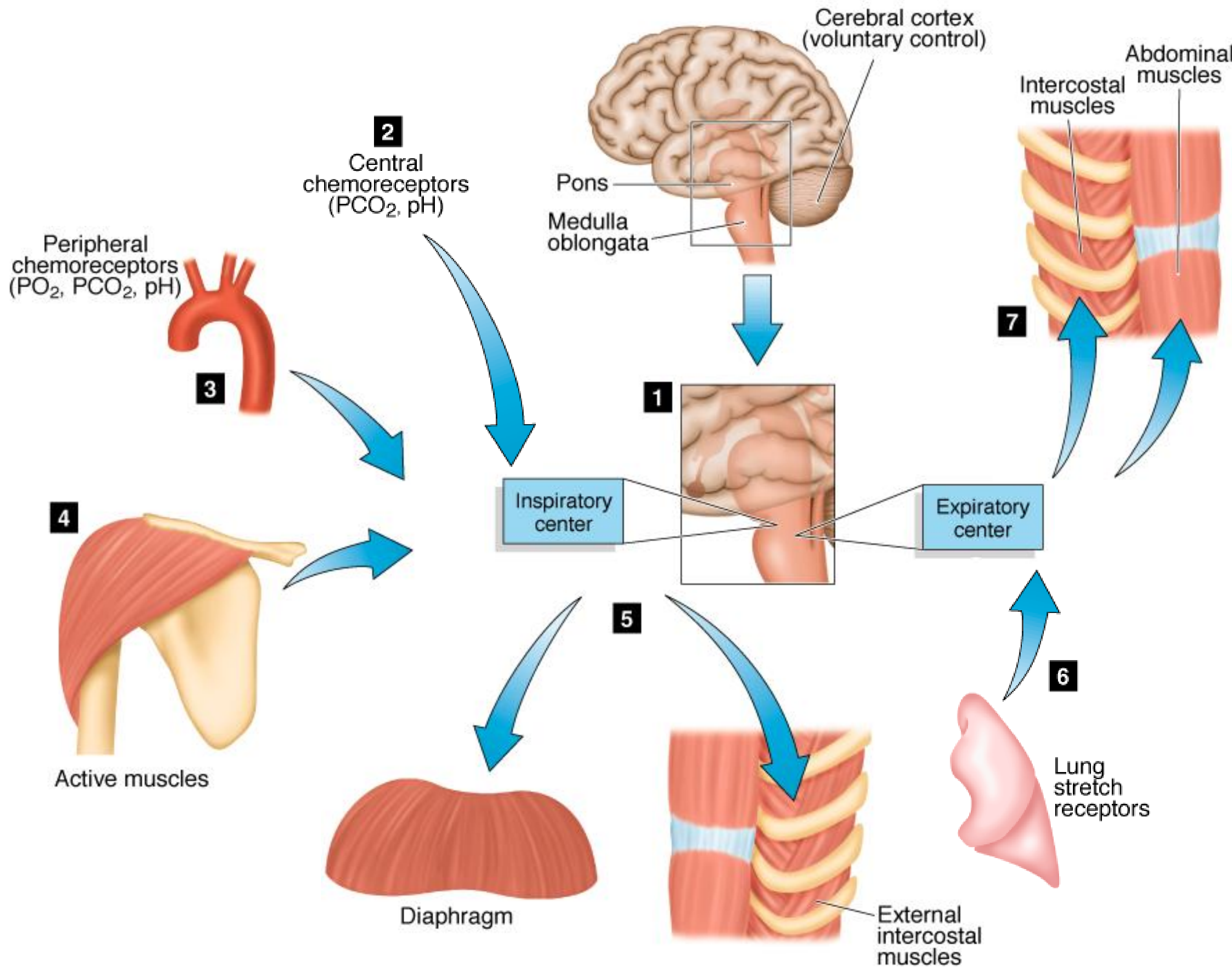
- VE (L/min) = Volume Corrente (L) x Freqüência Respiratória (frm);

Repouso: V_E (L/min) = 12 (frm) x 0.5 (L) = 6 L/min

Exercício máximo: V_E (L/min) = 60 (frm) x 3.0 (L) = 180 L/min

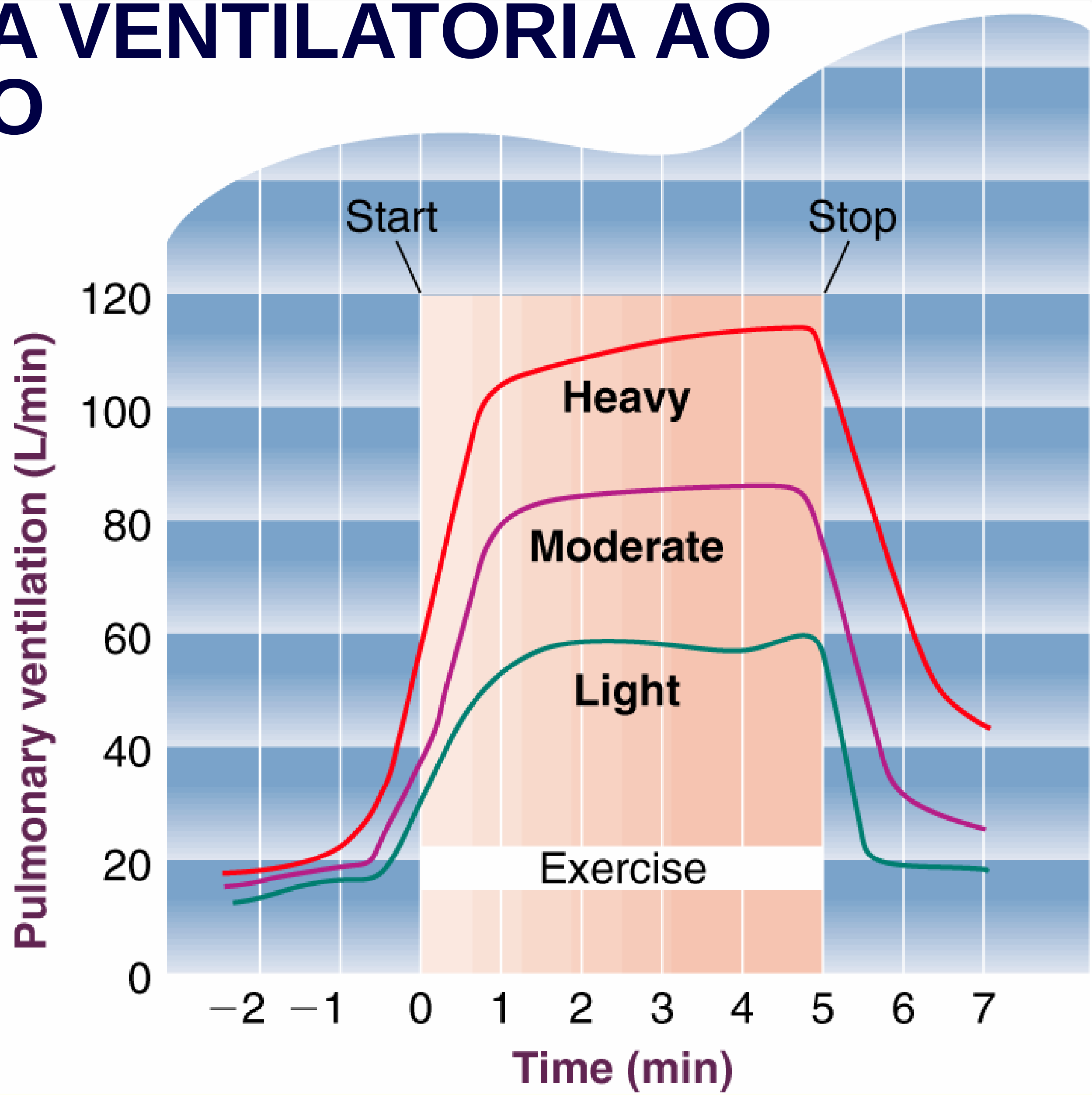
- Exercícios submáximos aumentam VE predominantemente por aumento do VC, e intensos por aumentos da FR.


Peripheral chemoreceptors
Motor cortex
Pons
Receptors in lung tissue
Proprioceptors in joints and muscles
Core temperature
Chemical state of blood in medulla
Respiratory center (Medulla)
To ventilatory muscles



Cerebral cortex (voluntary control)
Pons
Medulla oblongata
Abdominal muscles
Intercostal muscles
2
Central chemoreceptors (PCO_2, pH)
Peripheral chemoreceptors (PO_2, PCO_2, pH)
3
1
7
Inspiratory center
Expiratory center
4
5
6
Active muscles
Diaphragm
Lung stretch receptors
External intercostal muscles

RESPOSTA VENTILATÓRIA AO EXERCÍCIO

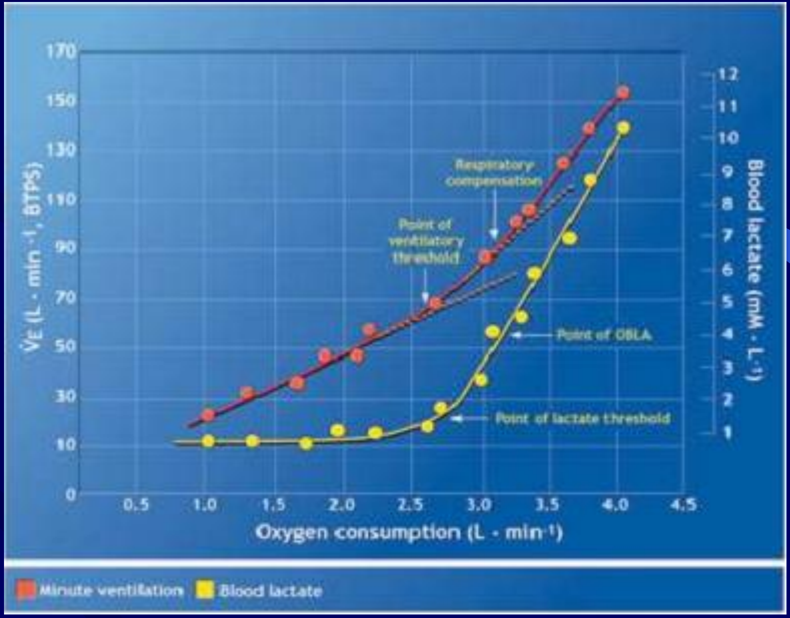


Pesquisa Clínica na EF

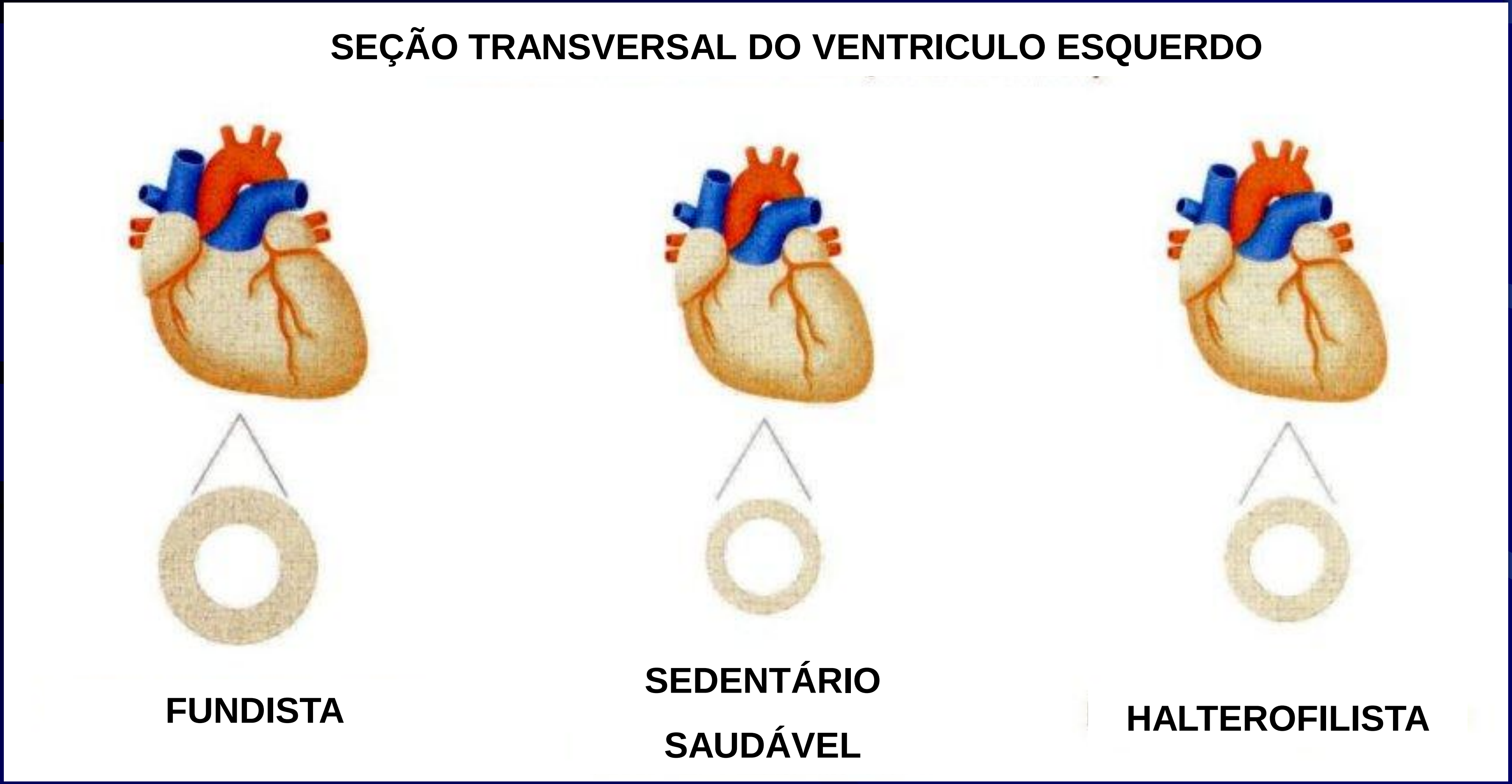
Detecting the Threshold of Anaerobic Metabolism in Cardiac Patients During Exercise*

Karlman Wasserman, M.D.† and Malcolm B. McIlroy, M.D.‡
Palo Alto and San Francisco, California

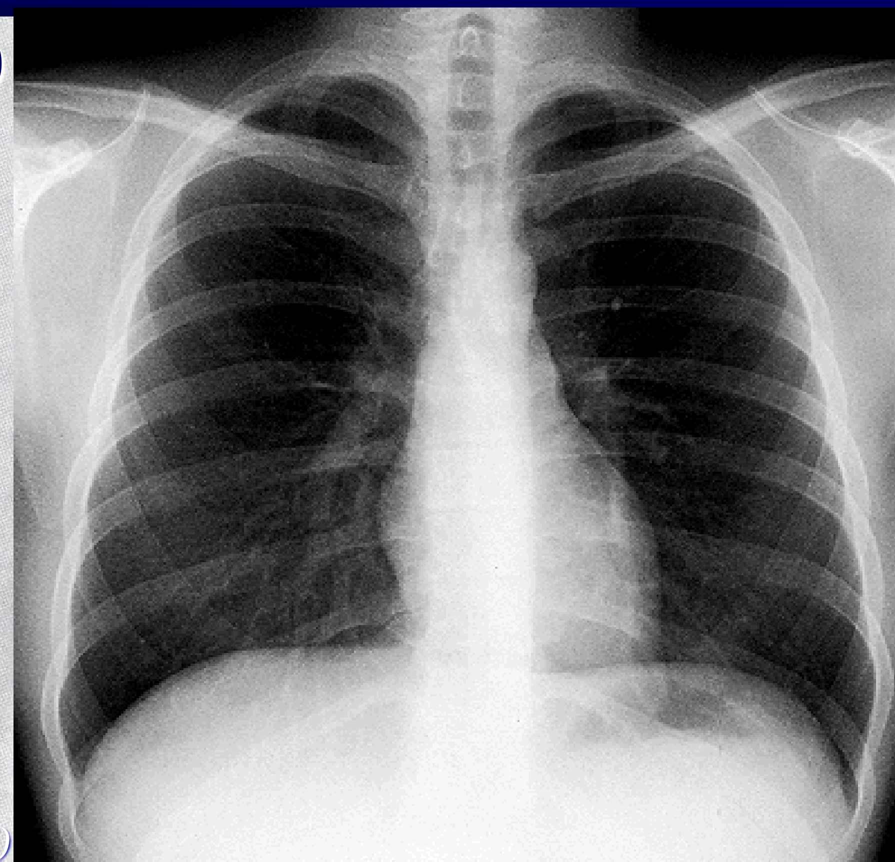
Am J Cardiol. 1964; 14: 844-852.



Dimensões do Coração



Massa do Ventrículo Esquerdo



Maior coração com vol. cardíaco de 1700 ml, sem nenhuma patologia.

VO_2 Máximo (VO_2max)

Table 13.1 $\dot{V}O_2$ max values measured in healthy and diseased populations

Population	Males	Females
Cross-country skiers	84	72
Distance runners	83	62
Sedentary: young	45	38
Sedentary: middle-aged adults	35	30
Post myocardial infarction patients	22	18
Severe pulmonary disease patients	13	13

Values are expressed in $ml \cdot kg^{-1} \cdot min^{-1}$. Taken from Saltin and Astrand (34), Astrand and Rodahl (3), and Howley and Franks (21).

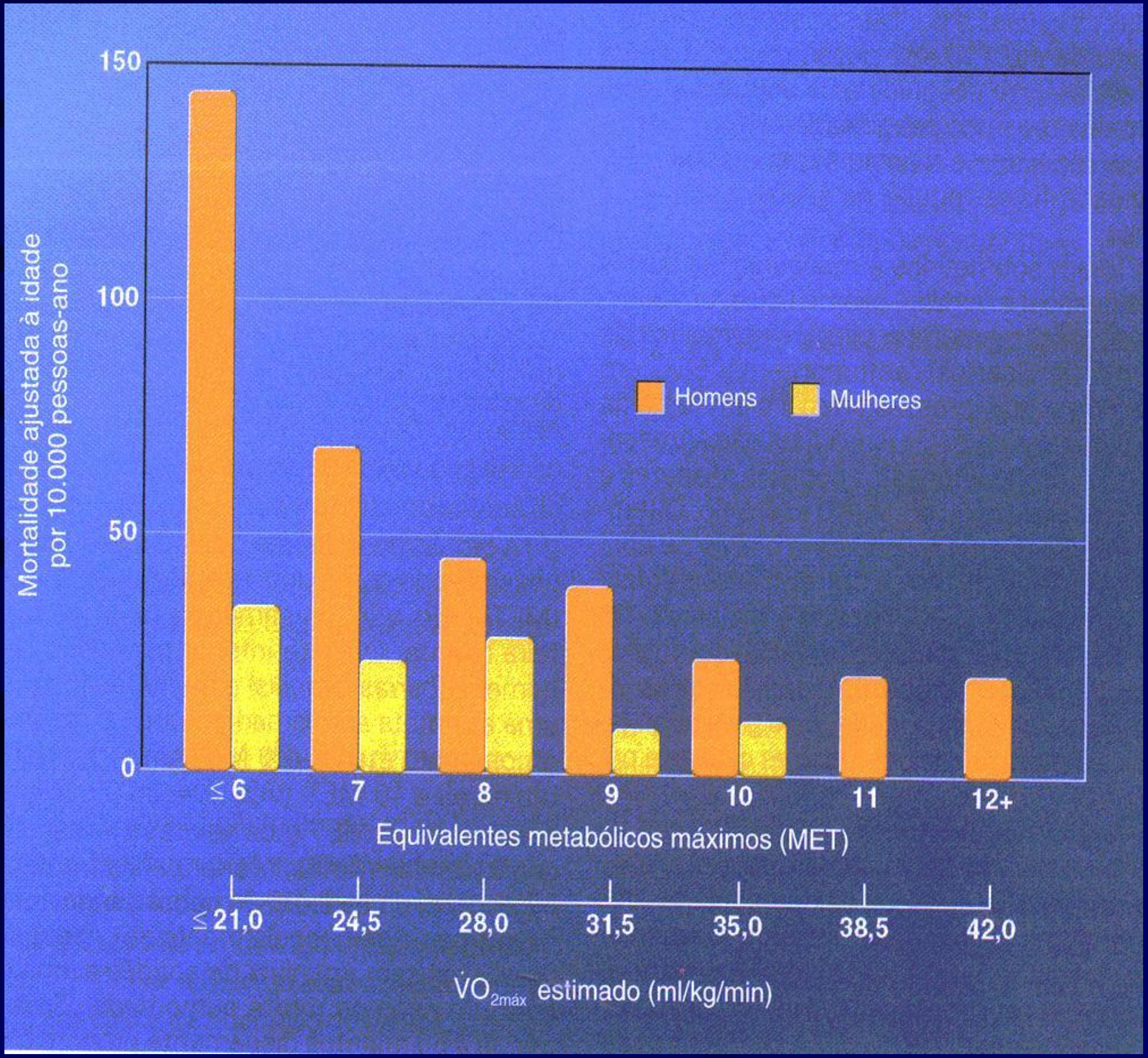
VO_2 Máximo (VO_2max)

Table 19–2. Standard Values for $\dot{V}O_{2max}$ in mL/kg/min*

Rating	Age (yrs) 20–29	30–39	40–49	50–59	60 +
Men					
Excellent	>51	>48	>46	>42	>40
Good	49–51	46–48	44–46	40–42	38–40
Average	42–48	39–45	37–43	33–39	31–37
Fair	39–41	36–38	34–36	30–32	28–30
Poor	<39	<36	<34	<30	<28
Women					
Excellent	>42	>39	>37	>33	>33
Good	40–42	37–39	35–37	31–33	31–33
Average	33–39	31–36	29–34	25–30	25–30
Fair	30–32	28–30	26–28	22–24	22–24
Poor	<30	<28	<26	<22	<22

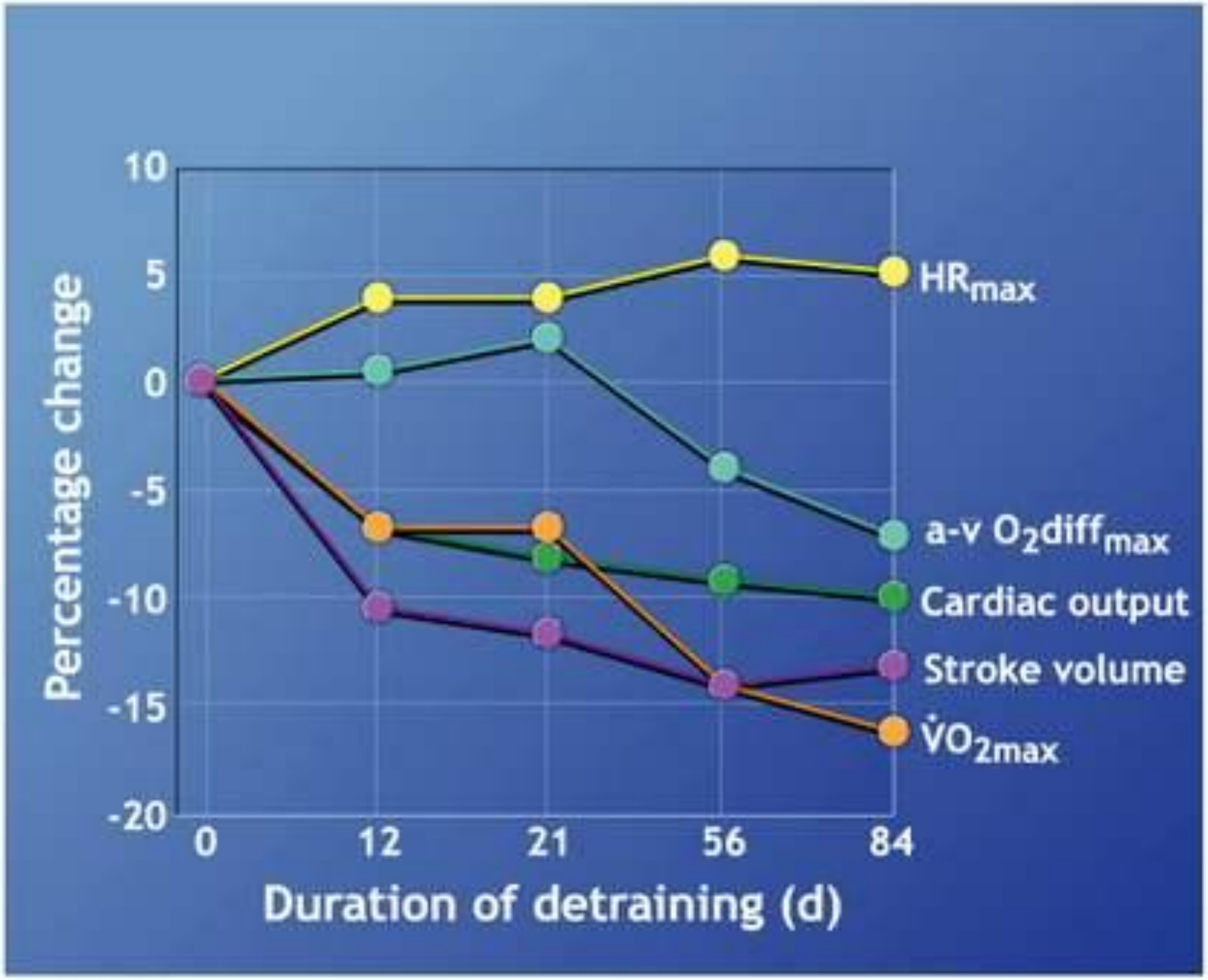
* With permission from Gettman LR: Personal Fitness Profile Database. National Health Enhancement Systems. Phoenix, AZ. 1987.

VO_2 Máximo (VO_2max)

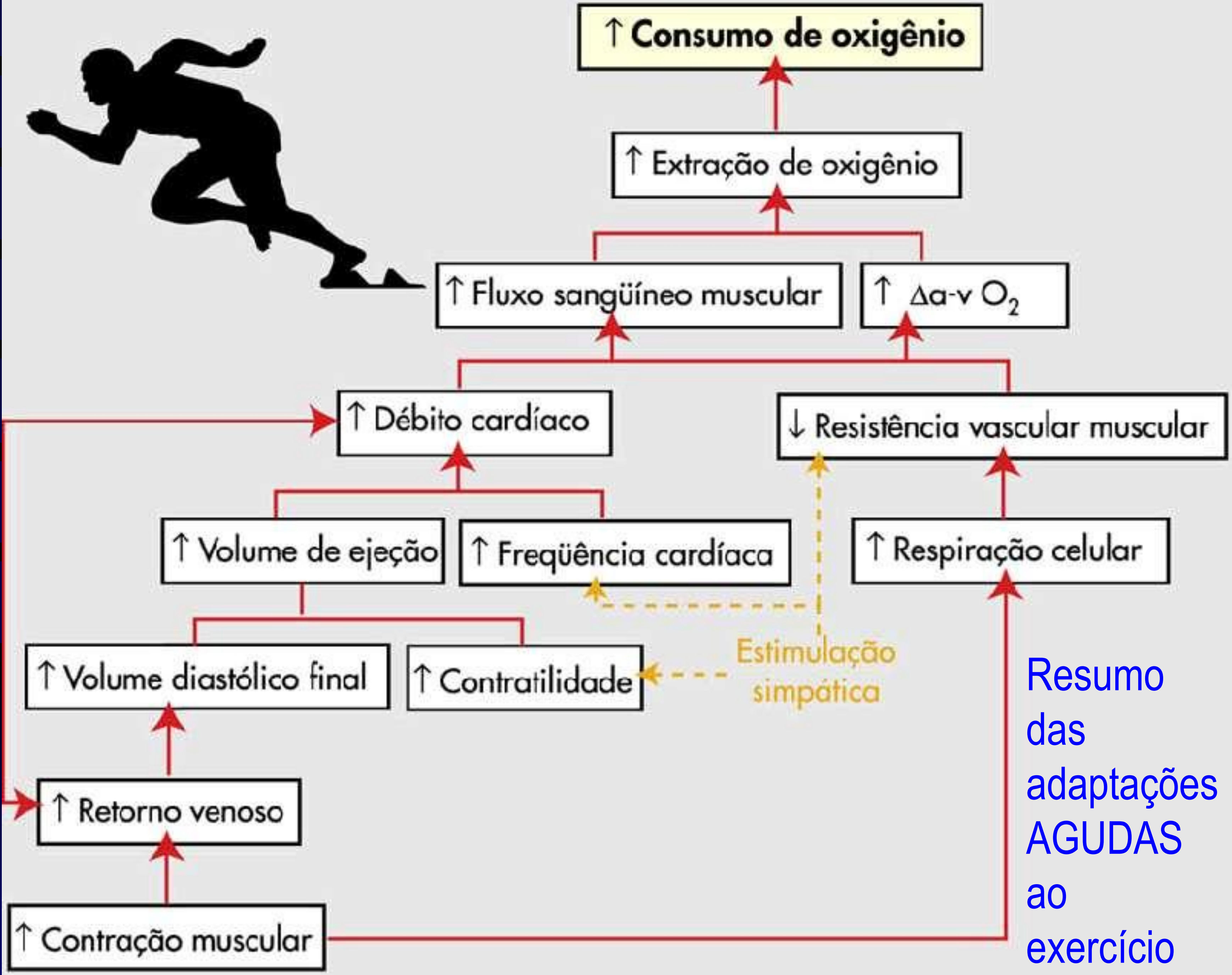


(Blair et al. - JAMA, 1989)

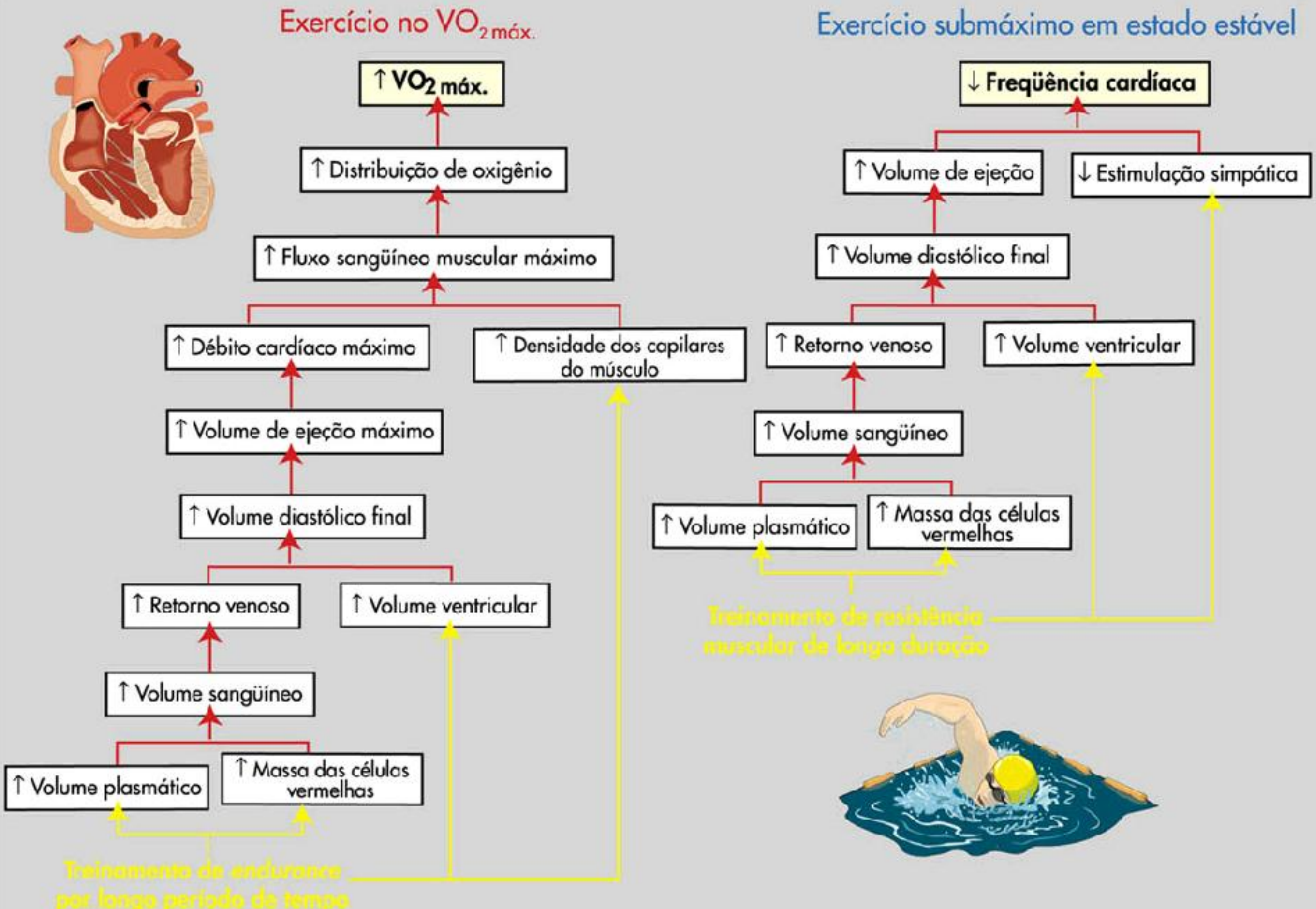
Destreinamento



unfig 17.1. Average changes in maximum heart rate (HR_{max}), stroke volume, arteriovenous oxygen differences ($a\text{-}\bar{v}\ O_2\ diff_{max}$), cardiac output, and $\dot{V}O_{2max}$ over 84 days of detraining.



Resumo das adaptações AGUDAS ao exercício



Resumo das adaptações CRÔNICAS ao treinamento de resistência

Effects of High-Intensity Endurance Training on Maximal Oxygen Consumption in Healthy Elderly People

Håvard Østerås
Sør-Trøndelag University College
Jan Hoff
Jan Helgerud
Norwegian University of Science and Technology

2005

- 21 idosos (69,7)
- Exercício (n = 10)
- Controle (n = 11)
- Sessão: 60 min
- 3 x por semana
- 10 semanas
- 4 sessões 85-95 $FC_{máx}$
- descanso = 4min

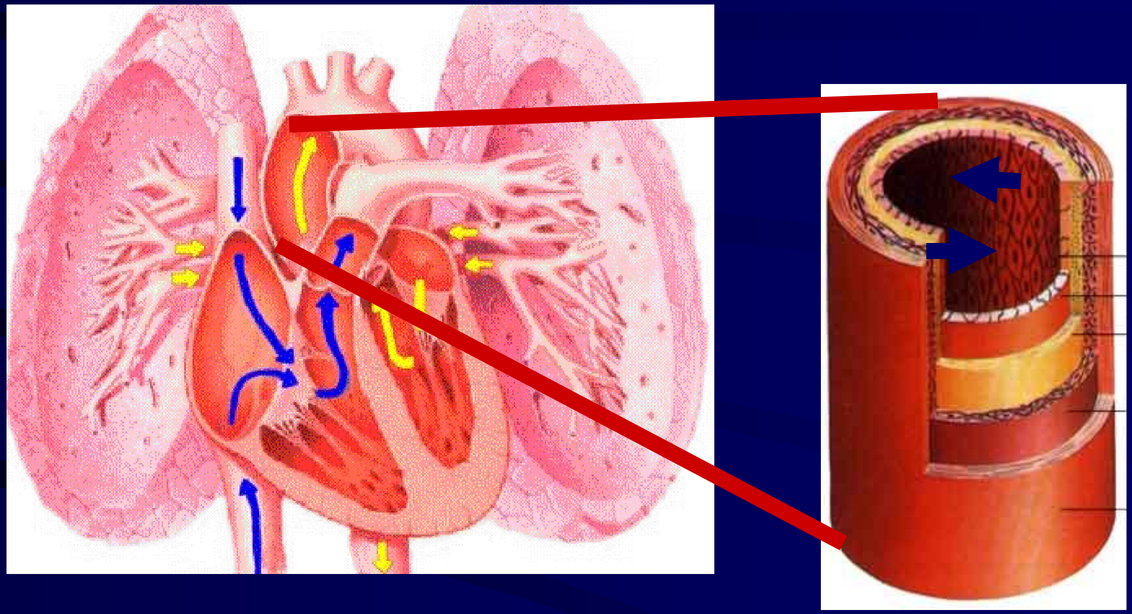
Table 2. Results From Endurance Testing Before and After 10 Weeks of High-Intensity Training

	Experimental Group (n = 10)				*Control Group (n = 11)*			
	Pretest		*Posttest*		*Pretest*		*Posttest*	
Variable	M	SD	M	SD	M	SD	M	SD
VO_{2max} ($l \times min^{-1}$)	1.89	0.39	2.14*	0.40	1.94	0.54	1.95	0.53
VO_{2max} ($ml \times kg^{-1} \times min^{-1}$)	24.2	2.5	27.8*	2.3	26.7	6.4	26.2	6.2
VO_{2max} ($ml \times kg^{-0.75} \times min^{-1}$)	71.5	8.9	82.3*	8.6	77.8	18.6	77.7	18.3
C_w ($ml \times kg^{-0.75} \times m^{-1}$) ($4.5\ km \times h^{-1}$)	0.81	0.11	0.77	0.09	0.78	0.09	0.77	0.08
C_w ($ml \times kg^{-0.75} \times m^{-1}$) ($5.5\ km \times h^{-1}$)	0.76	0.12	0.74	0.09	0.75	0.10	0.75	0.10
Body mass (m_b) (kg)	76.6	10.4	76.4	9.7	72.9	12.2	73.4	12.3
Respiratory exchange ratio	1.07	0.05	1.08	0.05	1.09	0.06	1.08	0.06

13,2%

Journal of Applied Gerontology, Vol. 24, No. 5, 377-387 (2005)

Pressão Arterial



✓ É a tensão que o sangue exerce sobre a parede das artérias.

Sintomas PA alta

- ✓ Sensação de peso na nuca;
- ✓ Cefaléia;
- ✓ Tonturas;
- ✓ Visão turva;
- ✓ A maioria dos casos “ASSINTOMÁTICOS”

Classificação Hipertensão

Primária/Essencial

- Não identificado o fator causal;

- 90-95% casos (genética e ambiente).

Secundária (pode ser curada)

- Fator causal conhecido;

- 5-10% casos.

Tabela 5 - Valores de pressão arterial no consultório, MAPA, AMPA e MRPA que caracterizam efeito do avental branco, hipertensão do avental branco e hipertensão mascarada

	Consultório	MAPA vigília[25]	AMPA	MRPA
Normotensão ou hipertensão controlada	<140/90	≤130/85	≤130/85	≤130/85
Hipertensão	≥140/90	>130/85	>130/85	>130/85
Hipertensão do avental branco	≥140/90	<130/85	<130/85	<130/85
Hipertensão mascarada	<140/90	>130/85	>130/85	>130/85

Tabela 6 - Classificação da pressão arterial de acordo com a medida casual no consultório (> 18 anos)

Classificação	Pressão sistólica (mmHg)	Pressão diastólica (mmHg)
Ótima	< 120	< 80
Normal	< 130	< 85
Limítrofe*	130–139	85–89
Hipertensão estágio 1	140–159	90–99
Hipertensão estágio 2	160–179	100–109
Hipertensão estágio 3	≥ 180	≥ 110
Hipertensão sistólica isolada	≥ 140	< 90

Quando as pressões sistólica e diastólica situam-se em categorias diferentes, a maior deve ser utilizada para classificação da pressão arterial.

** Pressão normal-alta ou pré-hipertensão são termos que se equivalem na literatura.*

Recomenda-se a avaliação médica antes do início de um programa de treinamento estruturado e sua interrupção na presença de sintomas. Em hipertensos, a sessão de treinamento não deve ser iniciada se as pressões arteriais sistólica e diastólica estiverem superiores a 160 e/ou 105 mmHg respectivamente.

PA durante o Exercício

Parar: >180/105 mmHg

PA medida imediatamente pós-exercício
Subestima em 30% a PA de durante

VI Diretrizes Brasileiras de Hipertensão (2010)

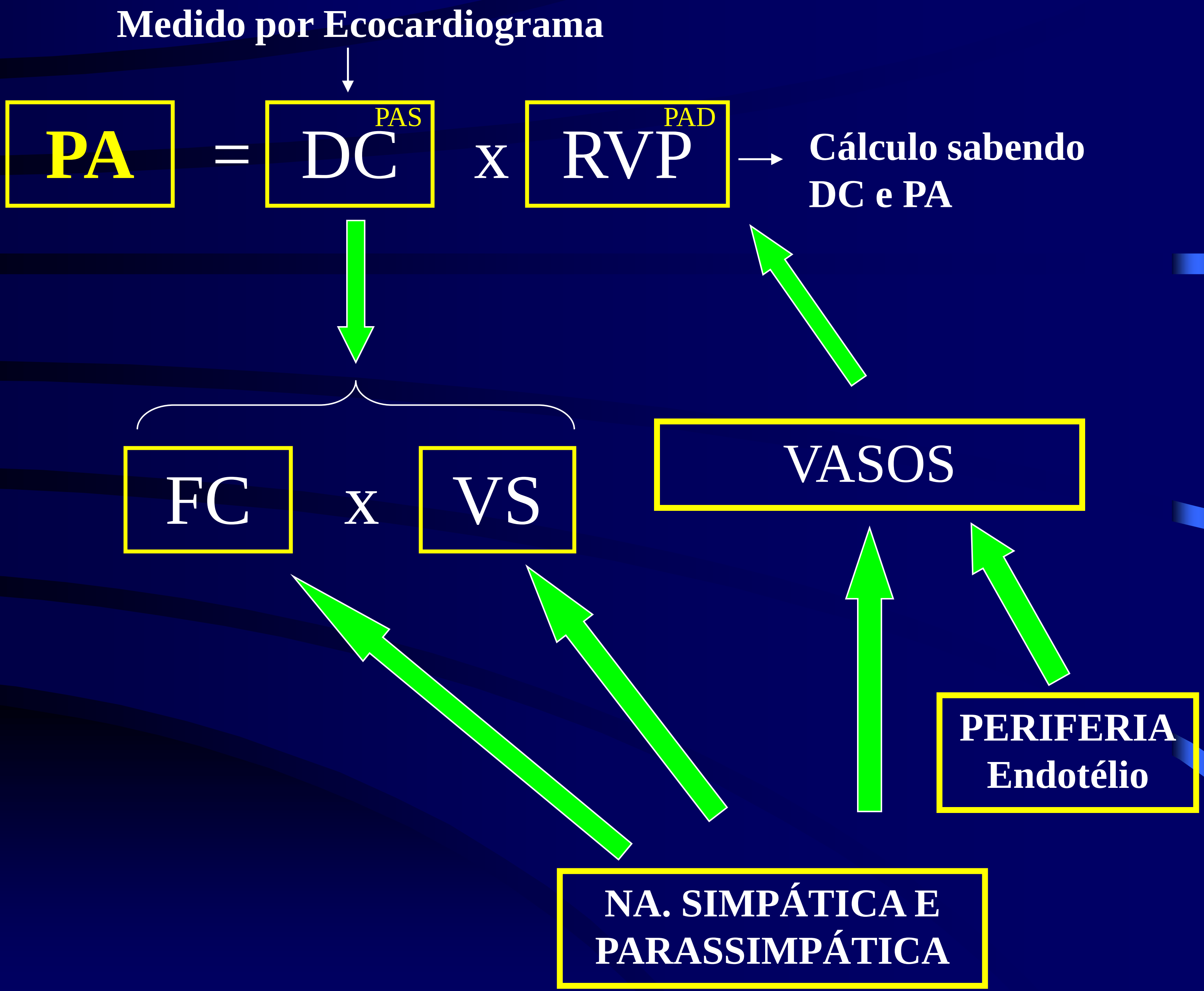
Medidas da MAPA

- PA período TOTAL (mmHg) Anormal: >120/75
- PA período VIGÍLIA (mmHg) Anormal: >130/85
- PA período SONO (mmHg) Anormal: >110/70

- Pico PA período TOTAL (mmHg)
- Pico PA período VIGÍLIA (mmHg)
- Pico PA período SONO (mmHg)

- Carga pressórica período TOTAL (%)
- Carga pressórica período VIGÍLIA (%)
- Carga pressórica período SONO (%)

- Descenso de sono (%) <10% / 10-20% / >20%
- Ascensão Matinal (mmHg)



Medido por Ecocardiograma
PA
=
DC
PAS
x
RVP
PAD
Cálculo sabendo DC e PA
FC
x
VS
VASOS
PERIFERIA
Endotélio
NA. SIMPÁTICA E PARASSIMPÁTICA

European Heart Journal (2006) 27, 2387–2393
doi:10.1093/eurheartj/ehl259

EUROPEAN SOCIETY OF CARDIOLOGY®

Review

High heart rate: a cardiovascular risk factor?

Stéphane Cook[1], Mario Togni[1], Marcus C. Schaub[2], Peter Wenaweser[1], and Otto M. Hess[1]*

[1] *Department of Cardiology, Swiss Cardiovascular Center, University Hospital, Freiburgstrasse, 3010 Bern, Switzerland and* [2] *Institute of Pharmacology, University of Zurich, Zurich, Switzerland*

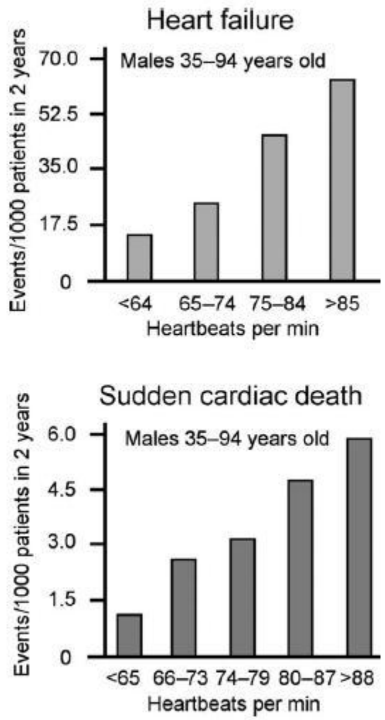


Figure 1 Dependency of heart failure events and sudden cardiac death on RHR divided in quartiles or quintiles. Included are men in a 36-year follow-up in the Framingham Heart Study.[6,8]

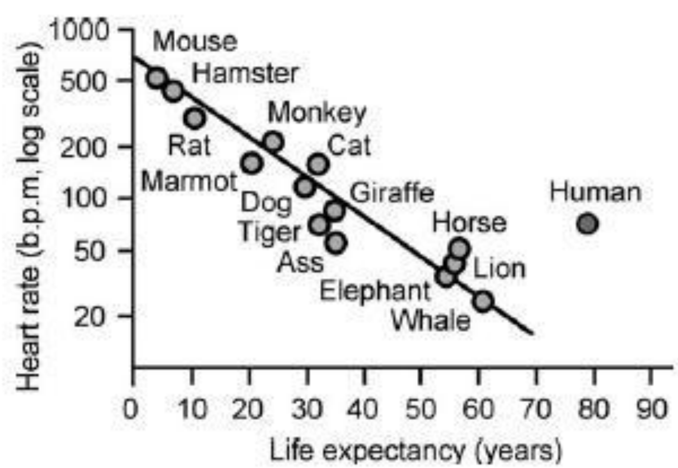
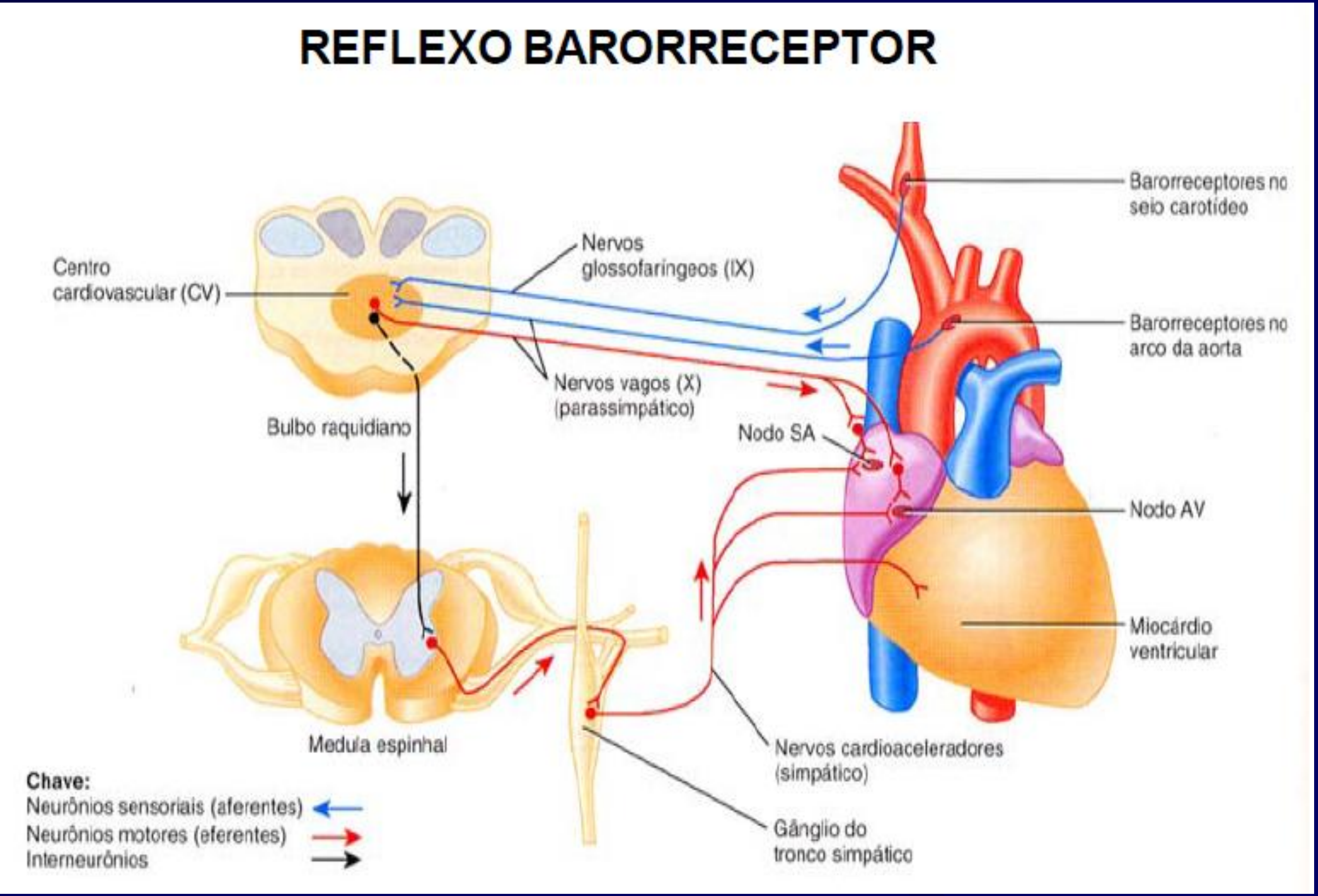


Figure 2 Inverse linear relation between RHR and life expectancy in mammals and humans. Redrawn from Levine[28] with permission from American College of Cardiology Foundation.

REFLEXO BAROCEPTOR

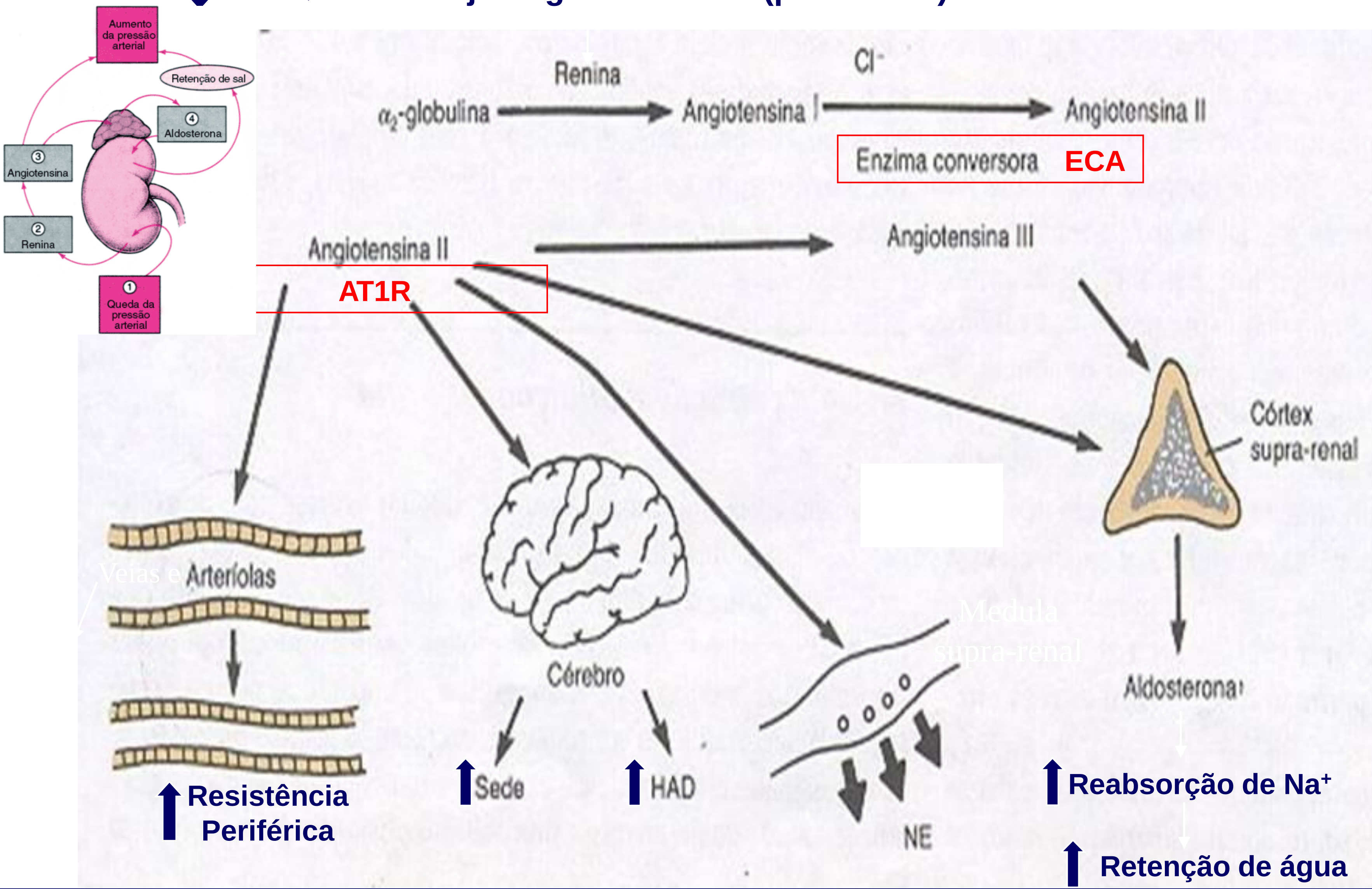
(Lei de Marey, 1859)



(ação dos baroceptores - redução de variações abruptas da PA)

Controle Lento da PA e FC

↓PA → Celulas justaglomerulares (pró-renina)



Prevalência de Hipertensão no Brasil

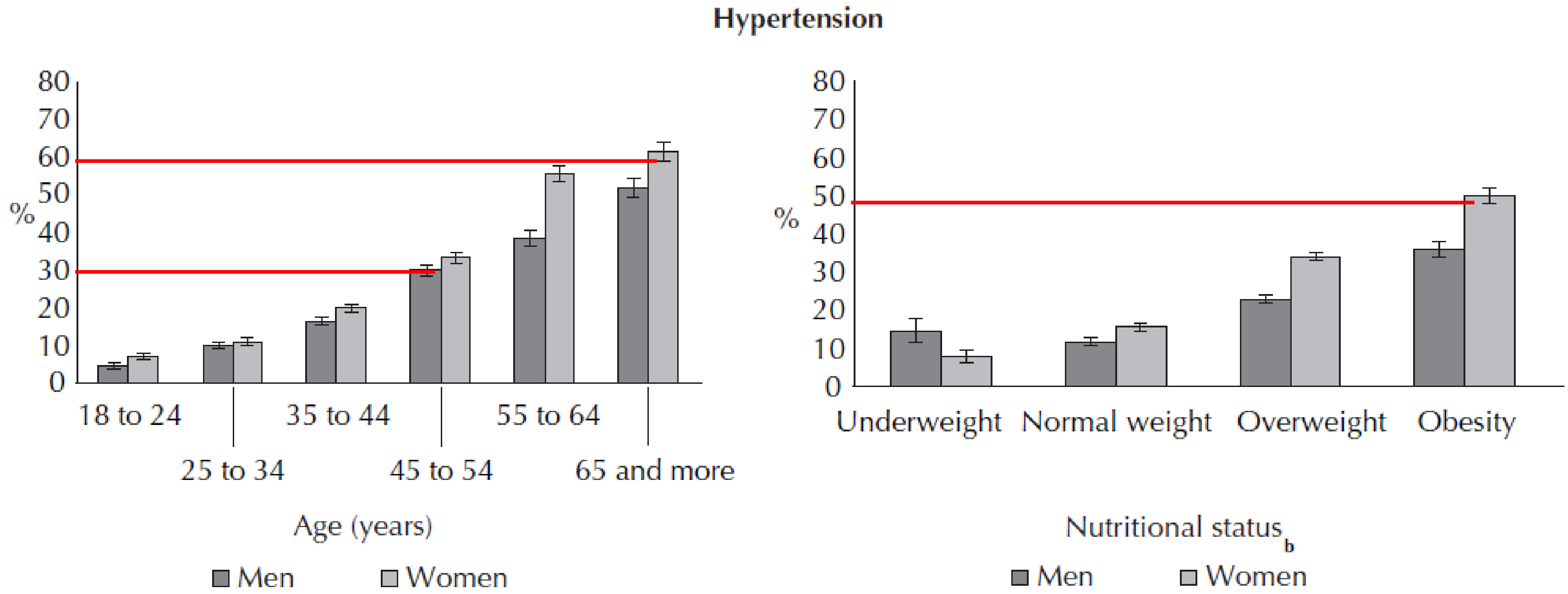


Figure. Estimated prevalence of self-reported diabetes and hypertension in adults ≥18 years in the group of capitals by sex and according to age (years) and nutritional status.[b] Brazil, 2006. (N=54,369)

[a] Weighted to adjust the sociodemographic distribution of the VIGITEL sample to the adult population distribution of each city in the 2000 Demographic Census and considering each city's population weight.

[b] According to body mass index classification (Underweight: <18.5kg/m^2; Normal weight: 18.5 – 24.99kg/m^2; Overweight: 25 – 29.99kg/m^2; Obesity: ≥30kg/m^2)

(Schmidt MI et al., 2009; Revista de Saúde Pública)

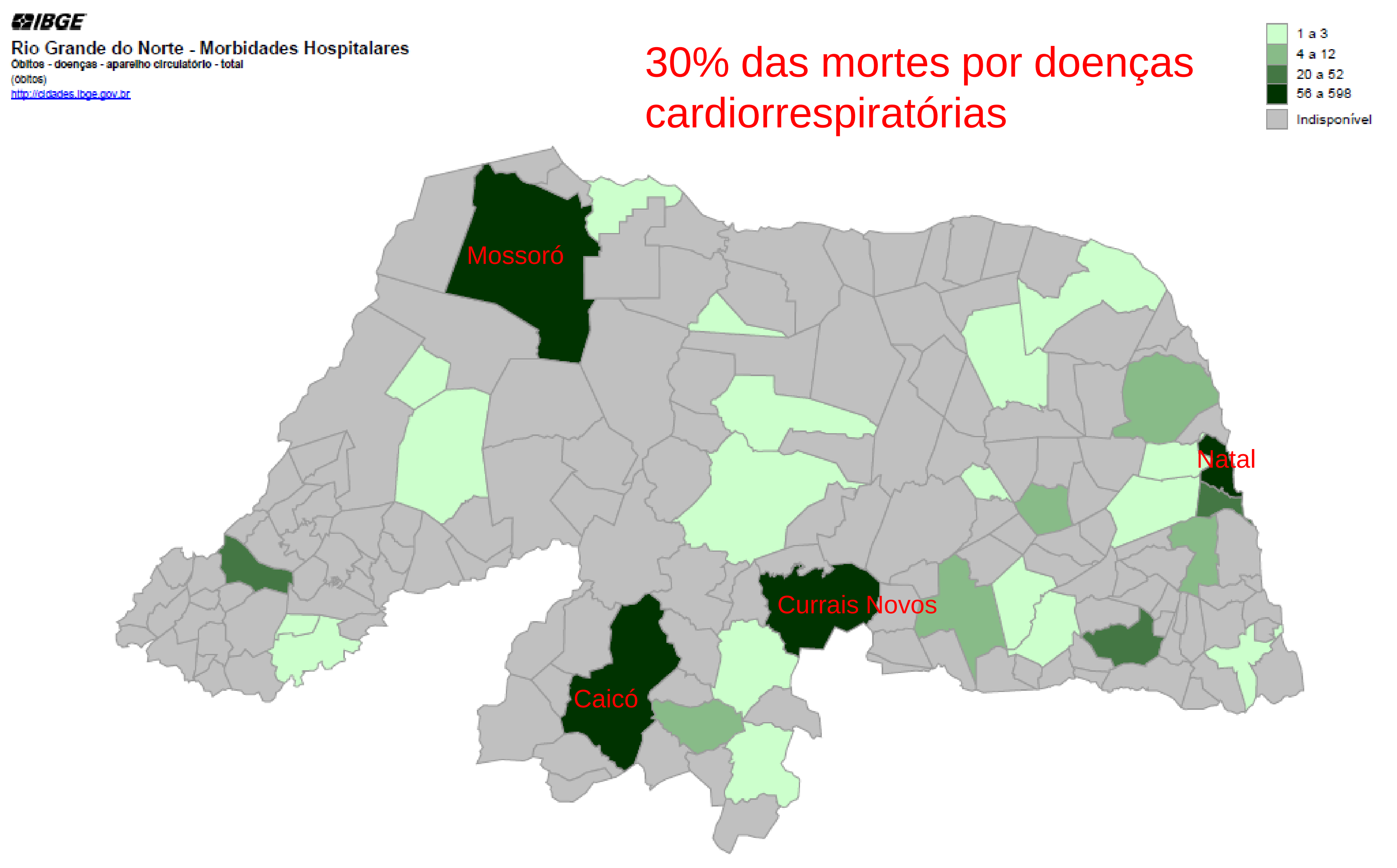
Prevalência de Hipertensão em Natal

Table 2. Prevalence[a] of self-reported hypertension, according to sex. Brazil, 2006. (N=54,369)

Capitals/FD	Men %	Men (95% CI)	Women %	Women (95% CI)	Total %	Total (95% CI)
Aracaju	18.8	(16.0;21.6)	23.5	(21.2;25.8)	21.4	(19.6;23.2)
Belém	16.1	(13.6;18.7)	21.2	(18.9;23.5)	18.9	(17.2;20.6)
Belo Horizonte	22.7	(19.8;25.6)	24.5	(22.1;26.9)	23.7	(21.8;25.5)
Boa Vista	16	(13.5;18.5)	21.8	(19.5;24.1)	18.9	(17.2;20.6)
Campo Grande	21.2	(18.3;24.1)	23.3	(21.0;25.7)	22.3	(20.5;24.1)
Cuiabá	19.8	(17.1;22.5)	21.6	(19.3;24.0)	20.7	(19.0;22.5)
Curitiba	18.6	(15.9;21.4)	23.3	(20.9;25.7)	21.1	(19.3;22.9)
Florianópolis	14.9	(12.5;17.3)	20.2	(17.9;22.4)	17.7	(16.0;19.3)
Fortaleza	15.7	(13.1;18.2)	20.8	(18.5;23.0)	18.5	(16.8;20.2)
Goiânia	17	(14.4;19.7)	20.6	(18.3;22.8)	18.9	(17.2;20.6)
João Pessoa	22.4	(19.5;25.4)	25.2	(22.7;27.6)	23.9	(22.1;25.8)
Macapá	15.6	(13.1;18.0)	22.1	(19.7;24.4)	18.9	(17.2;20.6)
Maceió	18.4	(15.6;21.1)	23.5	(21.1;25.9)	21.2	(19.4;23.0)
Manaus	18	(15.4;20.6)	19.2	(17.0;21.5)	18.6	(16.9;20.3)
Natal	19.1	(16.3;21.9)	25.4	(23.0;27.8)	22.6	(20.7;24.4)

(Schmidt MI et al., 2009; Revista de Saúde Pública)

Rio Grande do Norte – 2012 (3402 óbitos)
(993 por doenças cardiorrespiratórias)



TRATAMENTO HIPERTENSÃO

1. **Medicamentoso**

2. **Não-medicamentoso**
   - Peso
   - Sal
   - Álcool
   - Fumo
   - Atividade Física

Implicações funcionais

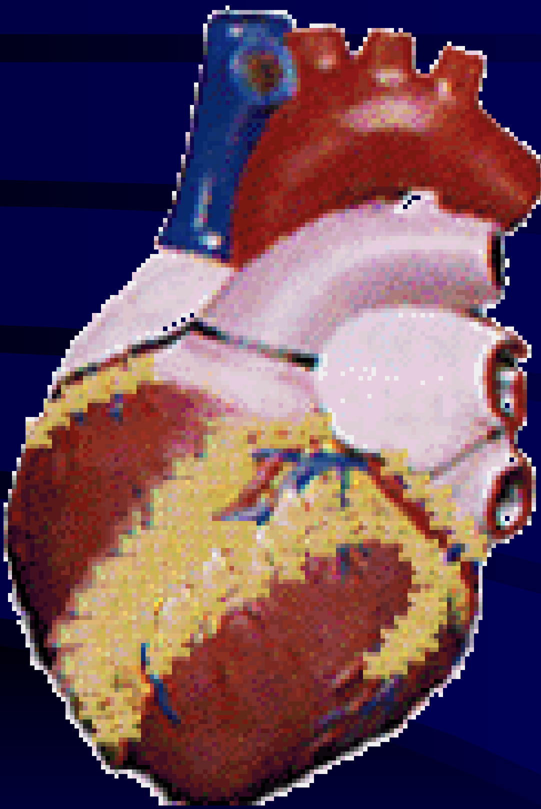
Enrijecimento das artérias → ↑ RVP

↓

Hipertrofia do Ventrículo esquerdo ← ↑ Pressão Arterial

Essas alterações associadas a um estilo de vida sedentário representam alto risco para doenças cardiovasculares

PRESSÃO ARTERIAL MANTIDA ALTA



CORAÇÃO GRANDE = ICC DERRAME CEREBRAL = AVE

Brazilian Journal of Medical and Biological Research (2001) 34: 475-478
ISSN 0100-879X Short Communication

Muscle sympathetic nerve activity and hemodynamic alterations in middle-aged obese women

M.M. Ribeiro[1], I.C. Trombetta[1], L.T. Batalha[2], M.U.P.B. Rondon[1], C.L.M. Forjaz[3], A.C.P. Barretto[1], S.M.F. Villares[2] and C.E. Negrão[1,3]

[1]Instituto do Coração, [2]Departamento de Endocrinologia, Faculdade de Medicina, and [3]Escola de Educação Física e Esportes, Universidade de São Paulo, São Paulo, SP, Brasil

n=15 obesas
n=11 magras

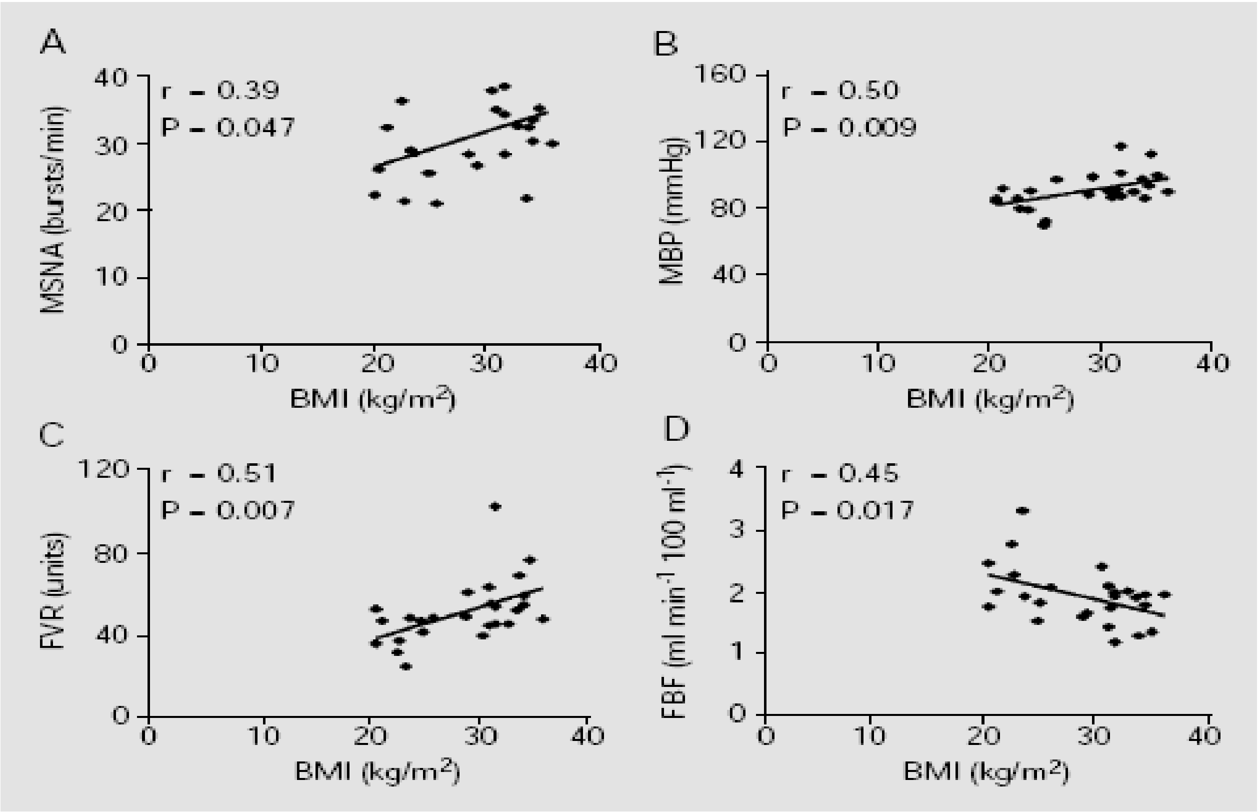


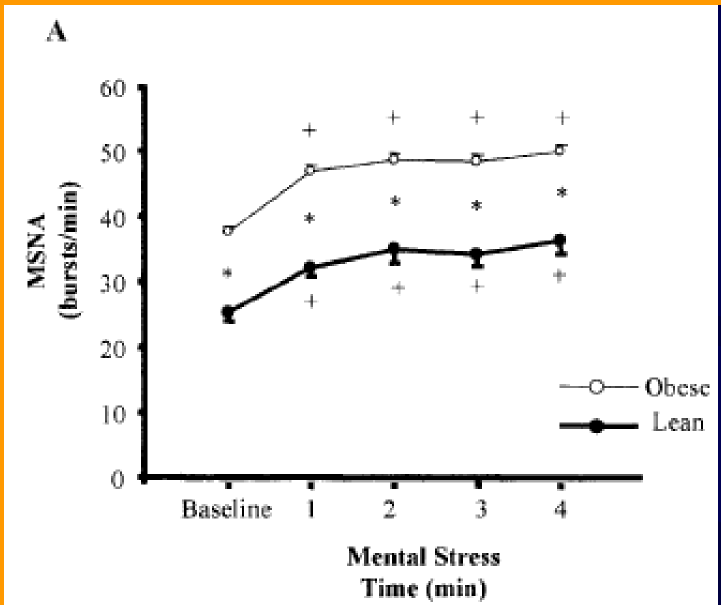
Figure 1 - Correlation between body mass index (BMI) and muscle sympathetic nerve activity (MSNA, panel A), mean blood pressure (MBP, panel B), forearm vascular resistance (FVR, panel C), and forearm blood flow (FBF, panel D) in middle-aged obese women. The Pearson correlation coefficient was used to evaluate the correlation between variables.

Abnormal Neurovascular Control during Sympathoexcitation in Obesity

Fátima H.S. Kuniyoshi,† Ivani C. Trombetta,* Luciana T. Batalha,‡ Maria U.P.B. Rondon,* Mateus C. Laterza,* Márcia M.G. Gowdak,* Antonio C.P. Barretto,* Alfredo Halpern,‡ Sandra M.F. Villares,‡ Eliudem G. Lima,† and Carlos E. Negrão*§*

OBESITY RESEARCH Vol. 11 No. 11 November 2003

n=29 obesas
n=12 magras



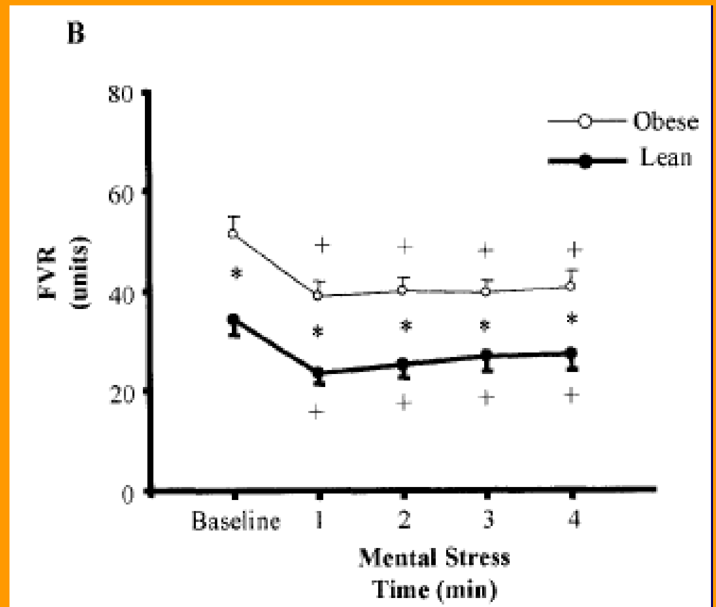
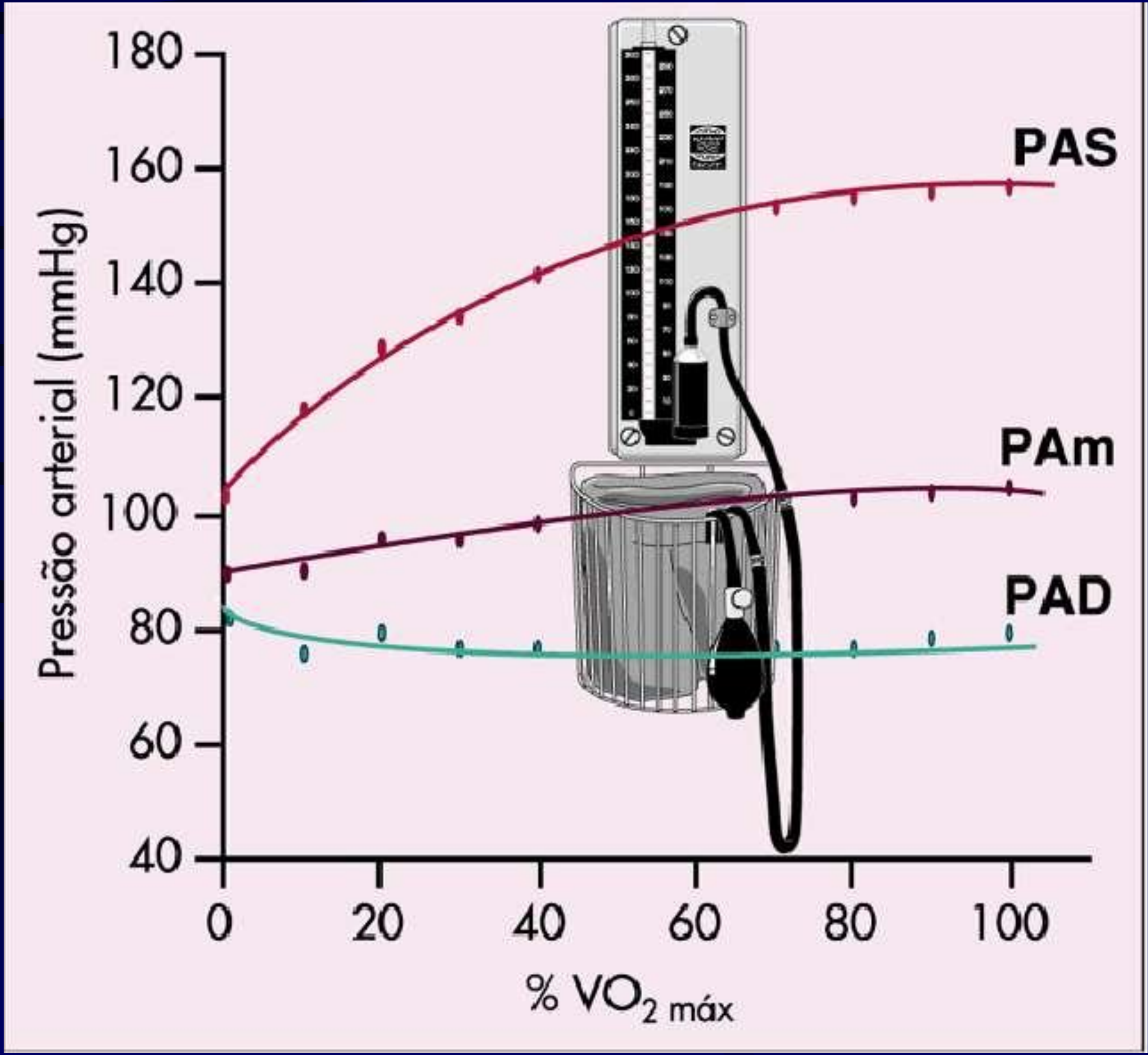


Figure 1: MSNA during mental stress in healthy obese individuals and in healthy lean individuals. (A) Muscle sympathetic nerve burst frequency. (B) Pulse synchronous sympathetic activity. Note that both muscle sympathetic nerve burst frequency and pulse synchronous sympathetic activity levels were greater in obese individuals compared with lean individuals, despite the similar magnitude of responses between groups.

Figure 2: FBF and FVR during mental stress in healthy obese individuals and in healthy lean individuals. (A) FBF. (B) FVR. Note that FBF was lower in obese individuals compared with lean individuals, whereas FVR was greater. In addition, the magnitude of change in FVR was not different between groups ($p = 0.55$), demonstrating that the vasodilatory response was similar between the two groups studied.

Como a pressão arterial responde ao exercício físico?


PAS
PAm
PAD
Pressão arterial (mmHg)
180
160
140
120
100
80
60
40
0
20
40
60
80
100
% VO2 máx

Arterial Blood Pressure Response to Heavy Resistance Exercise

MacDOUGALL et al.

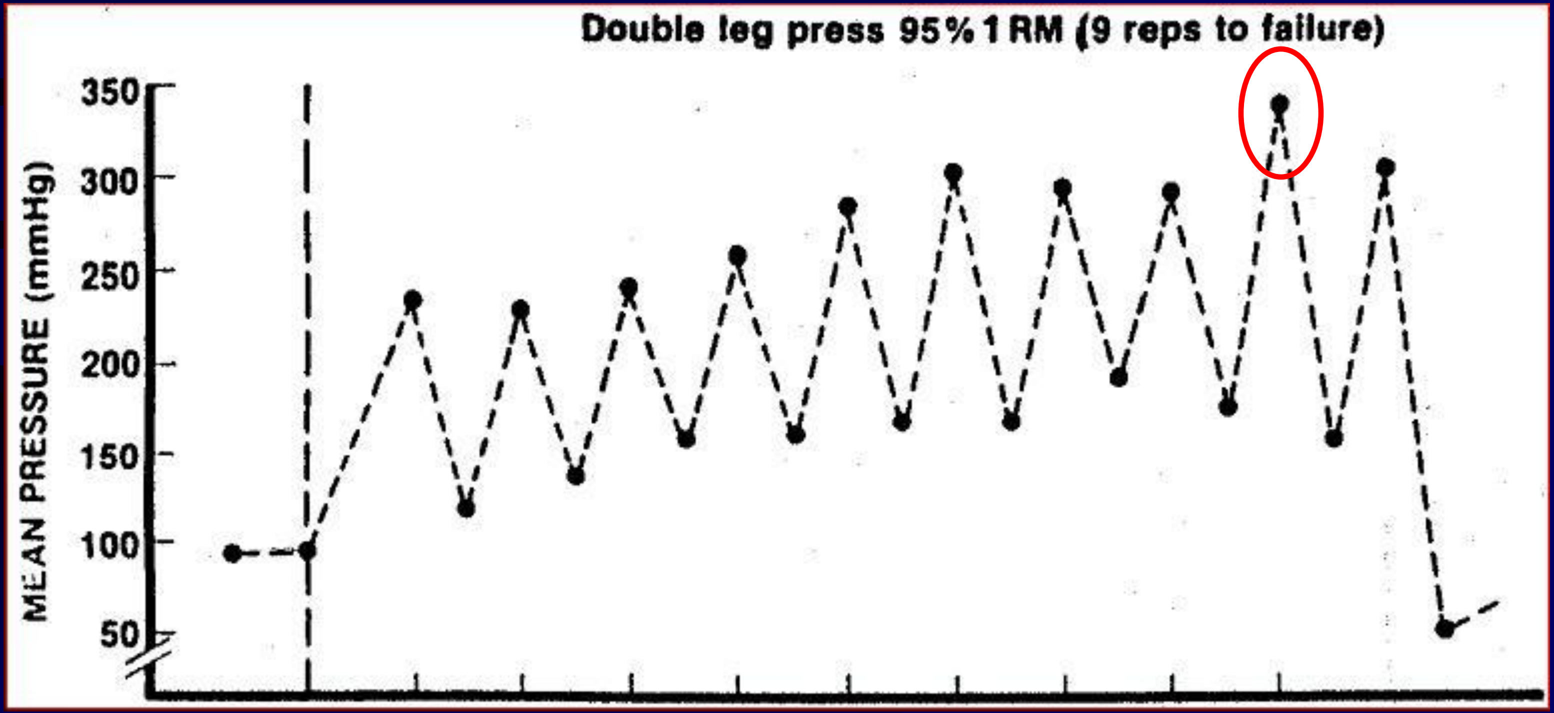
Journal of Applied Physiology

1985

PRESSÃO ARTERIAL

RESPOSTAS AGUDAS AO EXERCÍCIO

↑ PAS e PAD



MaCDougall *et al*. (1985)

Available online at www.sciencedirect.com
ScienceDirect
Journal of Science and Medicine in Sport 14 (2011) 254–258

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Journal of Science and Medicine in Sport
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Original research

The blood pressure response of older men to maximum and sub-maximum strength testing

Dale I. Lovell [a,*], Ross Cuneo [b], Greg C. Gass [c]

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[b] *Department of Diabetes and Endocrinology, Princess Alexandra Hospital, Queensland, Australia*
[c] *Faculty of Health Sciences and Medicine, Bond University, Queensland, Australia*

Received 13 May 2010; received in revised form 28 September 2010; accepted 10 December 2010

Abstract

Strength testing is commonly used to determine the muscular strength of older individuals participating in a resistance training program. The purpose of this study was to non-invasively examine and compare the blood pressure (BP) and heart rate (HR) response of maximum and sub-maximum strength tests in older men. Twenty-four healthy men aged 70–80 yr were recruited for the study. Participants completed a 1 repetition maximum (RM) strength test and four days later a sub-maximum strength test on an incline squat. Systolic blood pressure

Respostas de PA em idosos durante 1RM e RM´s

Table 1

Blood pressure and heart rate response before, during and after 1RM and sub-maximum strength tests.

	1 repetition maximum (1RM)				Sub-maximum (50% of 1RM)			
	Resting	During	Post (20 s)	Post (60 s)	Resting	During	Post (20 s)	Post (210 s)
Average SBP (mm Hg)	141 ± 21	215 ± 34*,#	160 ± 27*,#	125 ± 26*,#	143 ± 22	234 ± 35*	120 ± 30*	155 ± 26
Maximum SBP	144 ± 17	231 ± 31*,#	178 ± 30*,#	132 ± 24#	146 ± 19	268 ± 37*	134 ± 33	168 ± 27*
Minimum SBP	129 ± 21	190 ± 33*	148 ± 29*,#	118 ± 26#	134 ± 24	212 ± 32*	111 ± 31*	141 ± 30
Average DBP (mm Hg)	70 ± 12	118 ± 17*,#	68 ± 12#	71 ± 11	73 ± 14	135 ± 22*	52 ± 13*	64 ± 12
Maximum DBP	83 ± 14	128 ± 21*,#	79 ± 13#	84 ± 12	84 ± 15	151 ± 23*	64 ± 11*	77 ± 10
Minimum DBP	61 ± 10	109 ± 22*,#	67 ± 11#	62 ± 12	62 ± 12	128 ± 19*	43 ± 11*	56 ± 12
Average HR (beats min^{-1})	68 ± 10	112 ± 12*,#	91 ± 10*,#	79 ± 9#	67 ± 9	145 ± 12*	120 ± 13*	90 ± 9*
Maximum HR	76 ± 11	121 ± 15*,#	105 ± 13*,#	88 ± 13#	74 ± 10	153 ± 16*	128 ± 15*	108 ± 12*
Minimum HR	59 ± 10	94 ± 14*,#	86 ± 11*,#	69 ± 13#	58 ± 10	138 ± 14*	110 ± 12*	85 ± 11*

Values are mean ± SD. SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate.

* Significantly ($P < 0.05$) different from resting values.

\# Significantly ($P < 0.05$) different from sub-maximum test.

DP 1RM = 27951 mmHg*bpm vs. DP RM´s = 41004 mmHg*bpm, significa 47% aumento!

Respostas de PA em idosos durante RM´s

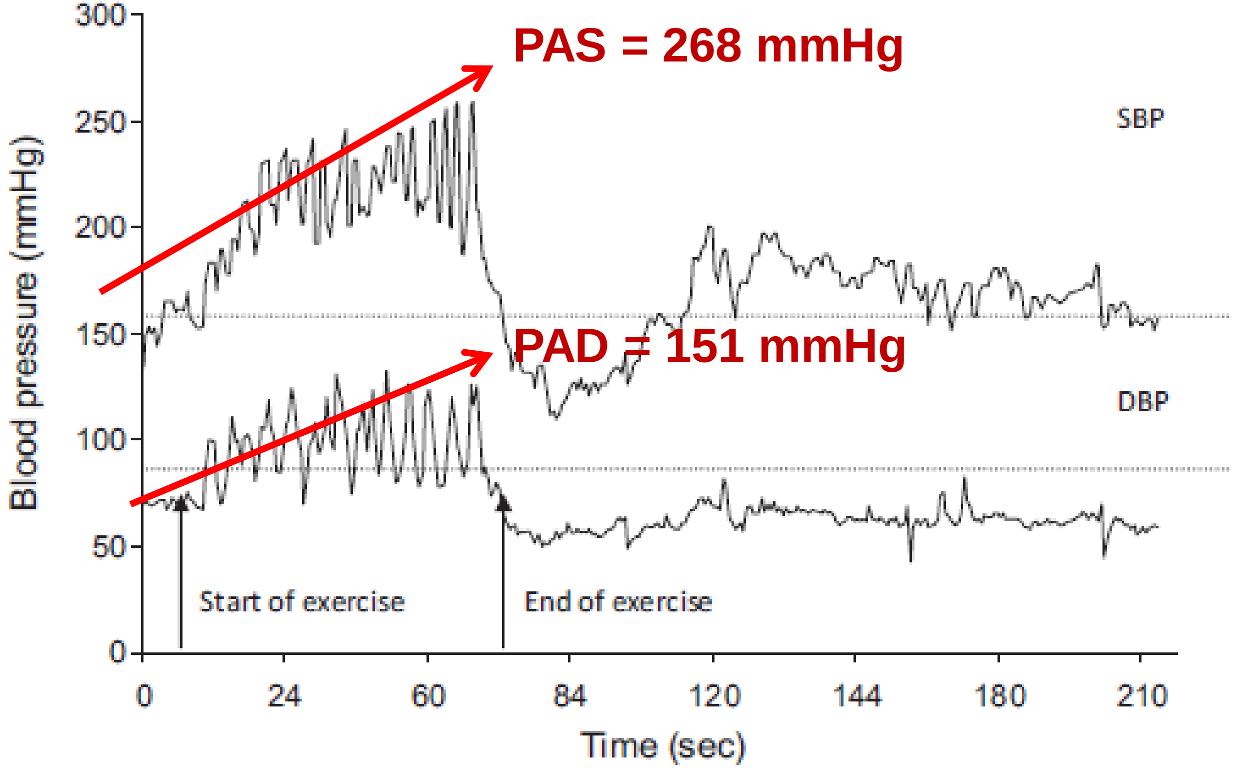
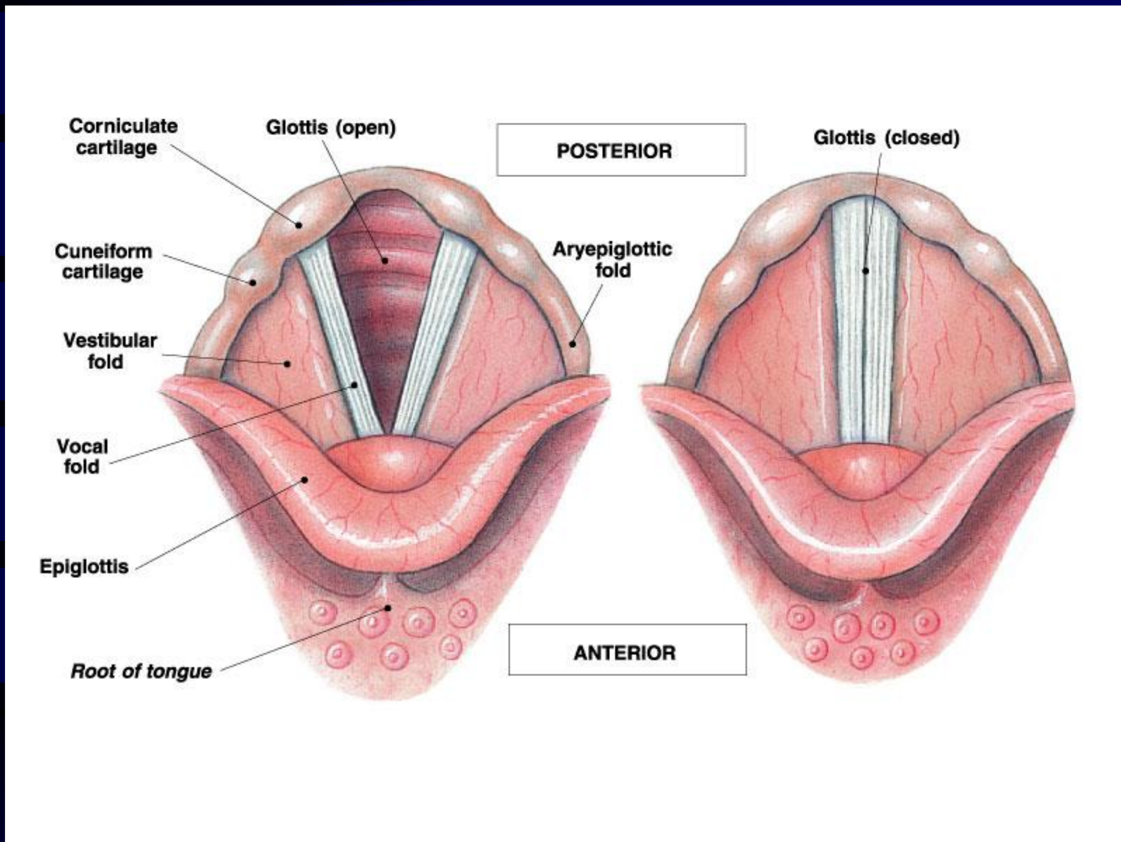


Fig. 1. An example of time-course analysis of systolic and diastolic blood pressures during a sub-maximum strength test on the incline squat machine. Dotted lines indicate resting values for systolic (SBP) and diastolic (DBP) blood pressures.

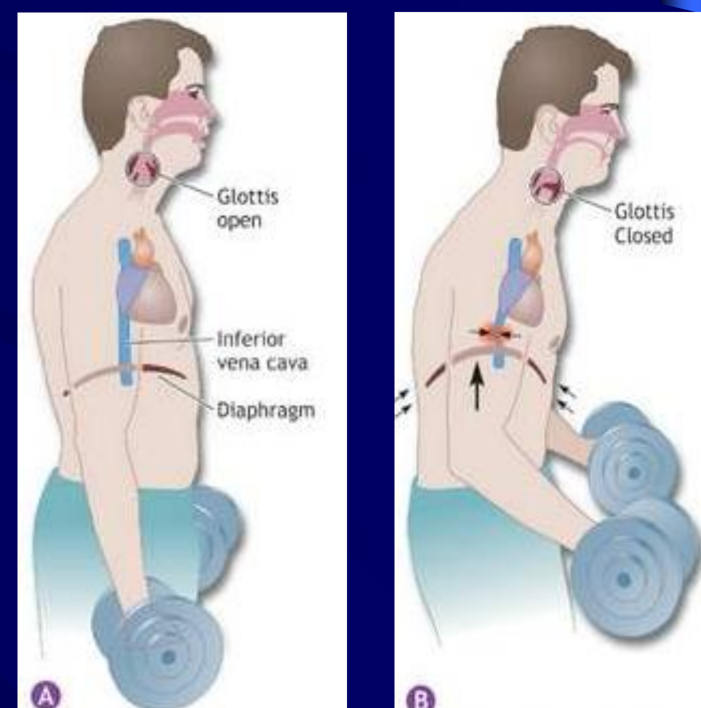
Manobra de Valsalva

uma inspiração,
xalação podem
torácica;

vantamento de



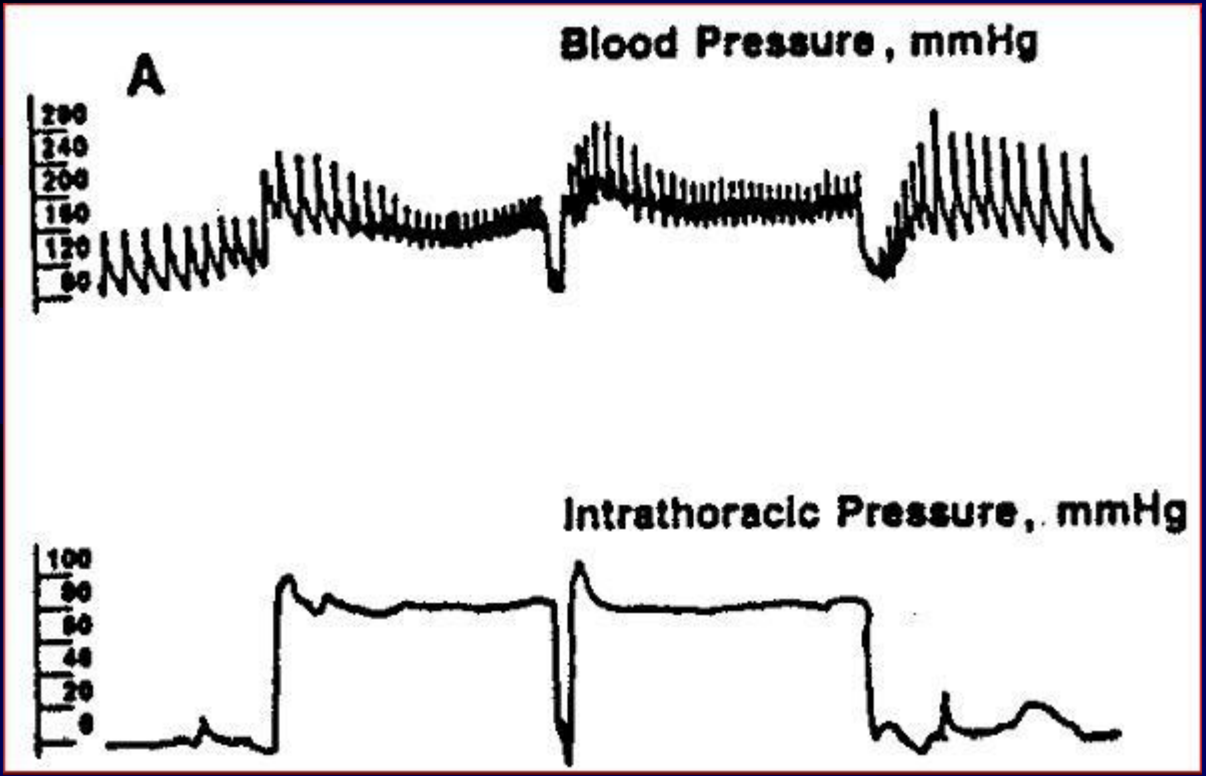
arterial durante levantamento
de pesos.



PRESSÃO ARTERIAL

RESPOSTAS AGUDAS AO EXERCÍCIO

- **Manobra de Valsalva**

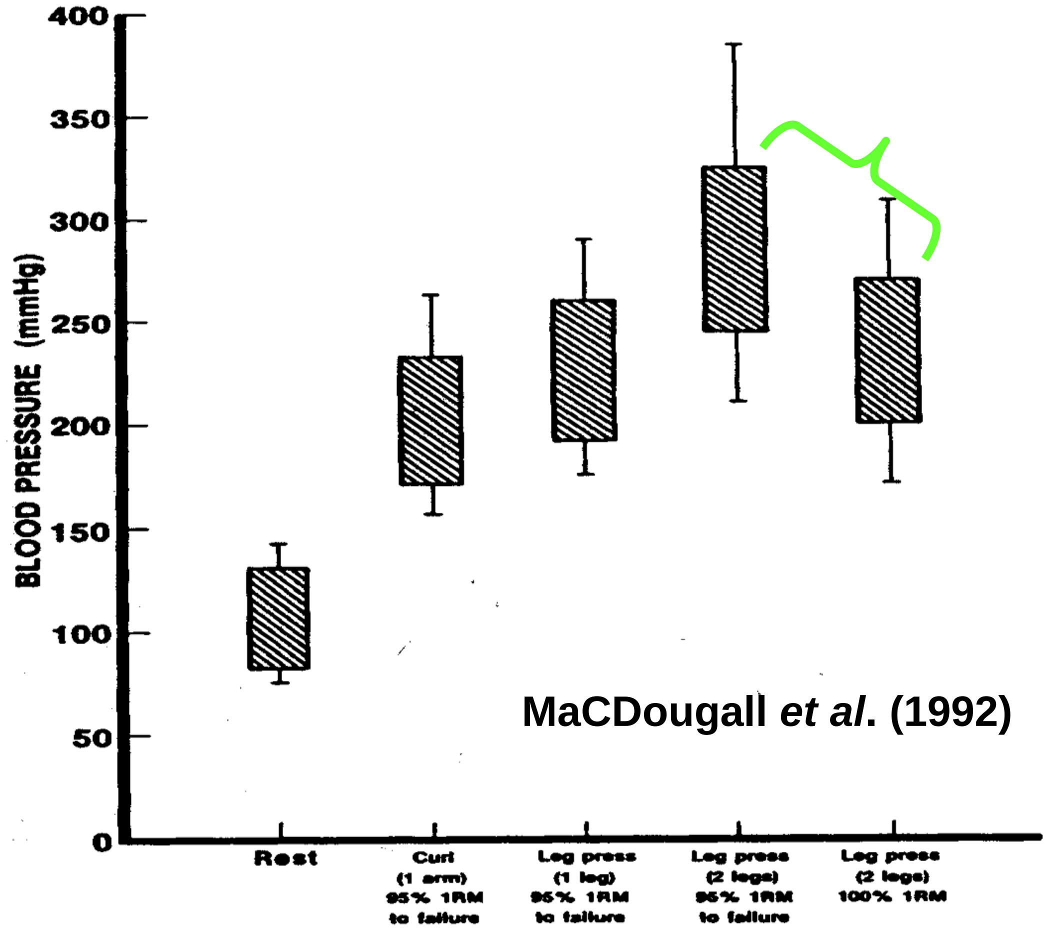


MaCDougall *et al*. (1992)

PRESSÃO ARTERIAL

RESPOSTAS AGUDAS AO EXERCÍCIO

- **Tamanho da massa muscular envolvida**



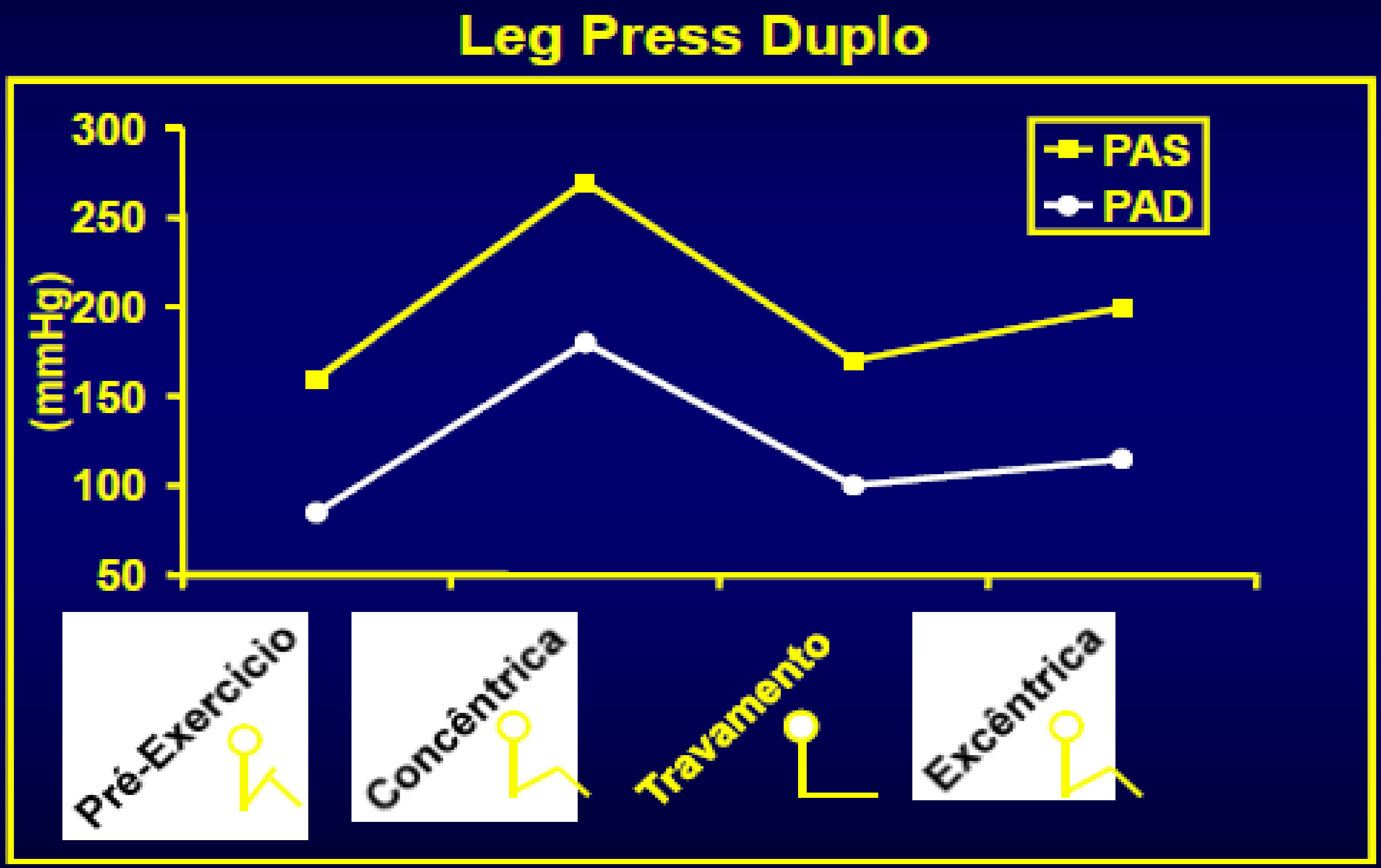
Peak systolic and diastolic blood pressures reached during various exercises. X̄ and SD, N=5

FIG. 4. Means ± SD peak blood pressures for all subjects during various exercises at 95 and 100% of their single maximum lift (1 RM).

< massa = < PA, embora alta.

Como minimizar?

RESPOSTAS CARDIOVASCULARES AGUDAS AO TRD



Adaptado de McCartney. Med. Sci. Sports Exerc. 31:31-7,1999

(FORJAZ, 2015)

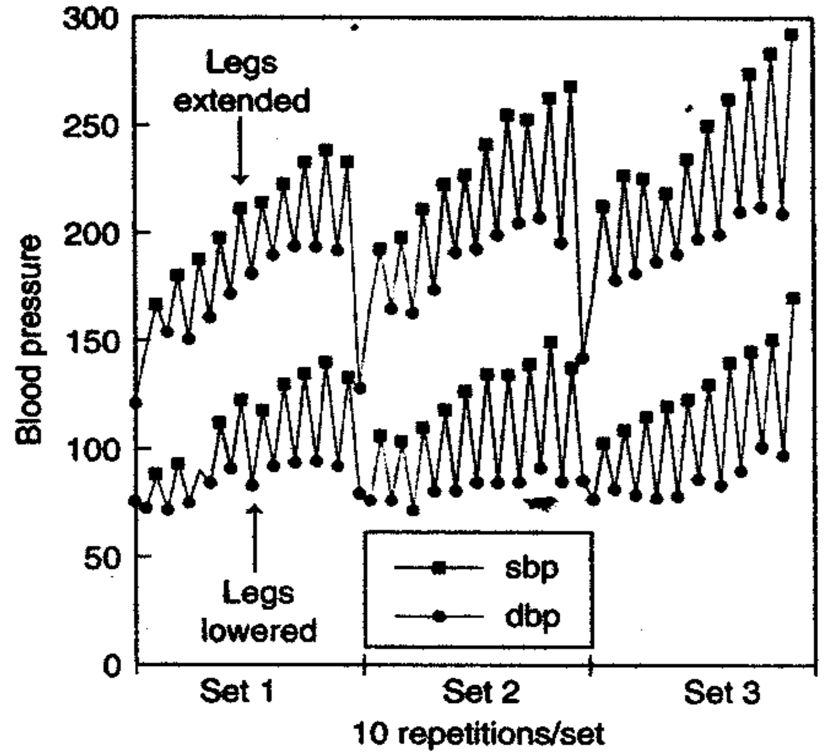


Figure 3.25 Blood pressure response increases during a two-legged leg press set to volitional fatigue as well as during three successive sets of 10 repetitions at a 10RM resistance.

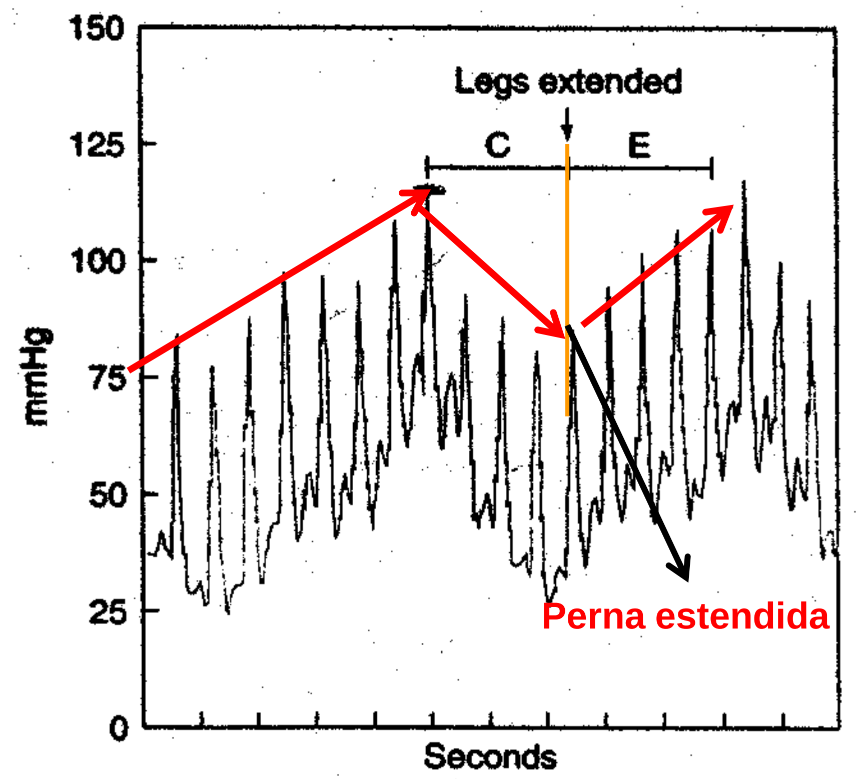


Figure 3.26 Blood pressure response during one complete repetition of a two-legged leg press exercise.

- Método não invasivo (Finapres™)
- 3s fase concêntrica e 3s na excêntrica

> - Para minimizar resposta pressórica, talvez cuidar dos ângulos de maior desvantagem mecânica!

Gotshall et al. (1999)

Qual o problema?

- Ocorrência de manobra de valsalva, redução de débito cardíaco com consequente menor perfusão nas coronárias;
- Promove picos na pressão arterial.

Qual o problema dos picos na PA?

- Possibilidades de aneurisma (dilatação do vaso) com consequente rompimento deste (ruptura arterial e AVC se for no cérebro).

P.S. Grande parte dos aneurismas são assintomáticos. Entretanto, os sintomas mais frequentes são: cefaleia, vômitos, convulsões, perdas de consciência, visão dupla ou outras alterações na vista, dentre outros.

Qual o papel do exercício no controle hemodinâmico?

EVIDÊNCIAS CIENTÍFICAS

Scand J Med Sci Sports 2006: 16 (Suppl. 1): 3–63

SCANDINAVIAN JOURNAL OF
MEDICINE & SCIENCE
IN SPORTS

Review

Evidence for prescribing exercise as therapy in chronic disease

B. K. Pedersen[1,2], B. Saltin[2]

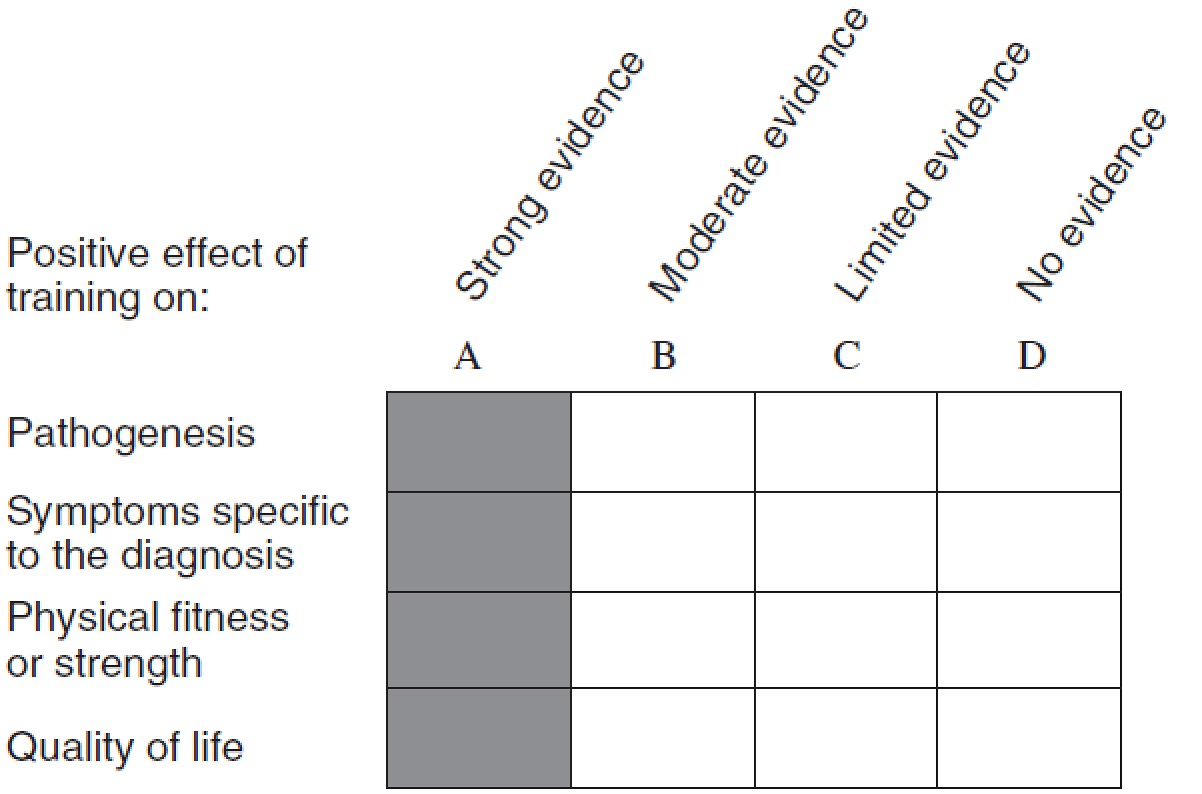


Fig. 4. Hypertension.

EFEITO AGÚDO!

AJH 2000;13:44–51

Ambulatory Blood Pressure After Acute Exercise in Older Men With Essential Hypertension

Nadine S. Taylor-Tolbert, Donald R. Dengel, Michael D. Brown, Steve D. McCole, Richard E. Pratley, Robert E. Ferrell, and James M. Hagberg

- **11 hipertensos (sedentários, obesos e idosos)**
- **45 minutos de esteira (3 séries de 15 minutos)**
- **4 minutos de recuperação**
- **Intensidade: 70 %VO_2max**
- **Resposta de Pressão Arterial 24 horas MAPA**

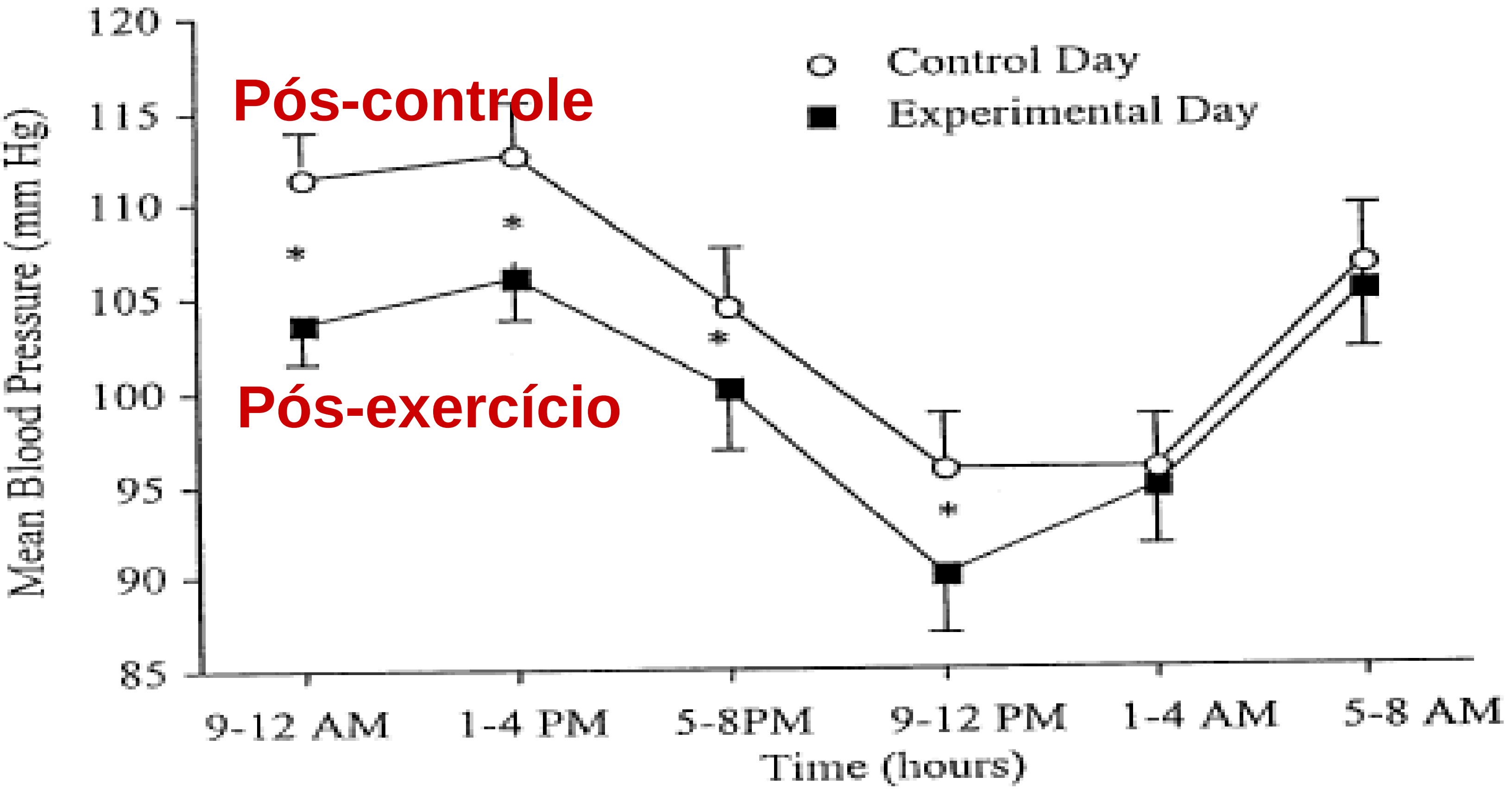


FIGURE 3. *Mean arterial BP for the 24-h ambulatory BP recording preceded by and not preceded by 45 min of acute aerobic exercise at 70% VO_{2max}. Values are expressed as mean ± SE. *P < .05 for the difference between the two recordings.*

Aging Clin Exp Res
DOI 10.1007/s40520-013-0017-x

2013

ORIGINAL ARTICLE

Exercise intensity modulates nitric oxide and blood pressure responses in hypertensive older women

**Hugo A. P. Santana · Sérgio R. Moreira · Ricardo
Cláudio Córdova · Carmen S. G. Campbell · Foue
Andrei C. Sposito · Otávio T. Nóbrega · Herbert G**

Received: 19 April 2011 / Accepted: 25 November 2011

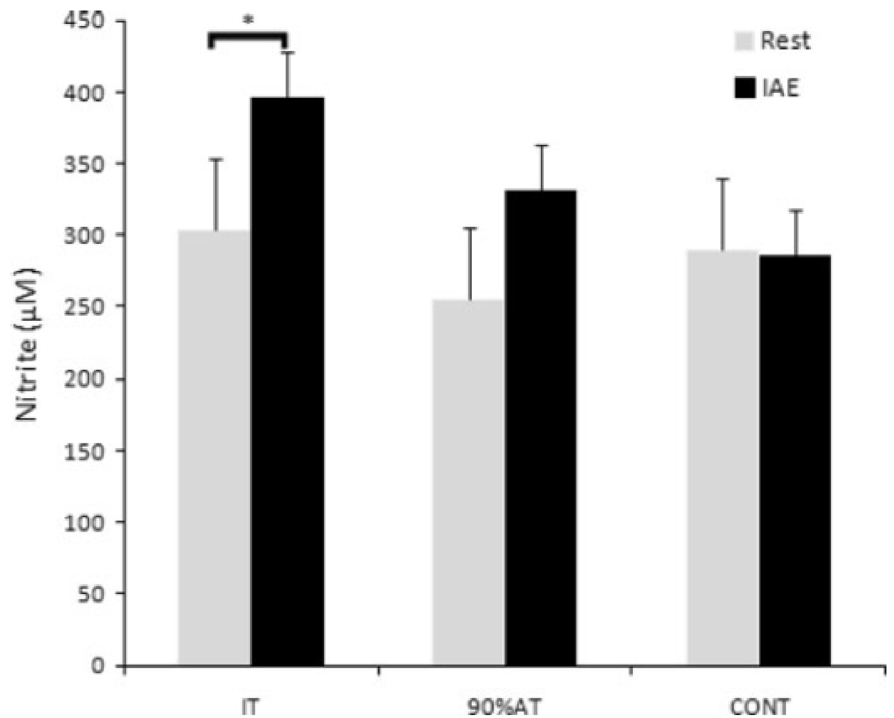


Fig. 1 Comparisons of nitrite values (mean ± SE) between resting and immediately after sessions (IAE) of incremental test (IT), at 90 % of anaerobic threshold (90 % AT) and control (CONT). $*p < 0.05$ compared with rests ($n = 22$)

Eur J Appl Physiol
DOI 10.1007/s00421-006-0257-y

ORIGINAL ARTICLE

Post-resistance exercise hypotension, hemodynami(c) rate variability: influence of exercise intensity

C. C. Rezk · R. C. B. Marrache · T. Tinucci · D. Mion Jr ·
C. L. M. Forjaz

Hipotensão

Pós-Exercício Resistido

- 40% 1RM – 16 rep
- 80% 1RM – 08 rep
- CONT

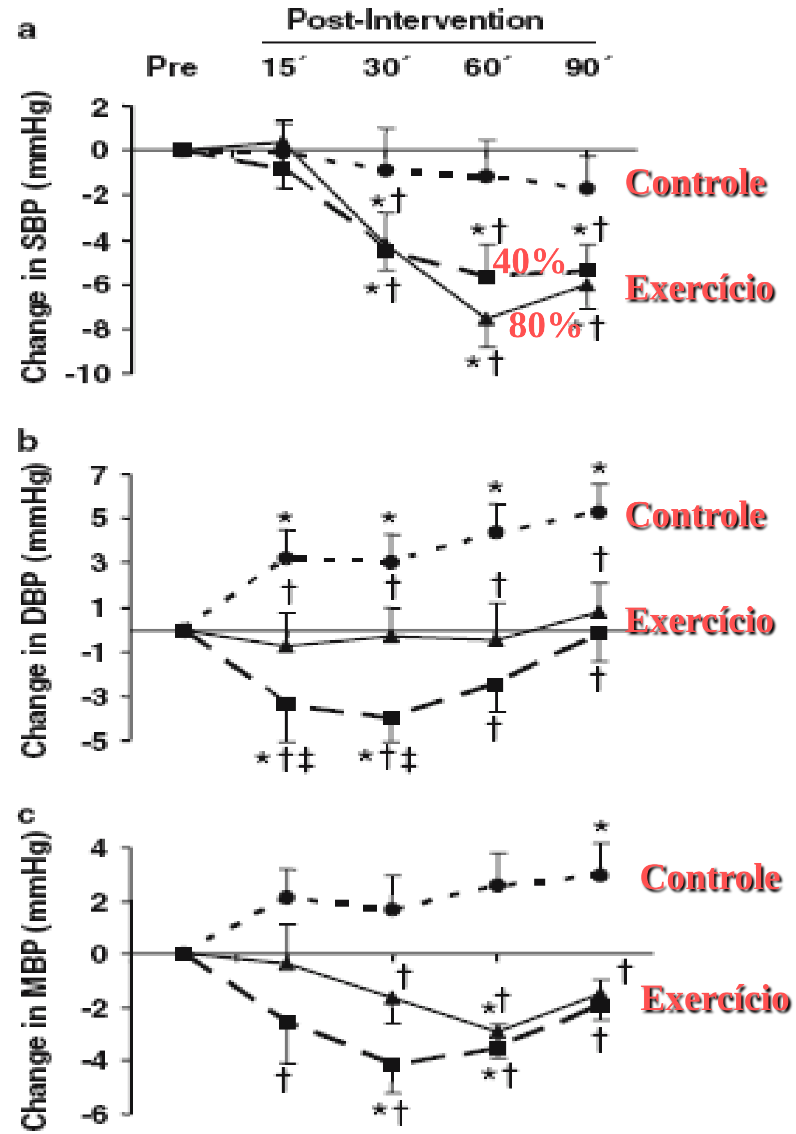


Fig. 1 Changes in systolic (*SBP panel a*), diastolic (*DBP panel b*), and mean (*MBP panel c*) blood pressures observed in 17 subjects after interventions in the control (*C circles*), resistance exercise at 40% of 1 RM (*E40% squares*), and resistance exercise at 80% of 1 RM (*E80% triangles*) sessions. *Significantly different from pre-intervention ($P < 0.05$). †Significantly different from the control session ($P < 0.05$). ‡Significantly different from the E80% session ($P < 0.05$)

- Sessões retangulares (*café da manhã padronizado – 280 Kcal*)

Controle → Sem exercício

43%RM - 16 rep. 2" cada rep. - ~45" desc. entre exercícios

Exercício (3 circuitos)

→

→

23%RM - 30 rep. 2" cada rep. - ~20" desc. entre exercícios

2' para coletas

←

←

←

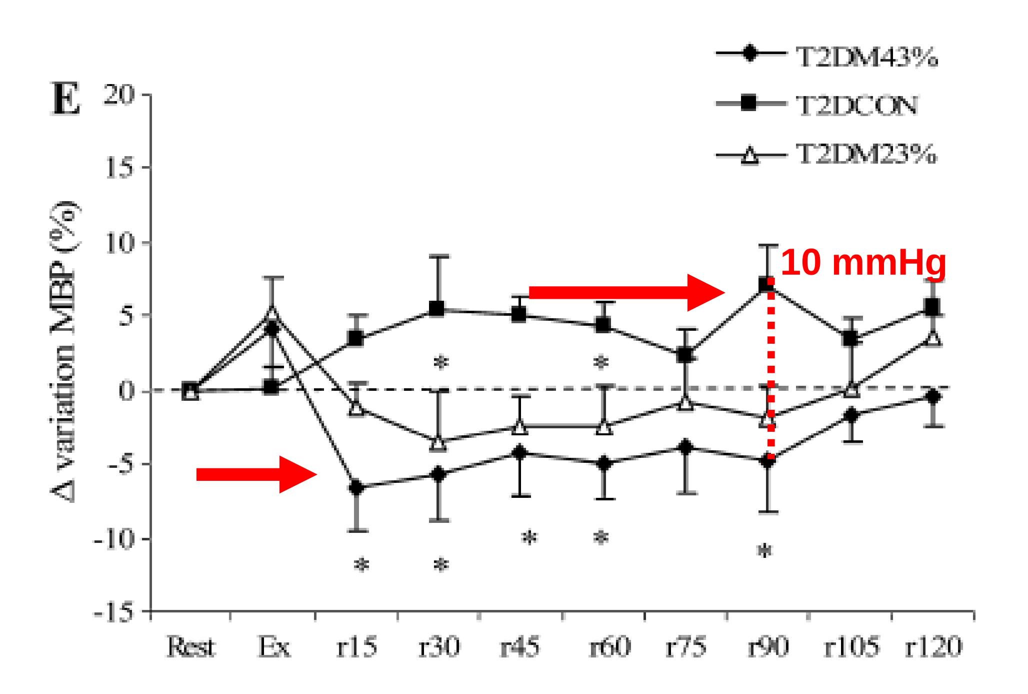
- Coletas de sangue e PA no repouso, a cada circuito e 15, 30, 45, 60, 75, 90, 105 e 120 minutos da recuperação.

Journal of Strength and Conditioning Research

Postresistance Exercise Blood Pressure Reduction is Influenced by Exercise Intensity in Type-2 Diabetic and Nondiabetic Individuals

Graziela C. Simões,[1] Sérgio R. Moreira,[1] Michael R. Kushnick,[2] Herbert G. Simões,[1] and Carmen S.G. Campbell[1]

[1]*Graduate Program on Physical Education and Health, Catholic University of Brasilia, Brasilia, Brazil; and*
[2]*School of Recreation and Sport Sciences, Ohio University, Athens, Ohio*



Pressão Arterial Média

(Simões et al., 2010)

Clinical Interventions in Aging

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Isometric handgrip does not elicit cardiovascular overload or post-exercise hypotension in hypertensive older women

Rafael dos Reis Vieira Olher[1,2,*]
Danilo Sales Bocalini[3,*]
Reury Frank Bacurau[4]
Daniel Rodriguez[5]
Aylton Figueira Jr[5]
Francisco Luciano Pontes Jr[4]
Francisco Navarro[6]
Herbert Gustavo Simões[1]
Ronaldo Carvalho Araujo[7]
Milton Rocha Moraes[8]

Table 3 Hemodynamic parameters at control condition and 30% and 50% of r

	SBP (mmHg)			DBP (mmHg)		
	Control	**30%**	**50%**	**Control**	**30%**	**50%**
Rest	121 ± 13	121 ± 10	120 ± 7	76 ± 12	74 ± 9	72 ± 8
Exercise peak	121 ± 12	127 ± 14	125 ± 11	76 ± 11	76 ± 6	78 ± 7
5 min	120 ± 12	125 ± 13	120 ± 9	73 ± 8	74 ± 5	72 ± 7
10 min	118 ± 5	123 ± 12	122 ± 9	72 ± 8	72 ± 8	72 ± 8
15 min	117 ± 8	122 ± 11	121 ± 11	73 ± 7	72 ± 5	71 ±7
30 min	118 ± 7	124 ± 11	121 ± 9	72 ± 7	72 ± 8	72 ± 8
45 min	123 ± 8	124 ± 10	121 ± 9	75 ± 6	73 ± 6	75 ± 10
60 min	122 ± 7	121 ± 10	120 ± 7	73 ± 6	75 ± 7	75 ± 7

Note: Values expressed in as the mean ± standard deviation.
Abbreviations: DBP, diastolic blood pressure; HR, heart rate; MAP, mean arterial pressure; RPP, ra

- Handgrip
- 4 sets
- 5 contrações de 10” cada set.

E o efeito da HPE permanece mesmo quando treinado?

Journal of Human Hypertension (2011), 1–7
www.nature.com/jhh

2011

ORIGINAL ARTICLE

Effect of 12 weeks of resistance exercise on post-exercise hypotension in stage 1 hypertensive individuals

MR Moraes
JB Pesquero
[1]Department c
Cruzes, Mogi
São Paulo, SP,
and Technolo
[1],
Mogi das
Paulo,
Science

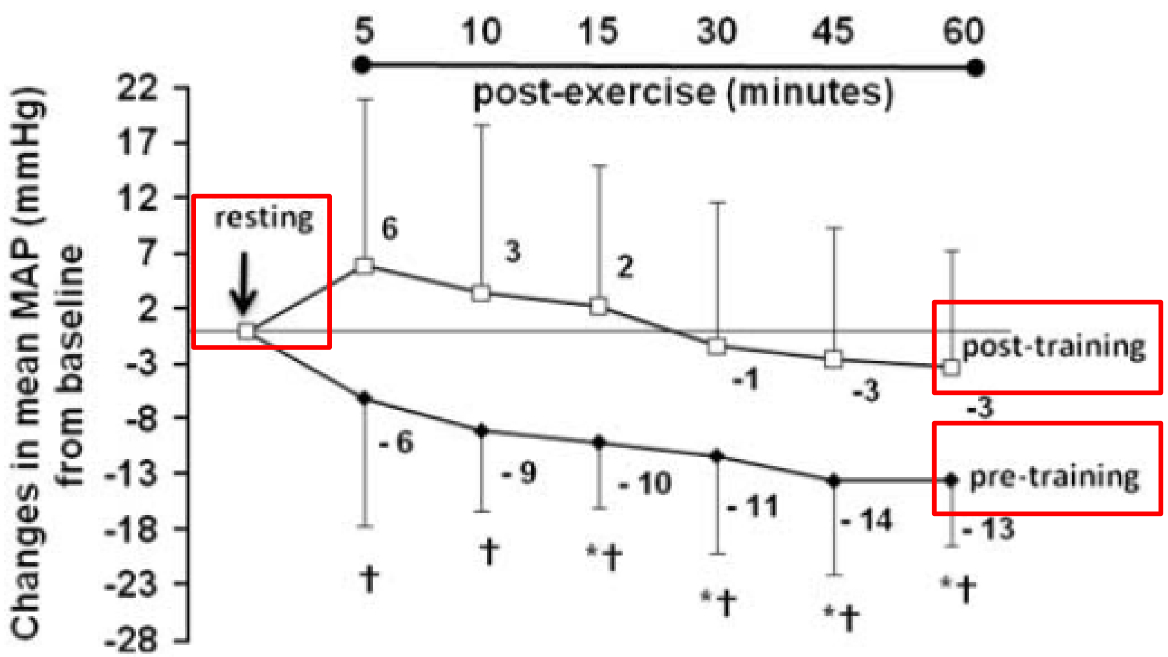


Figure 3 MAP after acute resistance exercise. Mean changes of MAP (when compared with the resting value) due to RES before (pre-training, lozenges) and after (post-training, squares) 12 weeks of RET. *$P<0.05$ in comparision to the resting value; †$P<0.001$ related to post-training values. Values given as mean ± s.d.

Mecanismos

Respostas durante e após o exercício

Published in final edited form as:
Exerc Sport Sci Rev. 2010 July ; 38(3): 122–127. doi:10.1097/JES.0b013e3181e372b5.

2010

Postexercise Hypotension: Central Mechanisms

Chao-Yin Chen[1] and **Ann C. Bonham**[1,2]
[1]Department of Pharmacology, University of California, Davis, CA, USA
[2]Department of Internal Medicine, University of California, Davis, CA, USA

INPUT
(músculos aferentes)

Núcleo **T**rato **S**olitário
(Reset da via Barorreflexa)

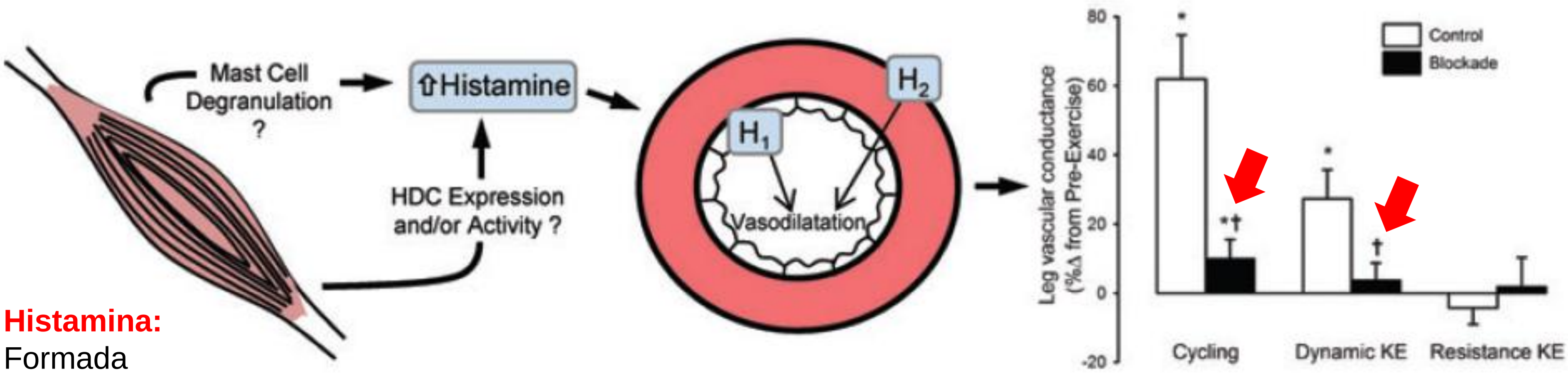
Central: Após o Exercício

OUTPUT simpático
(do centro de controle cardiovascular na medula)

(Chen & Bonahm, 2010; Halliwill et al. 2013)

Periférico: Após o Exercício

- Imediata: Hiperemia reativa (até 20min) / dose-dependente;
- Persistente: Substâncias vasoativas (2h) / dose-dependente;
- NO parece que contribui pouco em humanos (*Halliwill et al., 2000*).



Histamina: Formada nos mastócitos e por estresse de cisalhamento em grandes vasos.

Figure 2. Pathways for histaminergic component of sustained postexercise vasodilatation
Histamine, perhaps from mast cell degranulation or *de novo* production by histidine decarboxylase (HDC), stimulates histamine H_1 receptors on endothelium and H_2 receptors on smooth muscle in the skeletal muscle microcirculation. This leads to a sustained postexercise vasodilatation of the previously exercised muscle. As shown in the right panel, modified from Barrett-O'Keefe *et al.* (2012), cycling and single-leg dynamic knee extension, but not single-leg resistance knee extension, evoke histaminergic vasodilatation that is robust at 60 min after exercise. Open bars, control; filled bars, blockade. $^*P < 0.05$ *versus* pre-exercise; $^\dagger P < 0.05$ *versus* control.

(Halliwill JR et al. 2013; Exp Physiol)

Periférico: Após o Exercício

Aging Clin Exp Res
DOI 10.1007/s40520-013-0017-x

2013

ORIGINAL ARTICLE

Exercise intensity modulates nitric oxide and blood pressure responses in hypertensive older women

Hugo A. P. Santana · Sérgio R. Moreira · Ricardo Y. Asano ·
Cláudio Córdova · Carmen S. G. Campbell · Foued S. Espind
Andrei C. Sposito · Otávio T. Nóbrega · Herbert G. Simões

Received: 19 April 2011 / Accepted: 25 November 2011

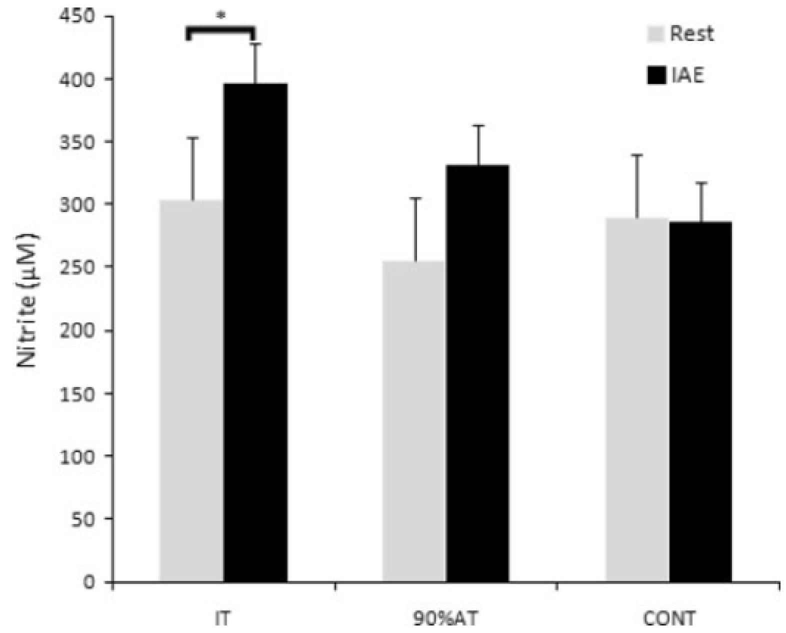


Fig. 1 Comparisons of nitrite values (mean ± SE) between resting and immediately after sessions (IAE) of incremental test (IT), at 90 % of anaerobic threshold (90 % AT) and control (CONT). $*p < 0.05$ compared with rests ($n = 22$)

Mecanismos: O que sabemos hoje?

Table 2. Recent observations

Recent observations (circa 2012)	
Previous understanding	New understanding
Baroreflex is reset, but mechanism is unknown	Skeletal muscle afferents may play a primary role in postexercise resetting of the baroreflex
Local vasodilator mechanism is unknown	H_1 and H_2 receptors contribute significantly
Possible benefits include alterations in fluid balance	Possible benefits include alterations in metabolism and promotion of angiogenesis

(Halliwill JR et al. 2013; Exp Physiol)

EFEITO CRÔNICO!

Exercise Training Increases Baroreceptor Gain Sensitivity in Normal and Hypertensive Rats

Patricia Chakur Brum, Gustavo José Justo Da Silva, Edson Dias Moreira, Fumio Ida, Carlos Eduardo Negrão, Eduardo Moacyr Krieger

Hypertension
Journal of the American Heart Association
American Heart Association®
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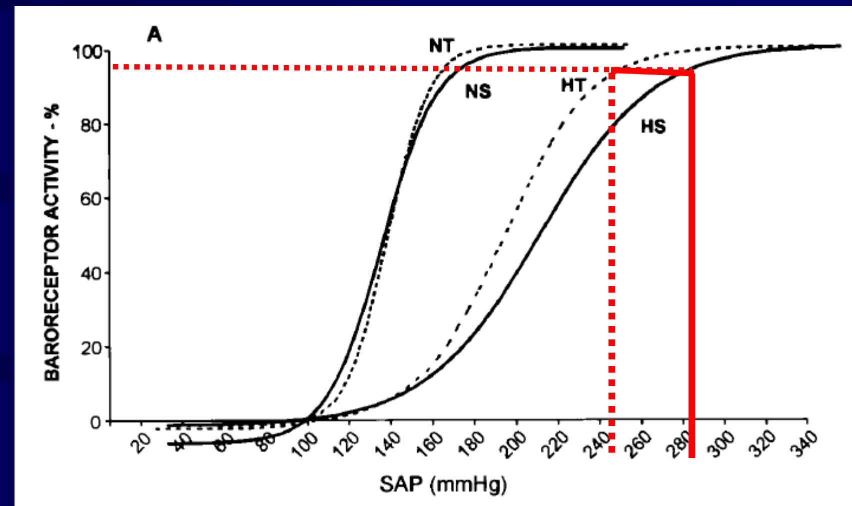
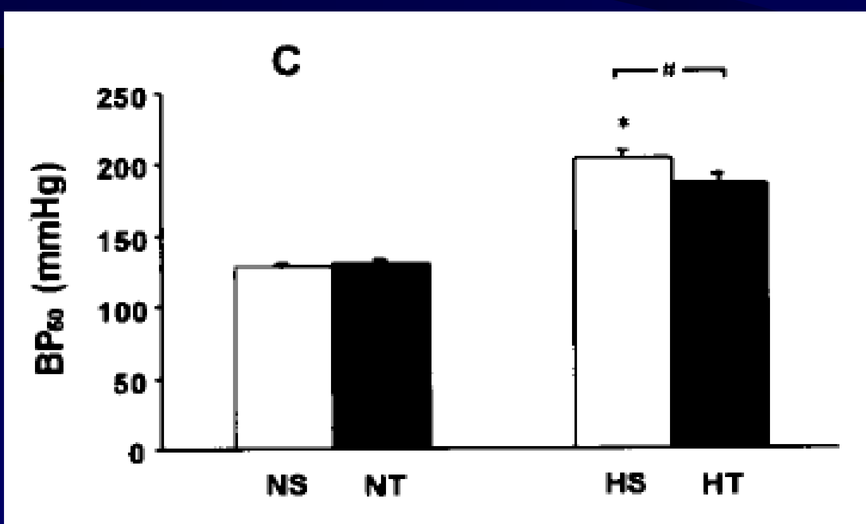
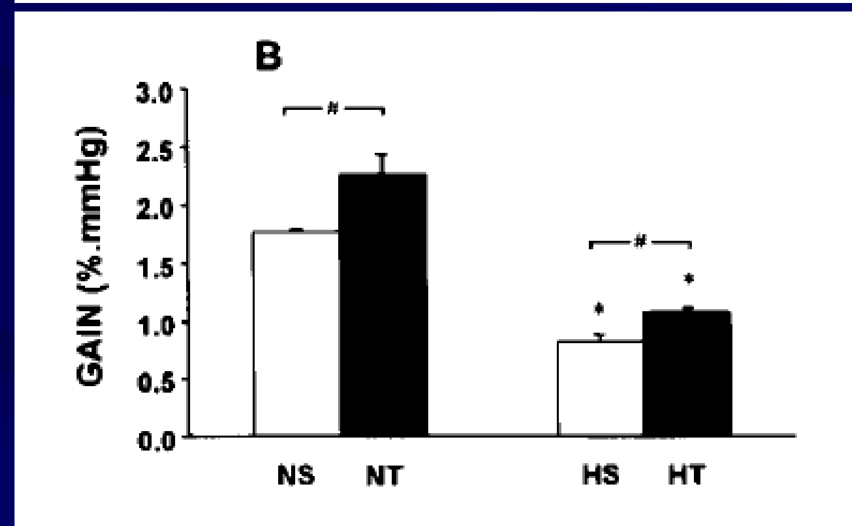


Treinamento Físico de baixa intensidade (5d/sem; 1h/dia) aumenta a sensibilidade baroreflexa em ratos.





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Vol. 42, No. 5, 2003
ISSN 0735-1097/03/$30.00
doi:10.1016/S0735-1097(03)00831-3

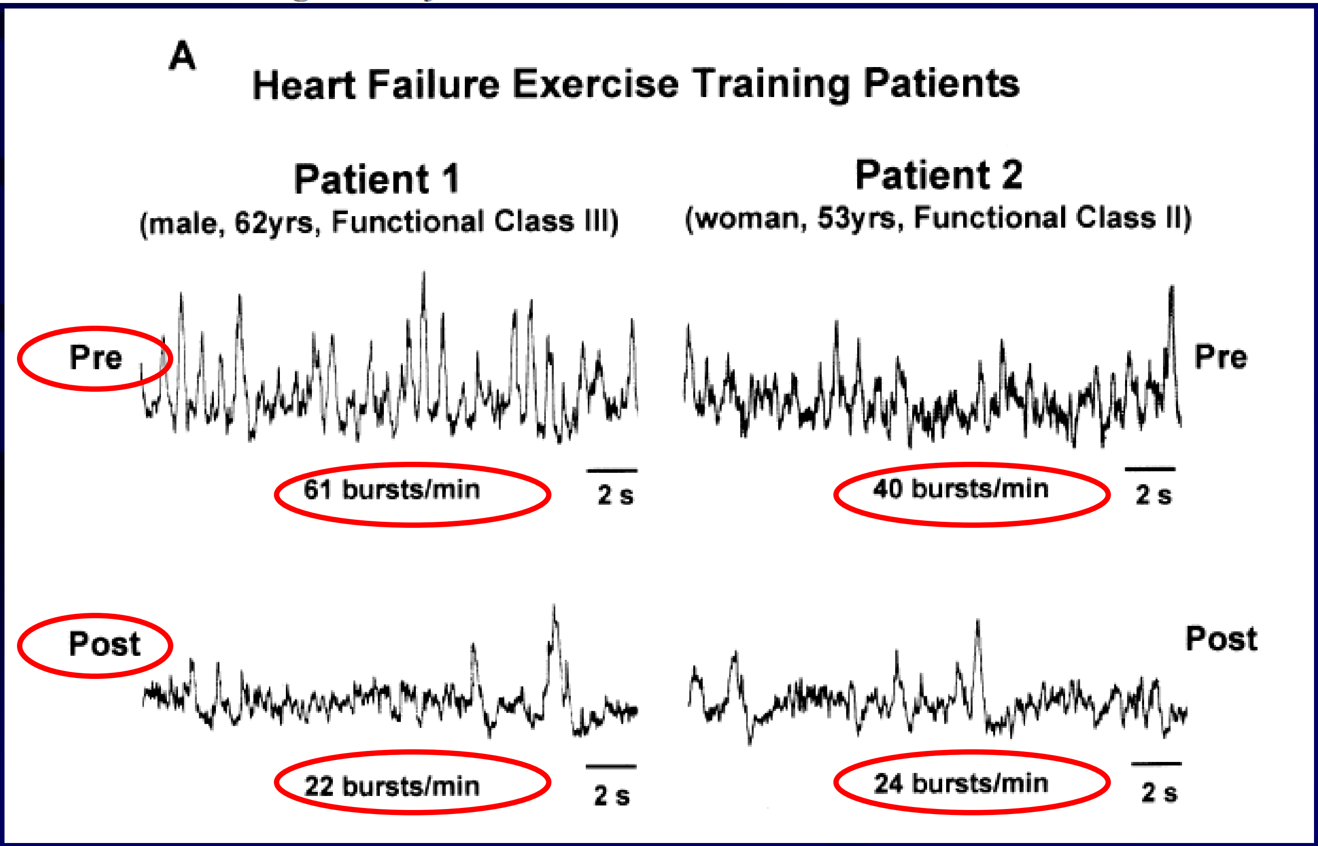
Exercise Training and Heart Failure

The Effects of Exercise Training on Sympathetic Neural Activation in Advanced Heart Failure

A Randomized Controlled Trial

Fabiana Roveda, MD, PhD,* Holly R. Middlekauff, MD,† Maria Urbana P. B. Rondon, PhD,* Soraya F. Reis, BS,* Márcio Souza, MS,‡ Luciano Nastari, MD,* Antonio Carlos P. Barretto, MD, PhD,* Eduardo M. Krieger, MD, PhD,* Carlos Eduardo Negrão, PhD*‡

São Paulo, Brazil; and Los Angeles, California



- 7 (GE)
- 9 (GC)
- 4 meses
- 3 sessões/sem
- 60min aeróbio
- 90% do PCR

Figure 1. Sympathetic neurograms. **(A)** Heart failure patients, exercise group. Pre-training, muscle sympathetic nerve activity (MSNA) is markedly elevated. Post-exercise training, sympathetic nerve activity levels are reduced. **(B)** Heart failure patients, sedentary group; MSNA levels are markedly elevated before and after the sedentary period.

Original Article

Nitric Oxide Synthesis Blockade Increases Hypertrophy and Cardiac Fibrosis in Rats Submitted to Aerobic Training

Hugo Celso Dutra de Souza, Daniel Martins Dias Penteado, Marli Cardoso Martin-Pinge, Octávio Barbosa Neto, Vicente de Paula Antunes Teixeira, João Henrique Dutra Blanco, Valdo José Dias da Silva

Faculdade de Medicina de Ribeirão Preto, Universidade Estadual de Londrina, Faculdade de Medicina do Triângulo Mineiro - Ribeirão Preto, SP, Londrina, PR, Uberaba, MG - Brazil

Óxido Nítrico tem papel importante nas adaptações cardiovasculares promovidas pelo treinamento.

140 x 90 → Algum tempo depois → **120x80**

Chronic Conventional Resistance Exercise Reduces Blood Pressure in Stage 1 Hypertensive Men

2011

Milton R. Moraes,[1,2] Reury F.P. Bacurau,[3] Dulce E. Casarini,[4] Zaira P. Jara,[4] Fernanda A. Ronchi,[4] Sandro S. Almeida,[1] Elisa M.S. Higa,[4] Marcos A. Pudo,[2] Thiago S. Rosa,[1] Anderson S. Haro,[1] Carlos C. Barros,[1] João B. Pesquero,[1] Martin Würtele,[1] and Ronaldo C. Araujo[1]

[1]Departament of Biophysics, Universidade Federal University of São Paulo, São Paulo, Brazil; [2]School of Physical Education, University of Mogi das Cruzes, Mogi das Cr... São Paulo, Brazil; and [4]Nephrology Division...

-N= 15 hipertensos;
-Idade: 46±3 anos;
-Medicados a 6 anos;

-Interrupção/medicação;
-ER a 60% 1RM;
-12 semanas (3x/sem);
-1 mês destreinamento.

Table 1. Anthropometric parameters and blood pressure of the hypertensive volunteers pre- and posttraining.*

Variable anthropometric	Resistance exercise: Pretraining	Resistance exercise: Posttraining	*p*
Age, years	46 ± 3		
Body mass, kg	88 ± 6	87 ± 5	NS
BMI, kg·m^{-2}	29 ± 2	28 ± 1	NS
Fat-free mass, kg	61 ± 2	64 ± 3	0.005
Fat mass, kg	27 ± 2	23 ± 2	0.001
Body fat, %	30 ± 2	26 ± 2	0.001
Total body water, L	47 ± 2	48 ± 2	0.01
Σ Skinfold, mm	191 ± 14	153 ± 12	0.001
Total weightlifting, kg	140 ± 5	185 ± 11	0.001
Strength handgrip, kg·f^{-1}	43 ± 2	48 ± 2	0.041
Sit-and-reach, cm	16 ± 2	22 ± 2	0.001
$\dot{V}O_2$peak (ml·kg^{-1}·min^{-1})	41 ± 3	44 ± 3	NS
Blood pressure, mm Hg			
Systolic	150 ± 3	134 ± 3	0.001
Diastolic	93 ± 2	81 ± 1	0.01
Mean	112 ± 2	99 ± 3	0.01

*BMI = body mass index; Σ = sum of 7 skinfold; NS = not significant.

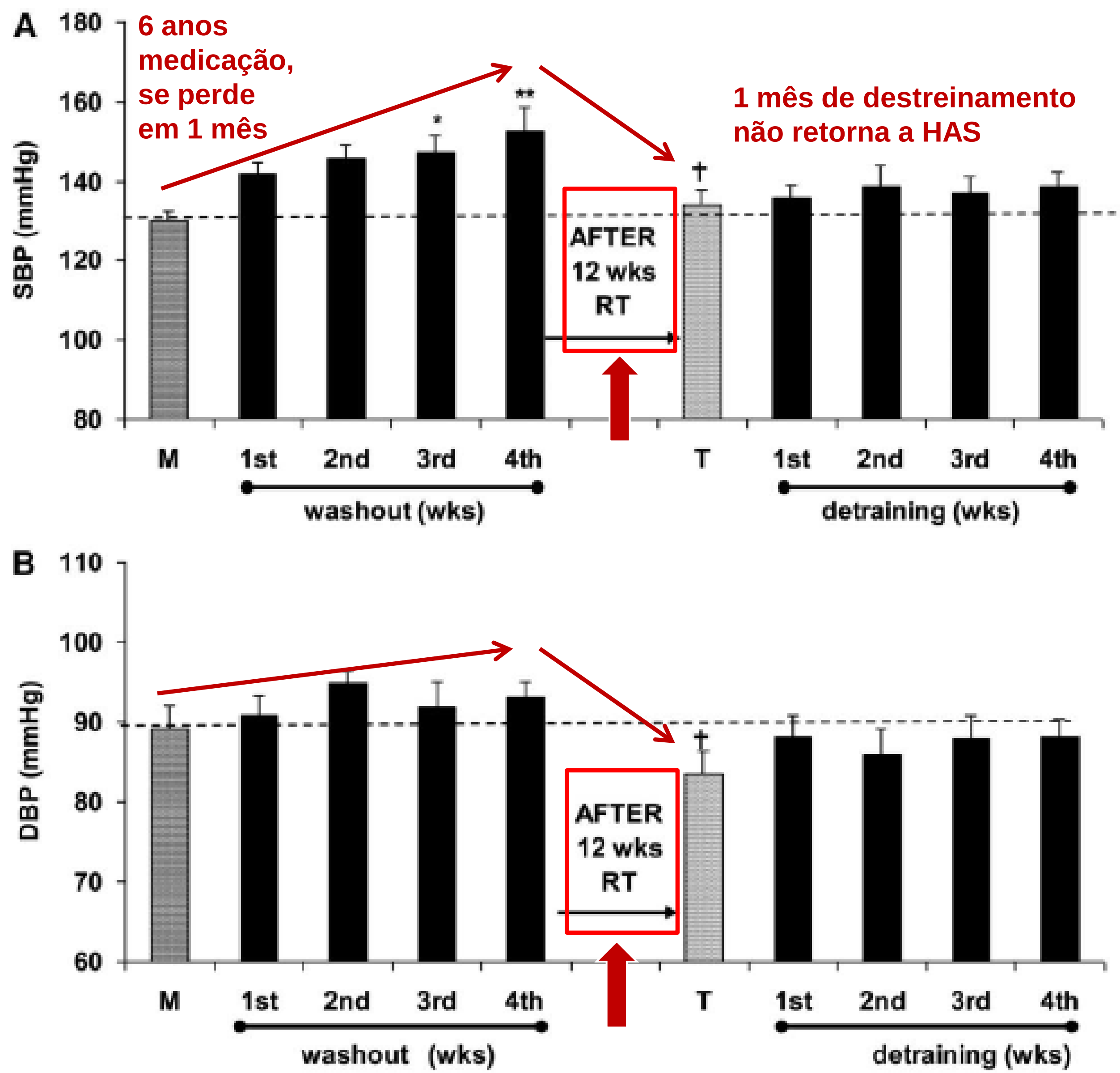


Figure 2. Blood pressure before and after 12 weeks of conventional resistance exercise. Systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP) of the volunteers ($n = 11$) before (M) the antihypertensive medication washout period, after the 12-week resistance exercise training period (T), and during the detraining period (*$p < 0.05$; **$p < 0.01$; †$p < 0.01$, related to last week of washout); wks = weeks; RT = resistance training.

(Moraes et al., 2011; JSCR)

É necessário as 12 semanas para ajustes na pressão arterial?

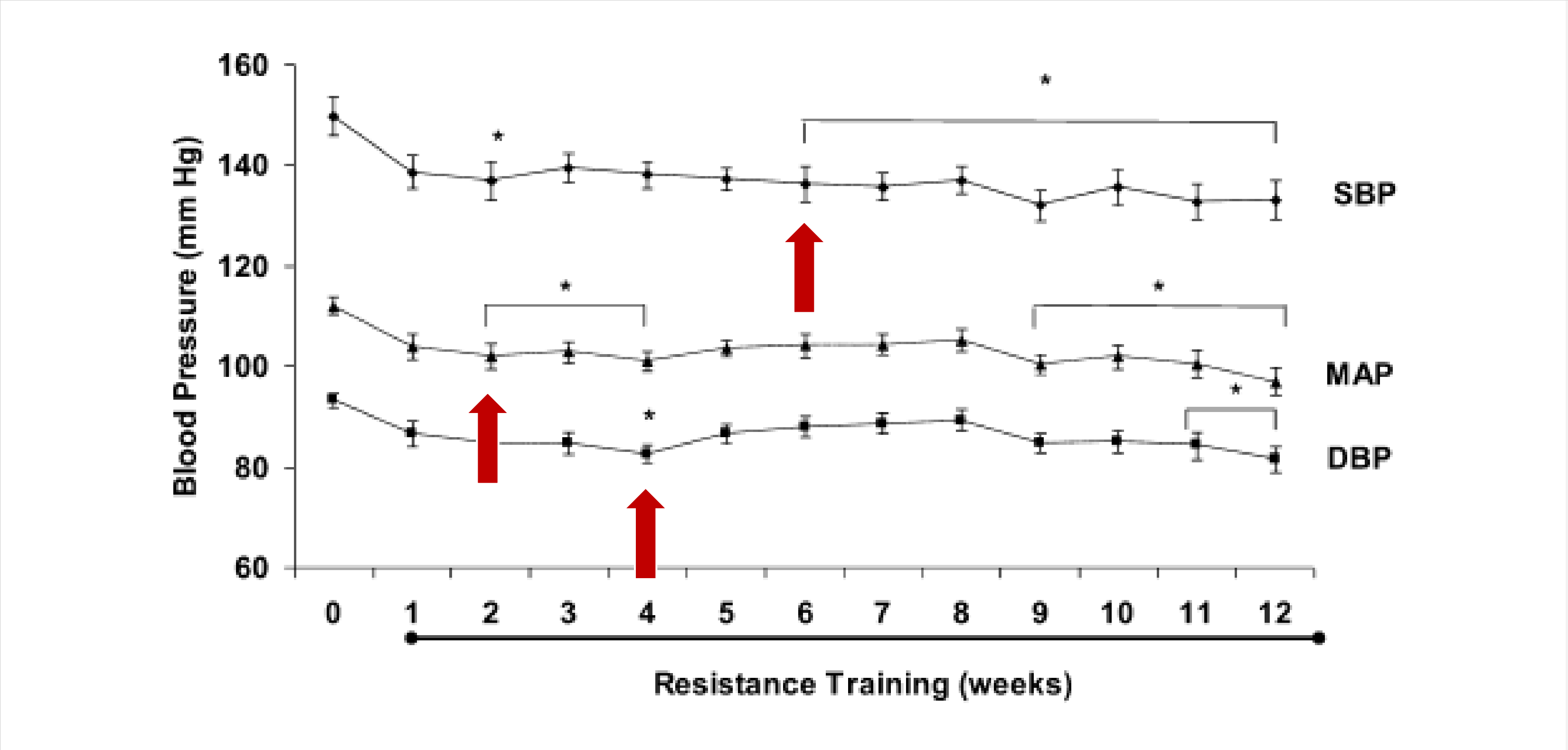


Figure 3. Blood pressure during 12 weeks of conventional resistance exercise (RE). Systolic blood pressure (SBP), diasotlic blood pressure (DBP), and mean arterial pressure (MAP) of the volunteers ($n = 15$) pretraining (0) and during the 12 weeks (1-12) of the RE training program (*$p < 0.05$).

(Moraes MR et al. 2011; JSCR)

Perspectivas Práticas Futuras

Exercícios não convencionais

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US National Library of Medicine
National Institutes of Health

PubMed

Advanced

Abstract

Send to:

J Sports Med Phys Fitness. 2016 Feb 3. [Epub ahead of print]

Ten weeks of capoeira progressive training improved cardiovascular parameters in male practitioners.

Moreira SR[1], Teixeira-Araujo AA, Oliveira Dos Santos A, Simões H.

Author information

Abstract

BACKGROUND: The present study analyzed the effects of ten weeks of Capoeira progressive training program on the cardiovascular parameters of male practitioners.

METHODS: Participants were assigned into two groups [Capoeira, n=10; 25.4±3.3 years; 24.2±2.2 kg.m2(-1) and Control, n=08; 29.6±6.3 years; 26.4±4.4 kg.m2(-1)]. The Capoeira group performed ten weeks of Capoeira progressive training program, being one session per week lasting 90min each. The Control group was instructed to avoid any exercise training program or intense physical activities during the experimental period. The blood pressure (BP), heart rate (HR), and rate pressure product (RPP), as well as HR variability (HRV) indicators were evaluated on resting, before and after intervention.

RESULTS: A two-way ANOVA revealed a main effect of group by time interaction to HR (F=6.649, η2=0.379; p=0.02), and HRV indicators (RRi: F=5.752, η2=0.313; rMSSD: F=4.652, η2=0.283; SD1: F=4.694, η2=0.409, and pNN50: F=5.561, η2=0.360; p<0.05). A main effect of time condition was verified for Capoeira group (p<0.05) on HR (Δ= -6.6±6.0 bpm), RRi (Δ= 80.1±65.4 ms), rMSSD (Δ= 14.1±11.6 ms), SD1 (Δ= 10.0±8.2 ms), and pNN50 (Δ= 11.3±9.7%). The between groups analysis identified significant differences (p<0.05) for the HR after intervention (Capoeira: -8.6±6.9% vs.

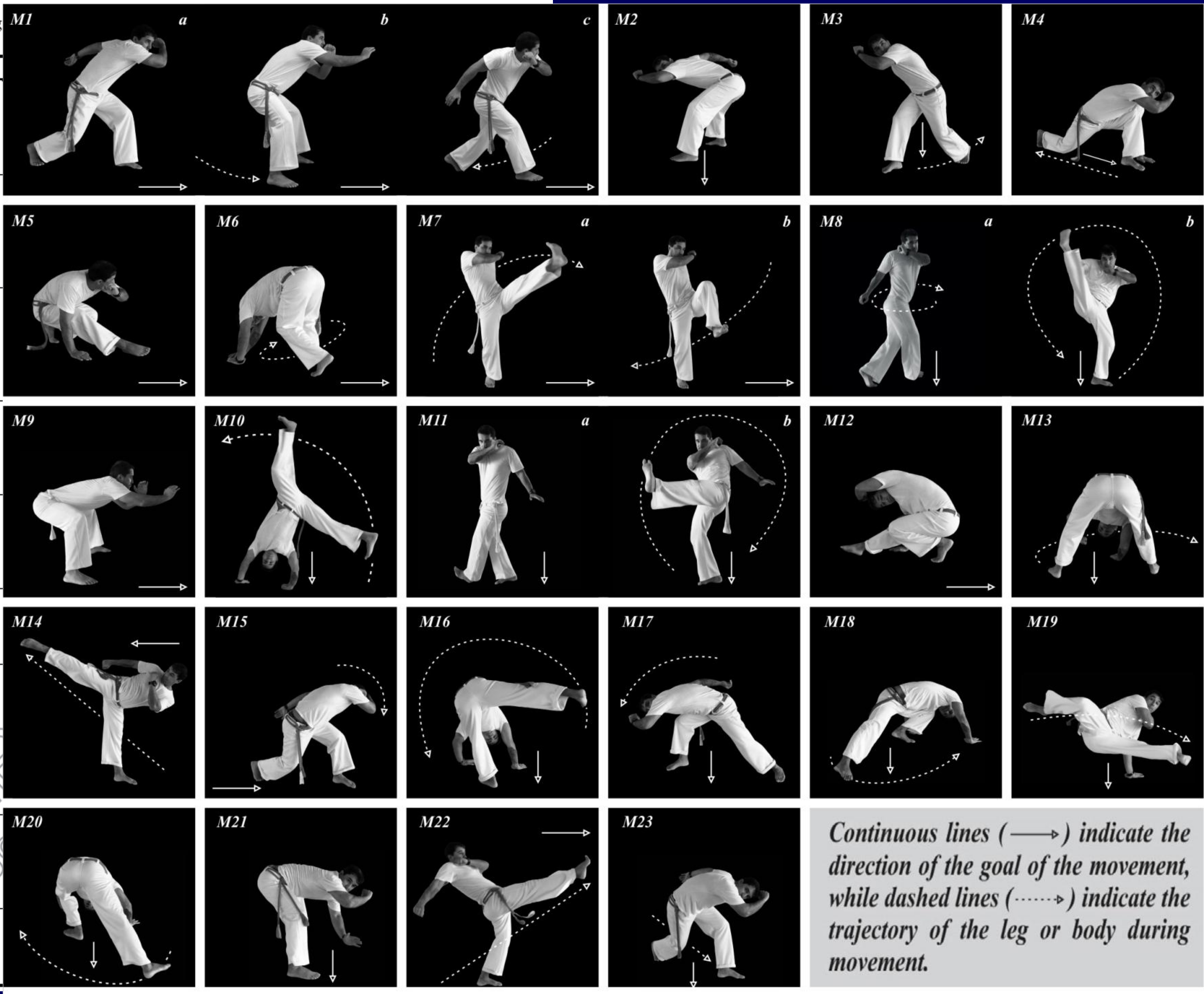
CONTROL: -0.7±3.9%). The comparison between Capoeira vs. Control for HRV indicators (RRi: Δ= 10.1±8.5% vs. 0.9±7.6%; rMSSD: Δ= 37.8±32.9% vs. 2.9±31.3%; pNN50: Δ= 96.2±78.7% vs. 0.3±54.1%; and SD1: Δ= 37.7±32.9% vs. 6.5±24.4%; respectively) differed to each other (p<0.05).

CONCLUSION: Our findings showed that ten weeks of Capoeira progressive training program improves both autonomic and cardiovascular parameters in male practitioners. Key words: Brazilian fight - Chronic effects - Blood pressure - Heart rate variability.

(MOREIRA SR et al, 2016; J Sports Med Phys Fitness)

Table II. – Progressive training

Frequency	Intensity	Time
1st week 1x	Low	15’ 55’ 20’
2nd week 1x	Low	15’ 55’ 20’
3rd week 1x	Low	15’ 55’ 20’
4th week 1x	Low to Moderate	15’ 55’ 20’
5th week 1x	Low to Moderate	15’ 55’ 20’
6th week 1x	Low to Moderate	15’ 55’ 20’
7th week 1x	Moderate	15’ 55’ 20’
8th week 1x	Moderate	15’ 55’ 20’
9-10th week 1x each	Moderate	15’ 55’ 20’



(MOREIRA SR et al., 2016; J Sports Med Phys Fitness)

Table III. – Mean (±SD) of cardiovascular variables and their percentual change (Δ%) in relation to pre-intervention for the *Capoeira* and Control groups.

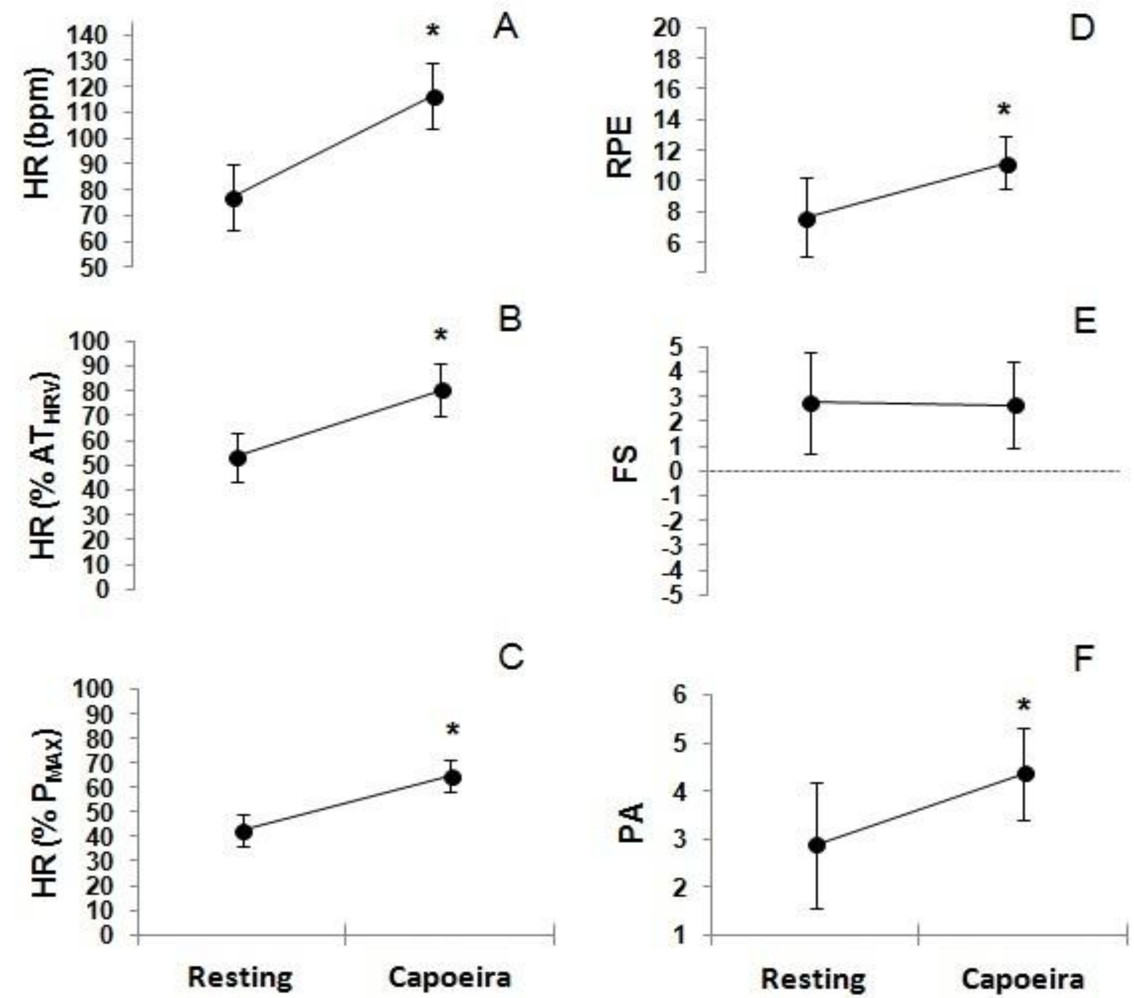
Variable	Time	CONTROL	*CAPOEIRA*	Main effect: Time*Group	Main effect: Time
HR (bpm)	**Pre**	68.5±8.3	75.9±9.3	F = 6.649	F = 9.750
	Post	67.8±7.0	69.3±10.2 **	p = 0.020	p = 0.007
	Δ%	-0.7±3.9	-8.6±6.9 ††	η^2 = 0.294	η^2 = 0.379
SBP (mmHg)	**Pre**	128.2±6.0	128.8±9.5	F = 0.924	F = 5.500
	Post	125.9±8.9	123.2±9.7 *	p = 0.351	p = 0.032
	Δ%	1.7±6.0	-4.2±4.6	η^2 = 0.055	η^2 = 0.256
DBP (mmHg)	**Pre**	81.5±5.5	83.4±8.3	F = 0.000	F = 8.178
	Post	78.4±9.9	80.3±7.9 *	p = 0.984	p = 0.011
	Δ%	-4.0±6.8	-3.6±4.2	η^2 = 0.000	η^2 = 0.338
MAP (mmHg)	**Pre**	97.0±4.9	98.5±8.1	F = 0.341	F = 8.194
	Post	94.5±8.9	94.6±8.0 *	p = 0.568	p = 0.011
	Δ%	-2.7±5.7	-3.9±3.7	η^2 = 0.021	η^2 = 0.339
RPP (mmHg*bpm)	**Pre**	8765.9±1050.3	9818.1±1707.1	F = 3.813	F = 8.239
	Post	8537.2±1038.0	8615.9±1900.9*	p = 0.069	p = 0.011
	Δ%	-2.3±9.0	-12.2±10.5	η^2 = 0.192	η^2 = 0.340

SBP: systolic blood pressure; DBP: diastolic blood pressure; MAP: mean arterial pressure; HR: heart rate; RPP: rate pressure product. **p*<0.05 and ***p*<0.01 in relation to Pre in the *CAPOEIRA group (adjusted p values by Bonferroni-corrected multiple pairwise comparisons); ††p<0.01 for Δ% in relation to CONTROL group*

Journal of Strength and Conditioning Research

Heart rate and perceptual responses of practitioners during the different moments of Capoeira progressive training session

--Manuscript Draft--

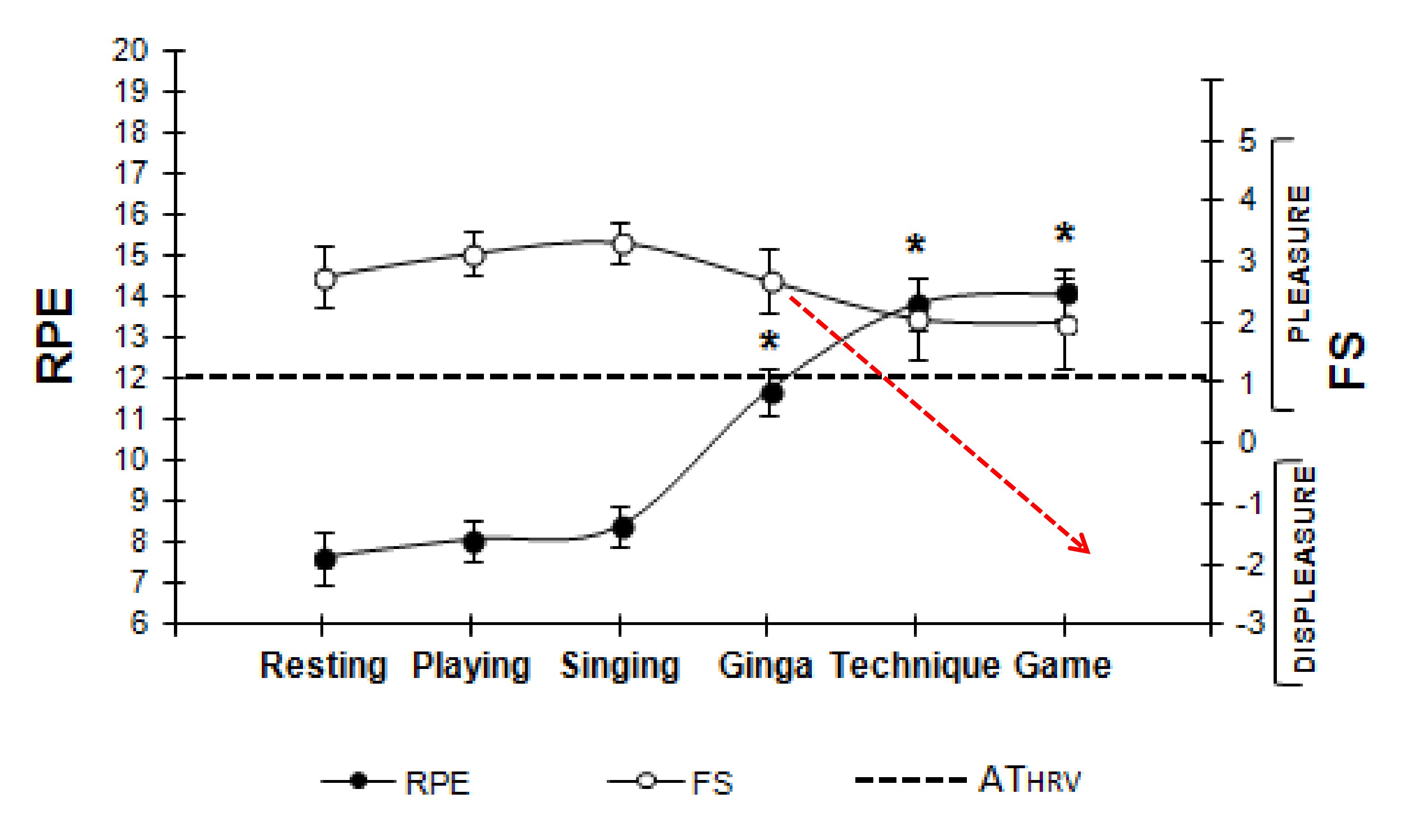


(MOREIRA SR et al., 2016; J Strenght and Cond Research)

Journal of Strength and Conditioning Research

Heart rate and perceptual responses of practitioners during the different moments of Capoeira progressive training session

--Manuscript Draft--



(MOREIRA SR et al., 2016; J Strenght and Cond Research)

Environ Health Prev Med (2010) 15:18–26
DOI 10.1007/s12199-009-0086-9

SPECIAL FEATURE

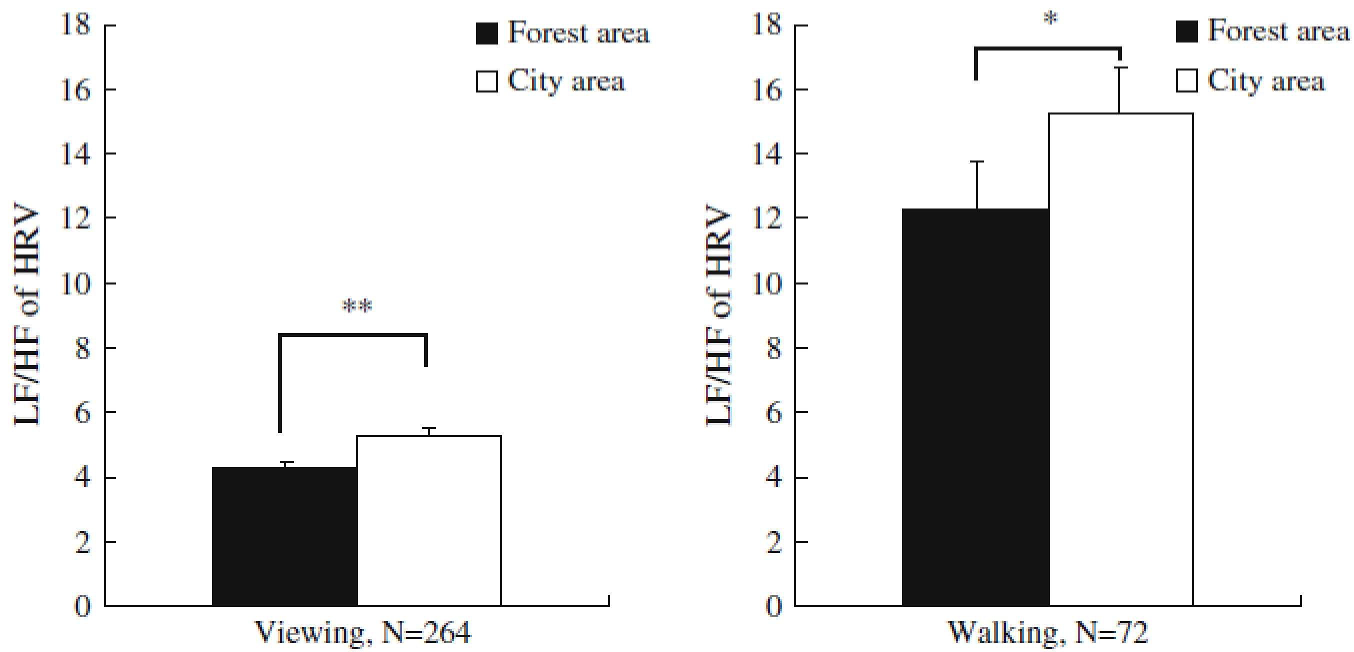
The Trends on the Research of Forest Bathing in Japan, Korea and in the World

The physiological effects of *Shinrin-yoku* (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan

Bum Jin Park · Yuko Tsunetsugu · Tamami Kasetani ·
Takahide Kagawa · Yoshifumi Miyazaki

Fig. 1 Forest viewing and walking

Fig. 7 Change in LF/HF of HRV upon forest viewing and walking. Mean ± SE; ** $p < 0.01$; * $p < 0.05$; p value by t test



Sistematicamente, o que a literatura tem mostrado sobre o treinamento crônico na PA?

ORIGINAL RESEARCH

Journal of the American Heart Association

OPEN ACCESS

2013

Exercise Training for Blood Pressure: A Systematic Review and Meta-analysis

Veronique A. Cornelissen, PhD;

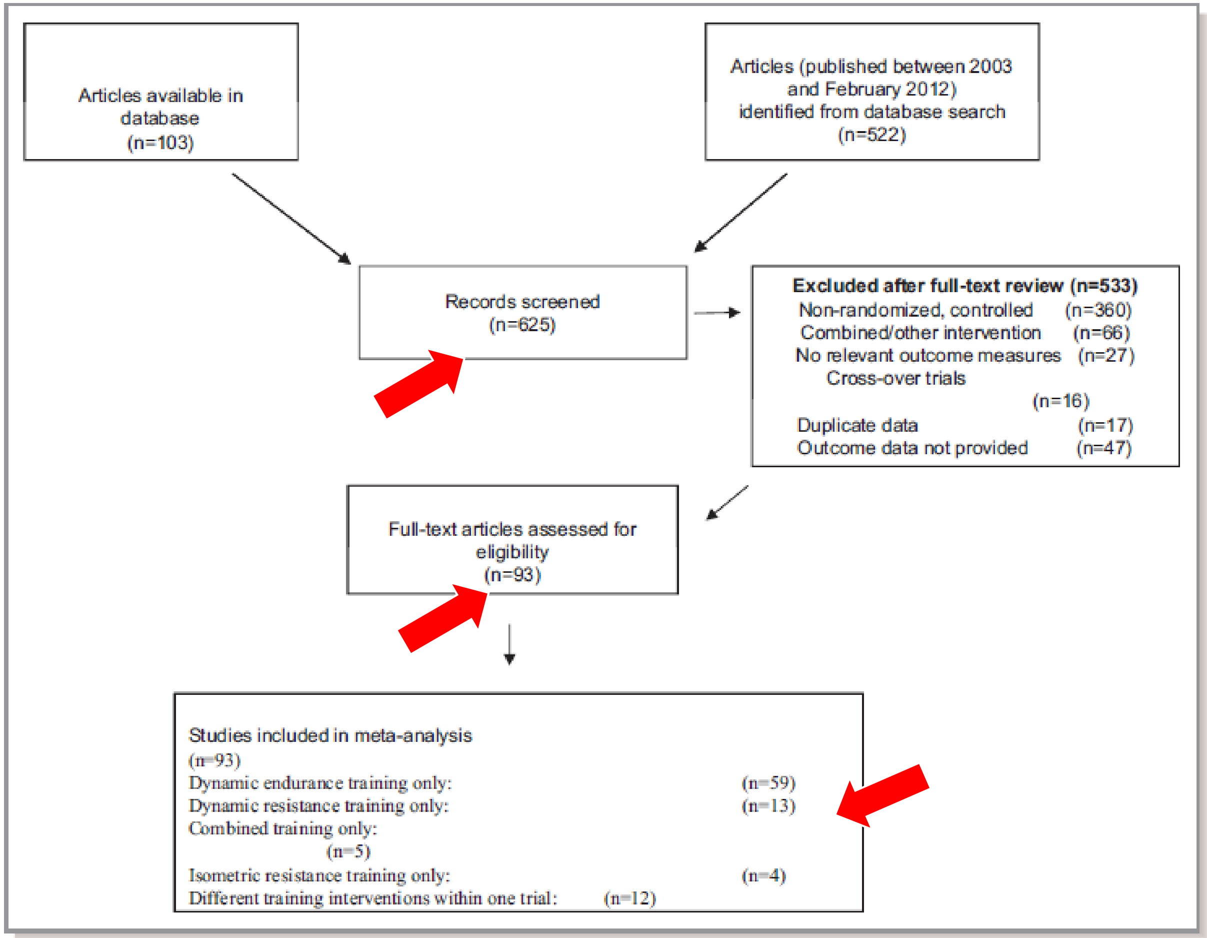


Figure 1. PRISMA flow diagram. PRISMA indicates preferred reporting items for systematic reviews and meta-analyses.

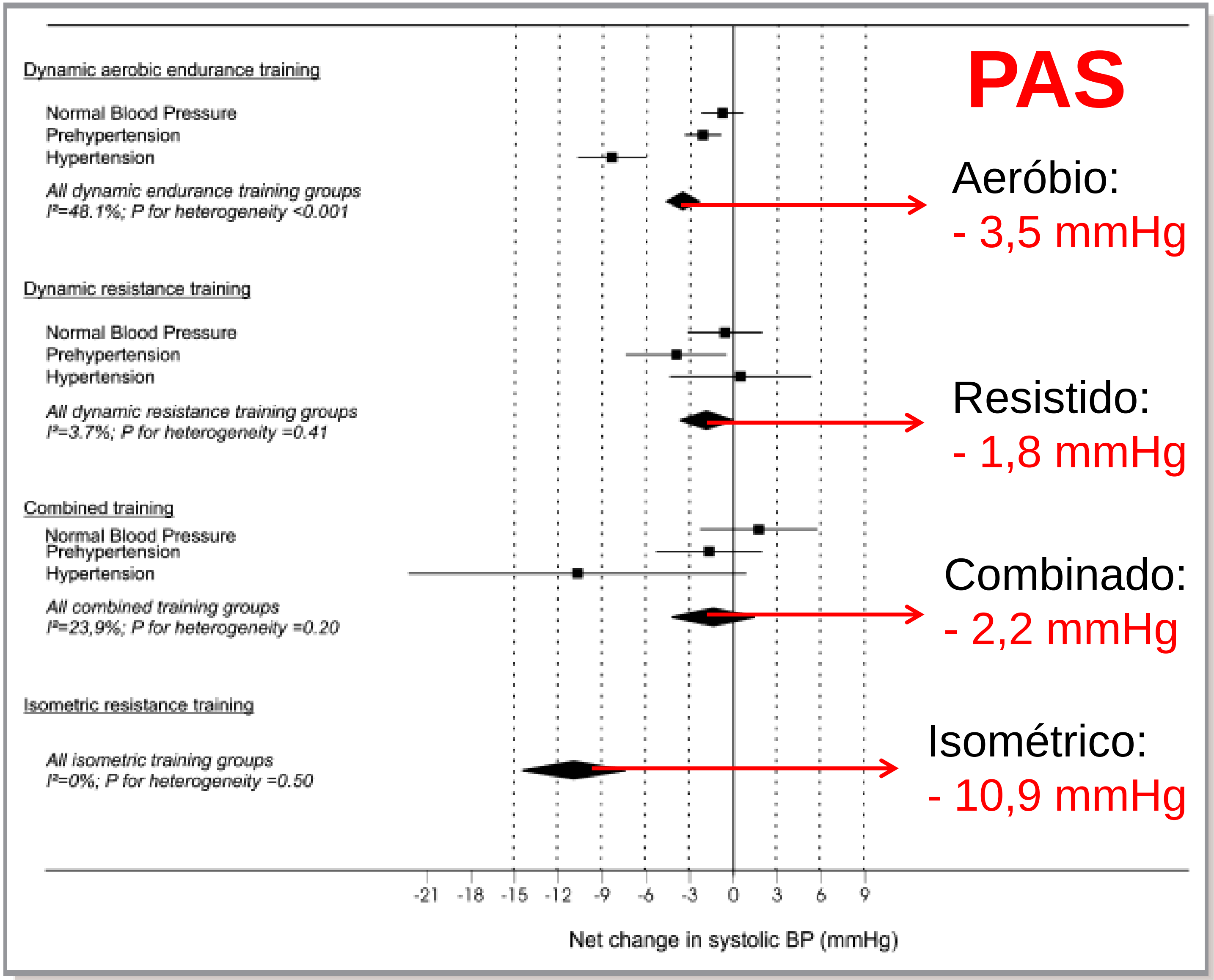


Figure 2. Net changes in systolic blood pressure (BP) after different exercise modalities using random-effects analyses. Data ar net mean changes, adjusted for control data (95% confidence limits).

(Cornelissen & Smart; AHA, 2013)

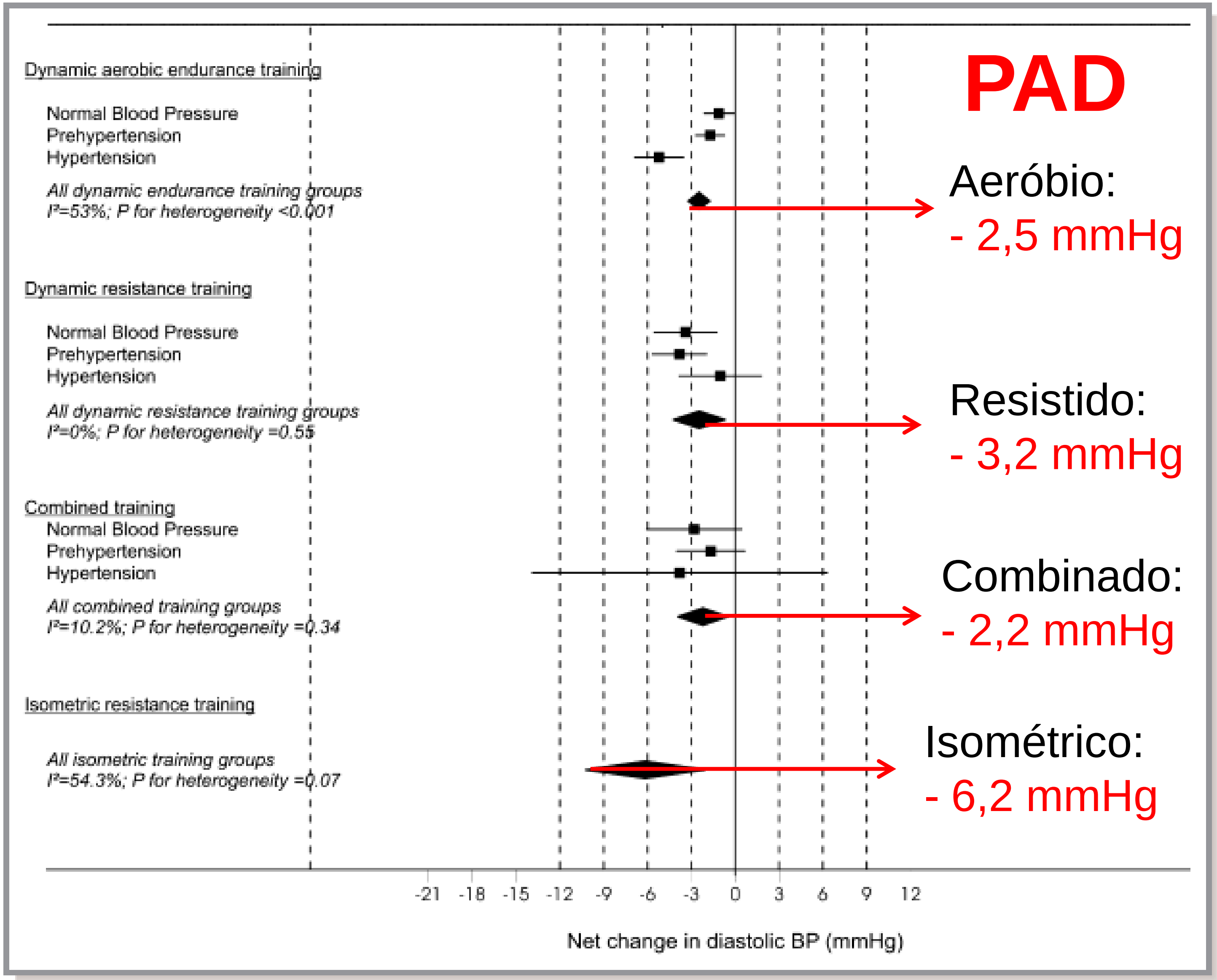


Figure 3. Net changes in diastolic blood pressure (BP) after different exercise modalities using random effects analyses. Data are net mean changes, adjusted for control data (95% confidence limits).

(Cornelissen & Smart; AHA, 2013)

JAMA®

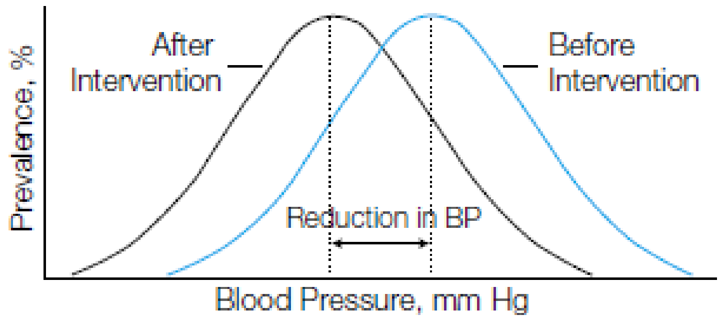
Online article and related content current as of October 26, 2009.

Primary Prevention of Hypertension: Clinical and Public Health Advisory From the National High Blood Pressure Education Program

Paul K. Whelton; Jiang He; Lawrence J. Appel; et al.

JAMA. 2002;288(15):1882-1888 (doi:10.1001/jama.288.15.1882)

Figure. Systolic Blood Pressure Distributions



Reduction in BP, mm Hg	% Reduction in Mortality		
	Stroke	CHD	Total
2	−6	−4	−3
3	−8	−5	−4
5	−14	−9	−7

BP indicates blood pressure; CHD, coronary heart disease. Adapted from *Arch Intern Med*,[7] with additional data from Stamler.[16]

Reduções de 2 mmHg na PAD:

-14% no risco de AVC e isquemias;

-6% no risco de doença coronariana;

-17% na prevalência de HAS em população de 35-64 anos de idade.

ORIGINAL RESEARCH

American Heart Association | American Stroke Association

Exercise Training for Blood Pressure: A Systematic Review and Meta-analysis

Veronique A. Cornelissen, PhD; Neil A. Smart, PhD

Dynamic endurance t… and combined training w… in SBP and DBP, and n… similar across these 3 … endurance training, we… pronounced in male pa… pants, but significant … participants with norma… after dynamic resistance training, reductions in SBP and DBP were largest in the study groups of prehypertensive participants. Moreover, the effects of endurance training, dynamic resistance training, and combined training on SBP and DBP in the individual with normal BP or prehypertension were similar, underlining the value of dynamic resistance training as an adjunct therapy for the prevention of high BP in these preclinical populations. Our results suggest endurance training might be superior to dynamic resistance training for hypertensive individuals, although it should be noted only 4 of

29 dynamic resistance study groups involved hypertensive patients. Therefore, until clearer evidence emerges, it may be prudent to prescribe endurance training rather than dynamic resistance training for the hypertensive individual if lower BP is desired.

Our findings further demonstrate that isometric handgrip training and isometric leg training result in larger reductions in SBP and a trend toward lower DBP compared with the 3 other exercise modalities, but the paucity of studies to date limits the strength of this conclusion. As stated earlier, there is no between-trial heterogeneity among the 5 isometric training groups,[8] and lack of significant publication bias suggests the findings are robust, although generalizability of the results might be premature as data were available from only 4 trials (5 study groups).

(Cornelissen & Smart; American Heart Association, 2013)

Aplicação Prática

Efeito redutor crônico do AERÓBIO na PA

1) Independente de idade os efeitos ocorrem;
2) Quanto maior o estado hipertensivo melhor o efeito;
3) Tempo de intervenção entre <12 a 24 semanas. Acima procurar modificar importantemente o estímulo;
4) Intensidade de moderada a alta;
5) Duração da sessão entre 30 a 45 min;
6) Volume semanal entre <150 a 210 min.

(Cornelissen & Smart; American Heart Association, 2013)

Aplicação Prática

Efeito redutor crônico do <u>RESISTIDO</u> na PA

1) Mais velhos ($\geq$50 anos) melhores são os efeitos;
2) Em pré-hipertensos os efeitos são melhores;
3) Tempo de intervenção entre <12 a 24 semanas;
4) Acima de 24 semanas procurar modificar os estímulos importantemente;
5) Sem diferenças na intensidade, com tendência de baixa a moderada parecer melhor.

(Cornelissen & Smart; American Heart Association, 2013)

LEADING ARTICLE

Sports Med 2006; 36 (2): 109-116
0112-1642/06/0002-0109/$39.95/0

The Anti-Hypertensive Effects of Exercise

Integrating Acute and Chronic Mechanisms

Mark Hamer

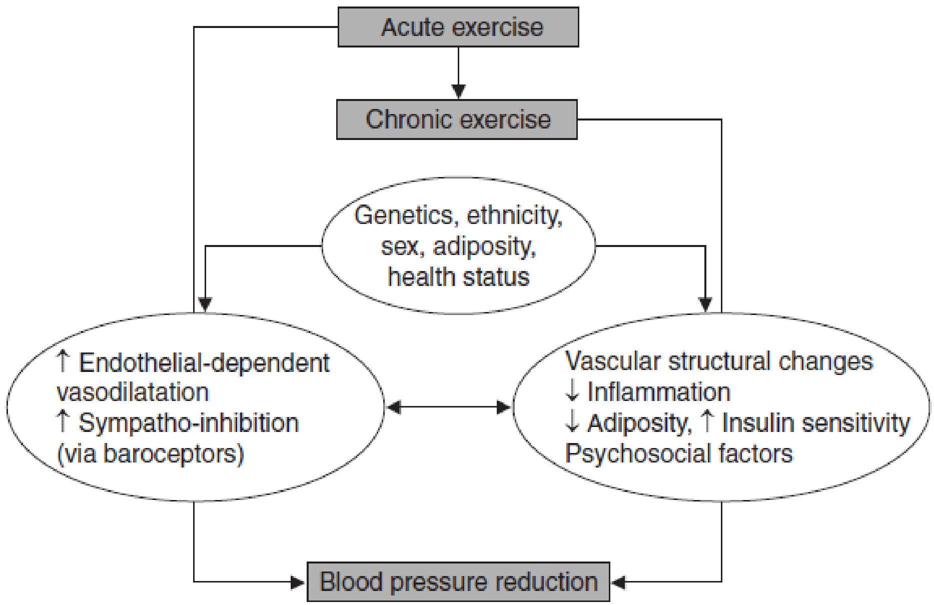


Fig. 1. The integration of acute and chronic anti-hypertensive mechanisms of exercise. ↓ indicates decrease; ↑ indicates increase.

A hipotensão pós-exercício tem alguma relação com o efeito crônico do treinamento em indivíduos com PA alta?

Blood Pressure Responses to Acute and Chronic Exercise Are Related in Prehypertension

2012

SAM LIU[1], JACK GOODMAN[1], ROBERT NOLAN[2], SHAWN LACOMBE[1], and SCOTT G. THOMAS[1]

[1]Graduate Department of Exercise Sciences, Faculty of Kinesiology and Physical Education, University of Toronto, Toronto, Ontario, CANADA; and [2]Behavioral Cardiology Research Unit, University Health Network, Toronto, Ontario, CANADA

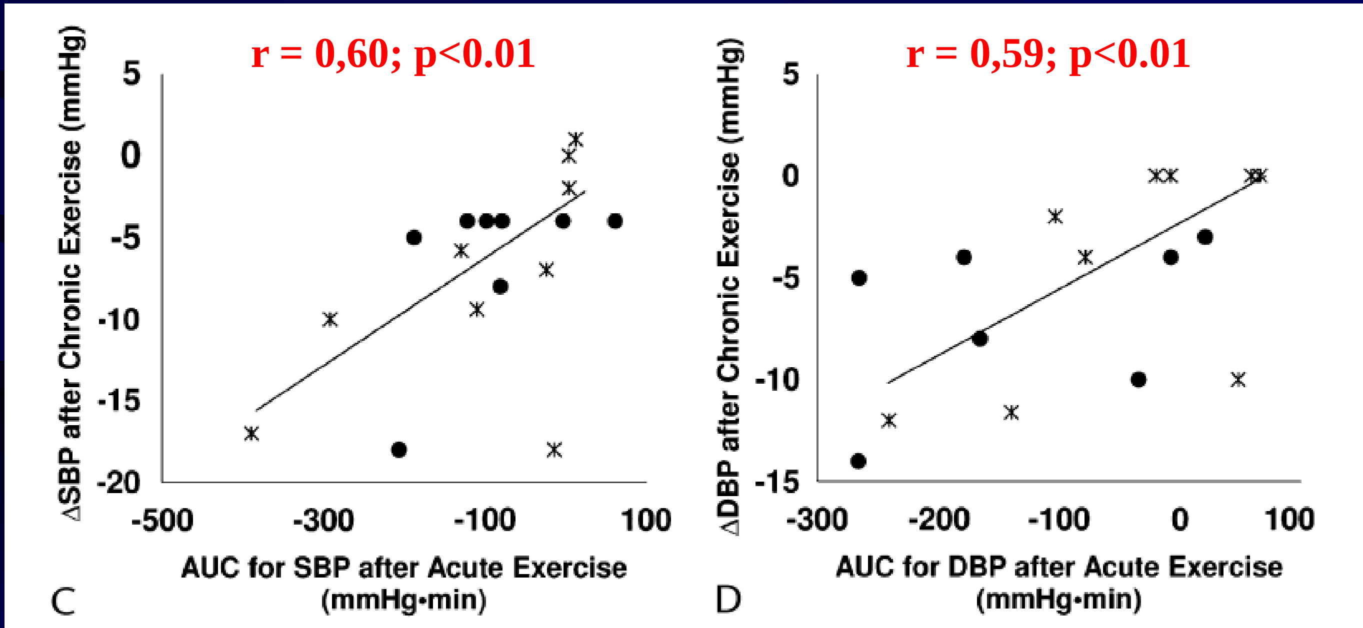


FIGURE 2—A. The magnitude of change (Δ) in SBP after acute exercise was significantly correlated with the magnitude of change (Δ) in resting SBP after chronic training ($r = 0.89$, $P < 0.01$; 1.1 ± 0.14 ($B \pm$ SE), $P < 0.01$; adjusted $r^2 = 0.78$, $P < 0.001$). Males: $r = 0.83$, $P < 0.01$; 0.53 ± 0.24 ($B \pm$ SE), $P < 0.001$; adjusted $r^2 = 0.82$ ($P < 0.01$). Females: $r = 0.90$, $P < 0.01$; 0.82 ± 0.15 ($B \pm$ SE), $P < 0.001$; adjusted $r^2 = 0.78$ ($P < 0.001$). B. Significant correlation between ΔDBP after acute exercise and resting ΔDBP after chronic training ($r = 0.75$, $P < 0.01$; 0.722 ± 0.19 ($B \pm$ SE), $P < 0.01$; adjusted $r^2 = 0.58$, $P < 0.001$). Males: $r = 0.77$, $P < 0.01$; 0.75 ± 0.29 ($B \pm$ SE), $P = 0.09$. Females: $r = 0.87$, $P < 0.01$; 0.85 ± 0.266 ($B \pm$ SE), $P < 0.01$; adjusted $r^2 = 0.79$, $P < 0.01$. C. The AUC for SBP after acute exercise was significantly correlated with ΔSBP after chronic training ($r = 0.60$, $P < 0.01$; 0.60 ± 0.10 ($B \pm$ SE), $P < 0.01$; adjusted $r^2 = 0.32$, $P < 0.01$). Males: $r = 0.57$, $P > 0.05$. Females: $r = 0.60$, $P > 0.05$. D. The AUC for DBP after acute exercise was significantly correlated with ΔDBP after chronic training ($r = 0.59$, $P < 0.01$; 0.60 ± 0.11 ($B \pm$ SE), $P < 0.001$; adjusted $r^2 = 0.31$, $P < 0.05$). Males: $r = 0.61$, $P > 0.05$. Females: $r = 0.62$, $P > 0.05$. The linear regressions are adjusted for baseline BMI.

IJSM/3967/6.6.2014/MPS

Correlation between Acute and Chronic 24-Hour Blood Pressure Response to Resistance Training in Adult Women

2014

Authors

R. A. Tibana[1], N. M. F. de Sousa[2], D. da Cunha Nascimento[1], G. B. Pereira[3], S. G. Thomas[4], S. Balsamo[5], H. G. Simoes[6], J. Prestes[7]

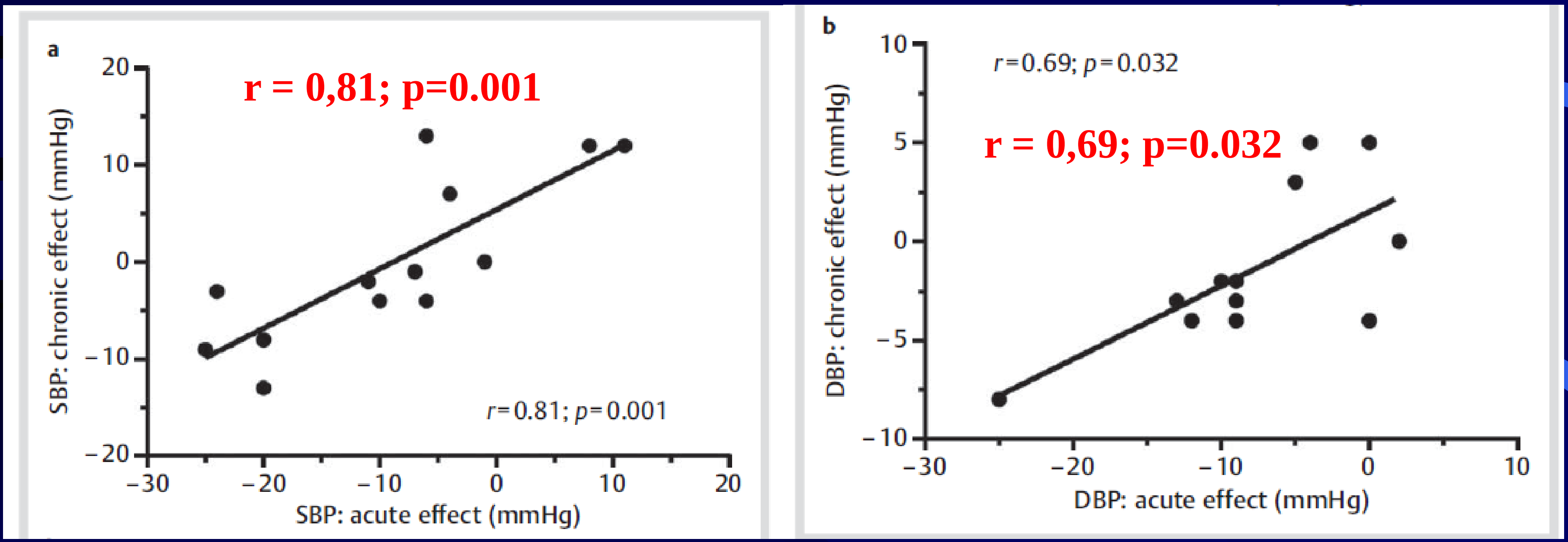


Fig. 3 Correlation between the magnitudes of change in chronic exercise training and the lowest values after acute exercise for systolic (SBP; **a**) and diastolic blood pressure (DBP; **b**).

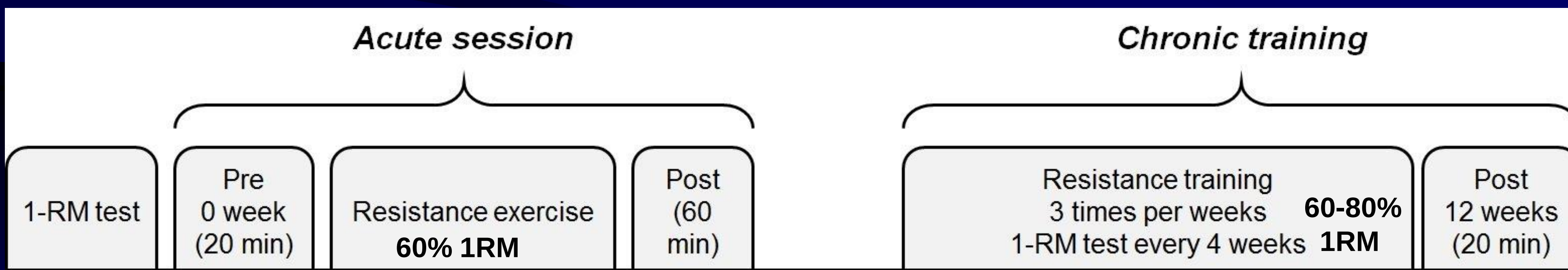
Clin Physiol Funct Imaging (2014) doi: 10.1111/cpf.12221

2014

Acute blood pressure changes are related to chronic effects of resistance exercise in medicated hypertensives elderly women

Sérgio R. Moreira[1], Gabriel G. Cucato[2], Denize F. Terra[3] and Raphael M. Ritti-Dias[2]

[1]College of Physical Education and Graduate Program on Health and Biological Sciences, Federal University of Vale do São Francisco, Petrolina, Pernambuco, [2]Hospital Israelita Albert Einstein, São Paulo and [3]Graduate Program in Physical Education, Catolic University of Brasilia, Brasilia, Distrito Federal



PAS PAD

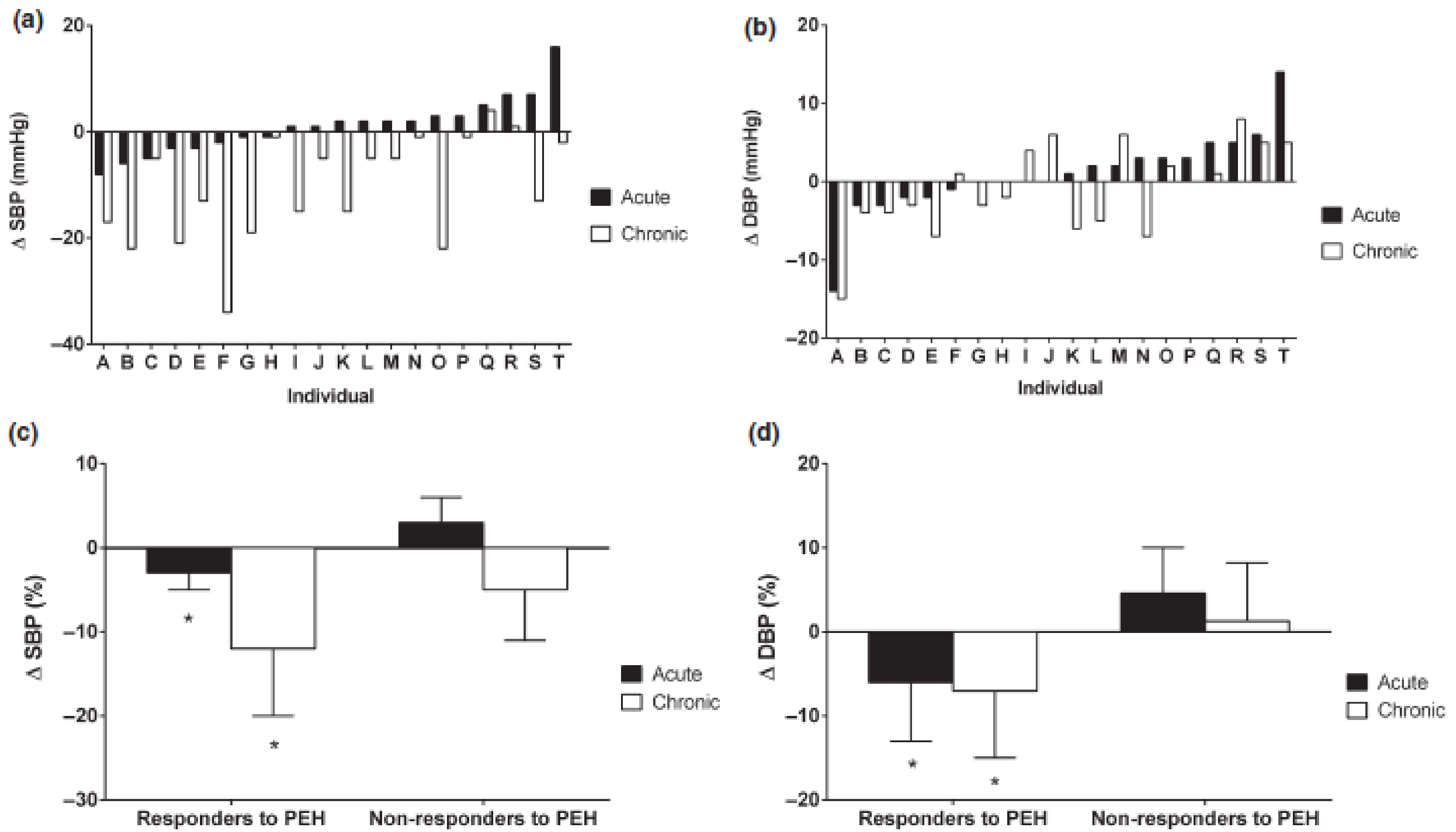


Figure 2 The individual acute and chronic systolic blood pressure (SBP) and diastolic blood pressure (DBP; upper) and comparison of acute and chronic responses between subjects with and without acute decreases in blood pressure (bottom). *$P<0.05$ versus patients without acute and chronic decreases in blood pressure.

(Moreira SR et al, 2014; Clin Fhysiol Funct Imaging)

PAS   PAD

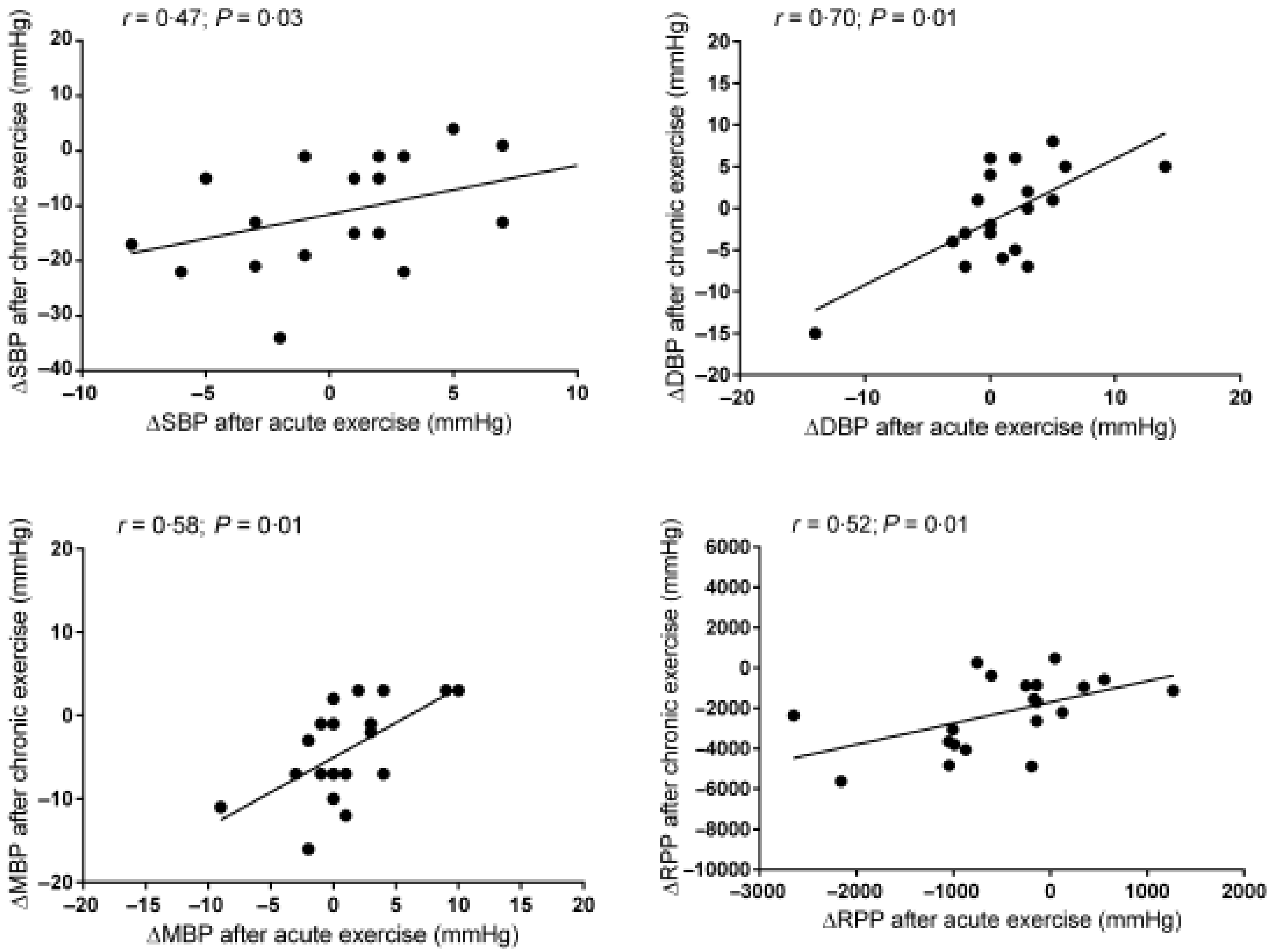


Figure 3 Relationship between the changes (Δ) of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and rate pressure product (RPP) after acute exercise and chronic resistance training (n = 20).

(Moreira SR et al, 2014; Clin Fhysiol Funct Imaging)

Qual a aplicação clínica da Hipotensão pós-exercício?

original article

2014 BJPT Brazilian Journal of Physical Therapy

Combined exercise circuit session acutely attenuates stress-induced blood pressure reactivity in healthy adults

Sérgio R. Moreira[1], Ricardo M. Lima[2], Karina E. S. Silva[3], Herbert G. Simões[4]

- N = 20 homens, aparentemente saudáveis;
- Exercício combinado 35min;
- Sessão controle;
- Aeróbio PSE =13 – 15min; Resistido 50%1RM – 20min;
- HPE e reatividade vascular de PA.

(Moreira SR et al, 2014; Braz J Fisiot)

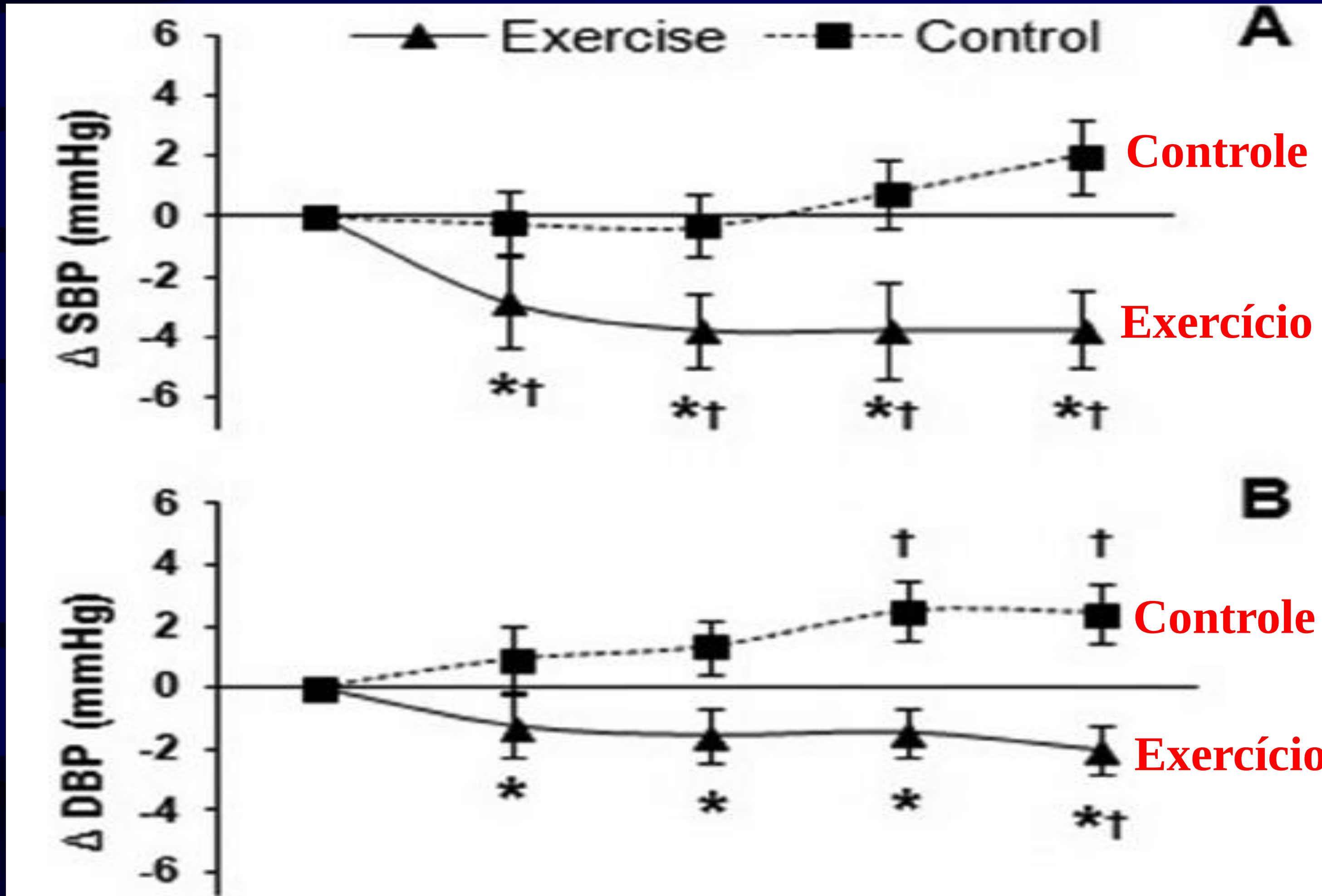


Figure 1. Range (mmHg) of systolic blood pressure (Δ SBP), diastolic blood pressure (Δ DBP), mean arterial pressure (Δ MAP), and heart rate (Δ HR) in the post-exercise session recovery moments (Rec15'-Rec60'). *p<0.03 compared to Control session; †p<0.03 compared to Rest.

(Moreira SR et al, 2014; Braz J Fisiot)

Reatividade PAS

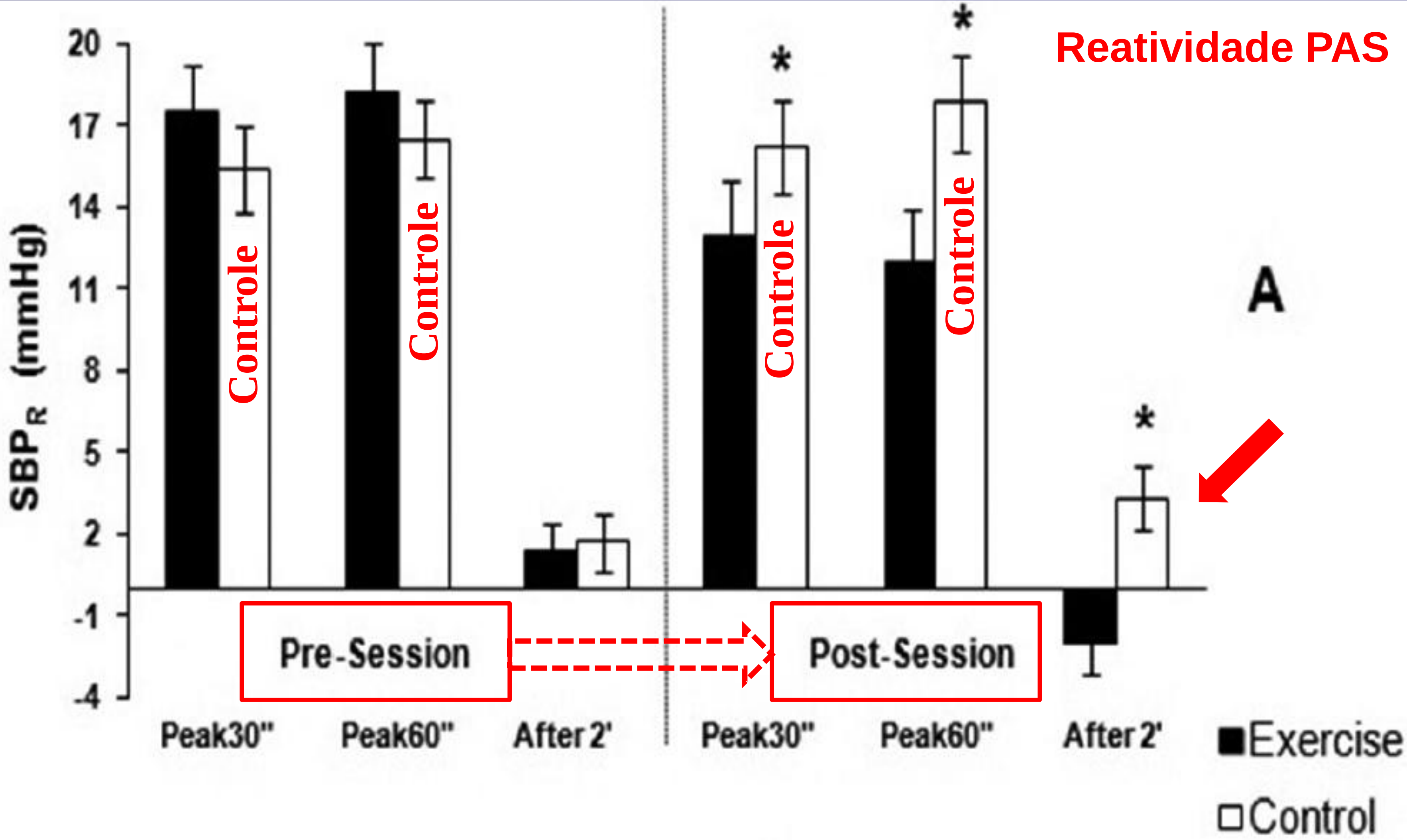


Figure 2. Range (Δ mmHg) of systolic blood pressure reactivity (SBP_R) and diastolic blood pressure reactivity (DBP_R) during (Peak30" and Peak60") and after (After2') the Cold Pressor Test in the pre-exercise session (Pre-Session) and post-exercise session (Post-Session) moments. *$p<0.01$ compared to exercise session.

(Moreira SR et al, 2014; Braz J Fisiot)

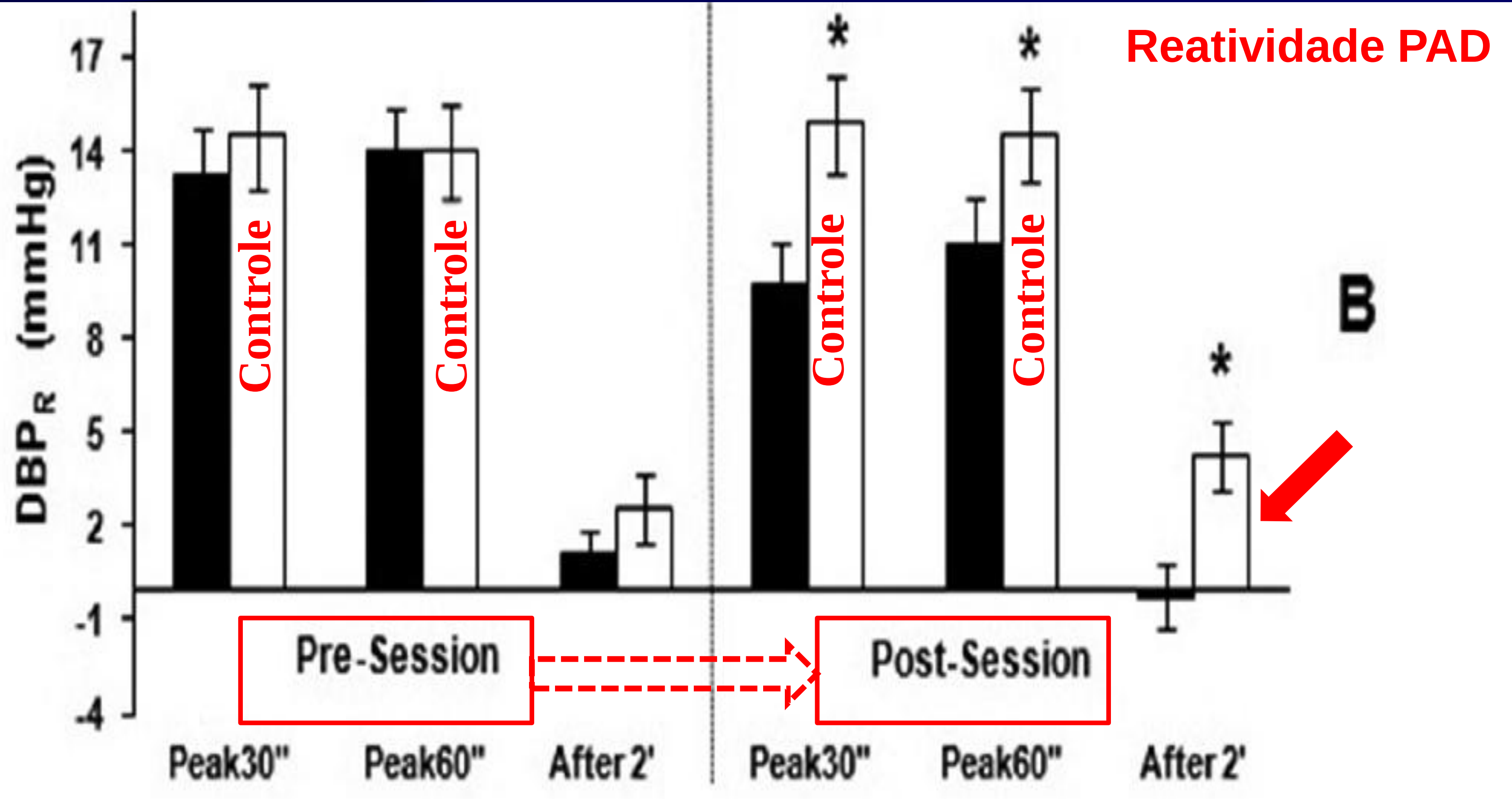
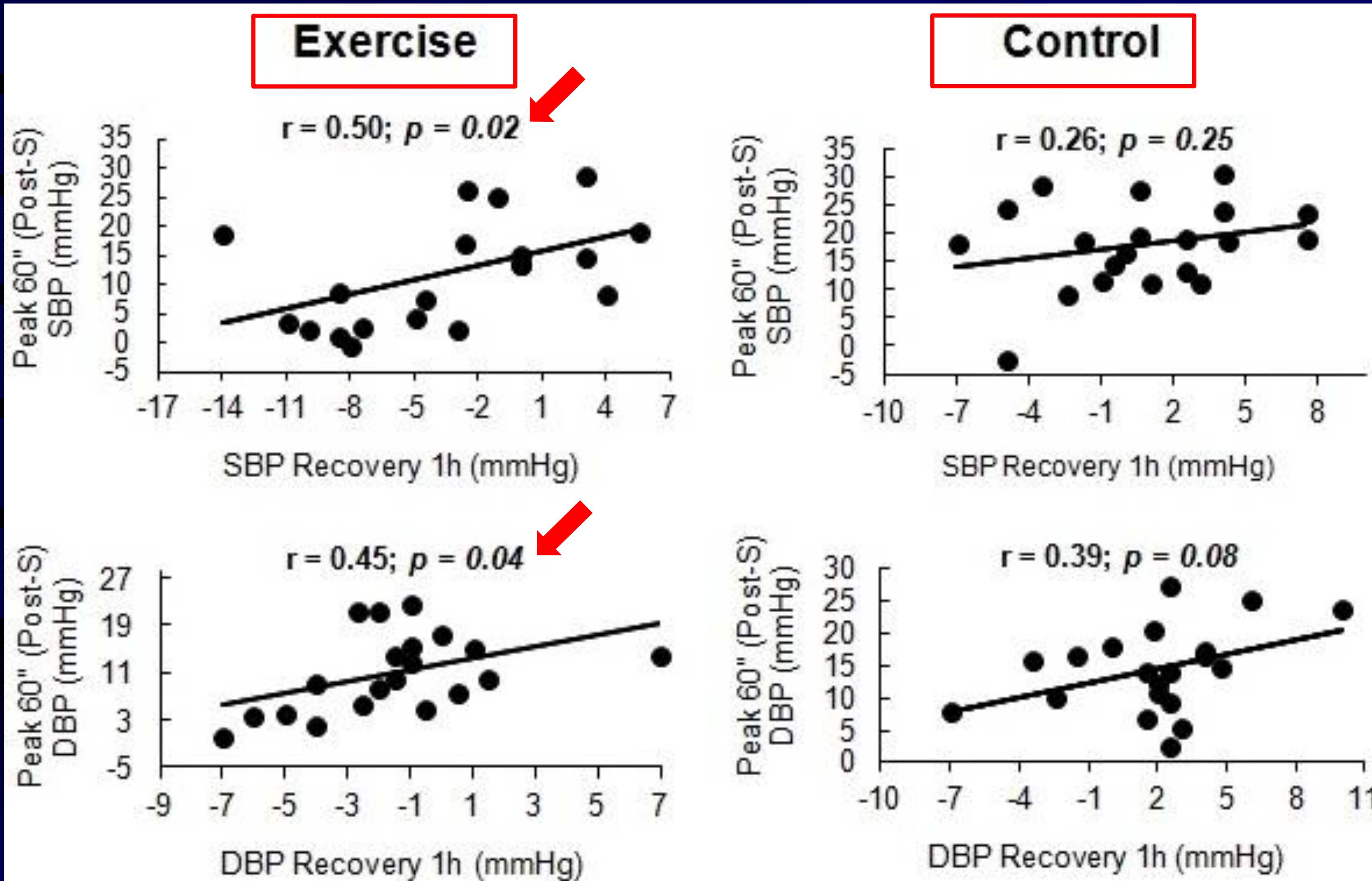


Figure 2. Range (Δ mmHg) of systolic blood pressure reactivity (SBP_R) and diastolic blood pressure reactivity (DBP_R) during (Peak30" and Peak60") and after (After2') the Cold Pressor Test in the pre-exercise session (Pre-Session) and post-exercise session (Post-Session) moments. *p<0.01 compared to exercise session.

(Moreira SR et al, 2014; Braz J Fisiot)



(Moreira SR et al, 2014; Braz J Fisiot)

International Journal of General Medicine

Dovepress

open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Exercise lowers blood pressure in university professors during subsequent teaching and sleeping hours

This article was published in the following Dove Press journal:
International Journal of General Medicine
18 October 2011

- Exercício Aeróbio
- 80-85% FC reserva
- 30 minutos
- Sessão Controle

Fabiana Ribeiro[1]
Carmen S Grubert Campbell[1]
Gisele Mendes[1]
Gisela Arsa[1,3]
Sérgio R Moreira[2]
Francisco M da Silva[1]
Jonato Prestes[1]
Rafael da Costa Sotero[1]
Herbert Gustavo Simões[1]

[1]Graduate Program on Physical Education and Health, Catholic University of Brasilia, Brasilia; [2]Federal University of Vale do São Francisco, Petrolina, [3]Graduate Program on Physical Education, Nine of July University, São Paulo SP, Brazil

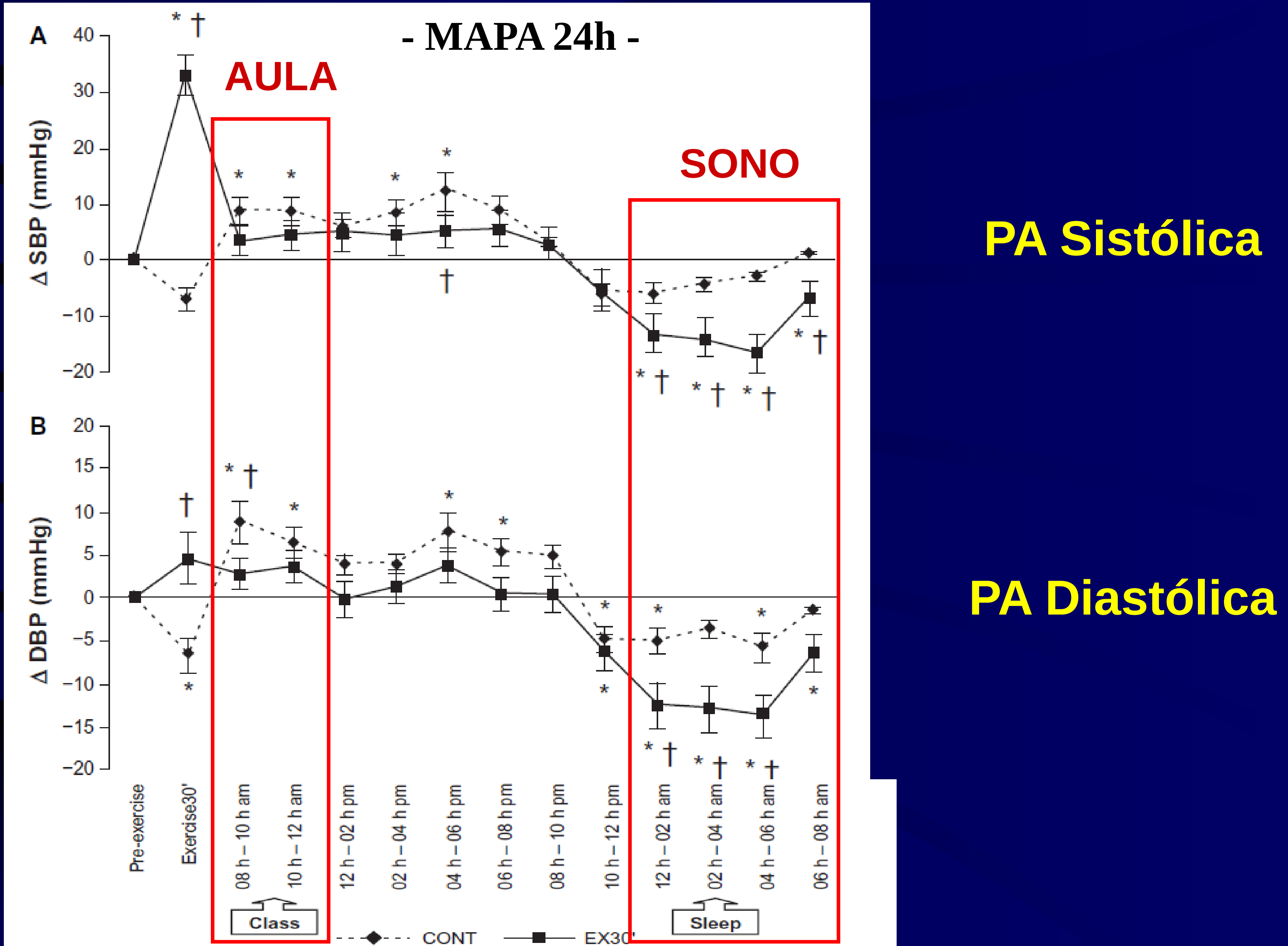


Figure 1 Change (Δ) in systolic blood pressure (**A**), diastolic blood pressure (**B**) and mean arterial pressure (**C**) during the 24 hours following exercise (EX30) and control (CONT) sessions.

Note: *$P < 0.05$ compared with rest (pre-exercise); †$P < 0.05$ compared with CONT session.

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure.

Dissertação a ser defendida em 06/08/2014!

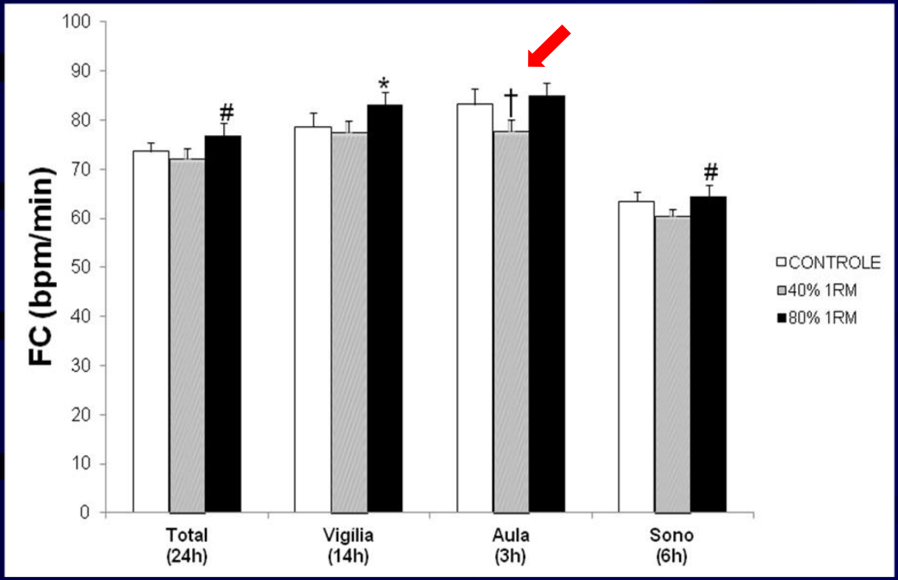
UNIVERSIDADE FEDERAL DO VALE DO SÃO FRANCISCO

UNIVERSIDADE FEDERAL DO VALE DO SÃO FRANCISCO

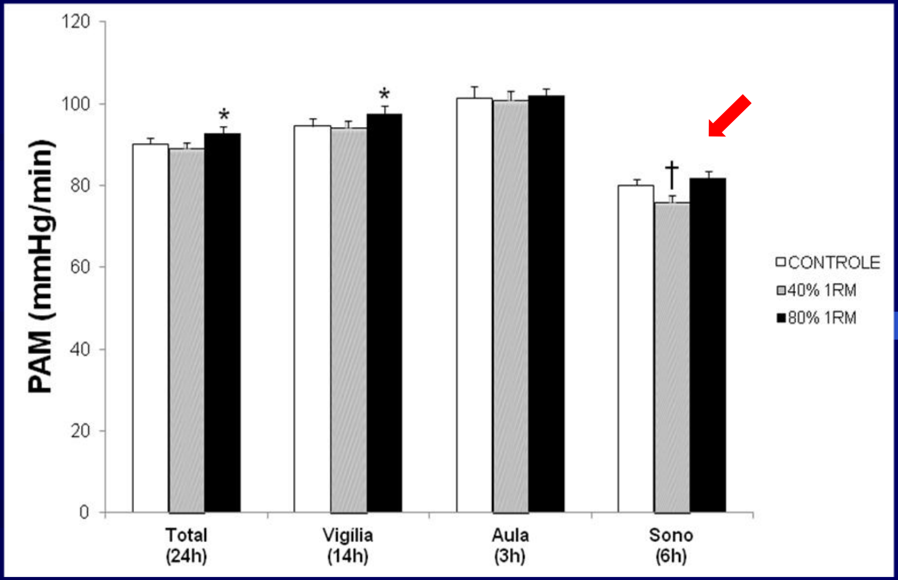
PROGRAMA DE PÓS-GRADUAÇÃO CIÊNCIAS DA SAÚDE E BIOLÓGICAS

Alfredo Anderson Teixeira de Araujo

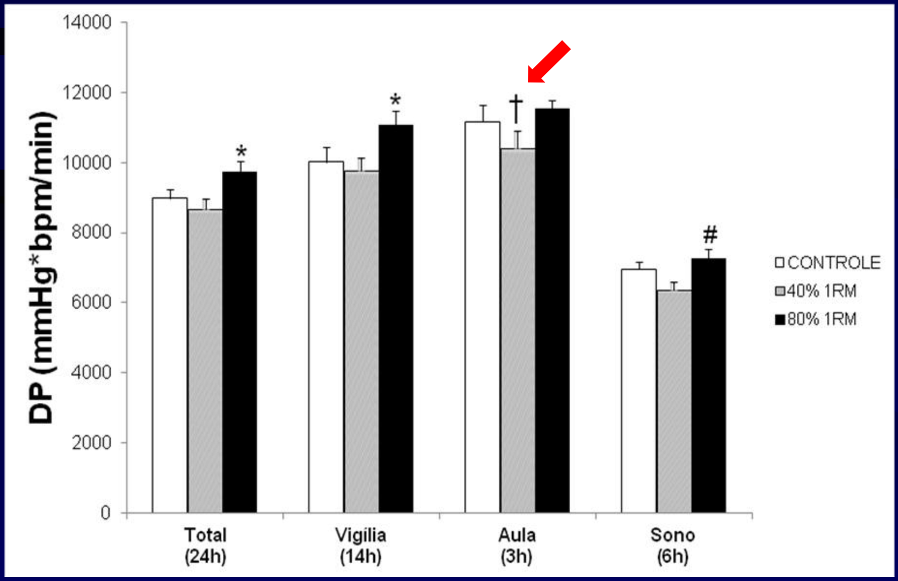
PRESSÃO ARTERIAL E DINÂMICA SIMPATO-VAGAL DE PROFESSORES UNIVERSITÁRIOS 24H PÓS-EXERCÍCIO RESISTIDO EM DIFERENTES INTENSIDADES



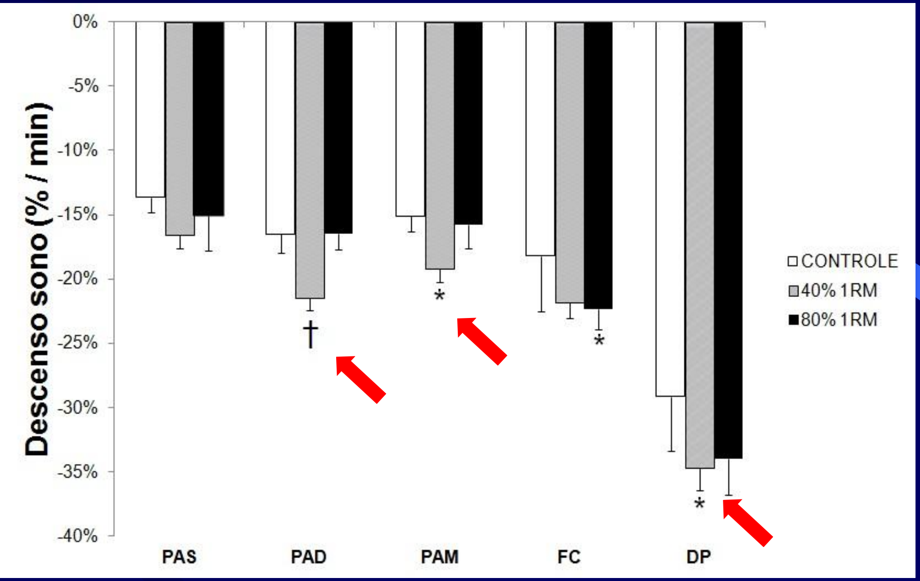
*p≤0,05 em relação às sessões Controle e 40%1RM; †p≤0,05 em relação às sessões Controle e 80%1RM; #p≤0,05 em relação à sessão 40%1RM.



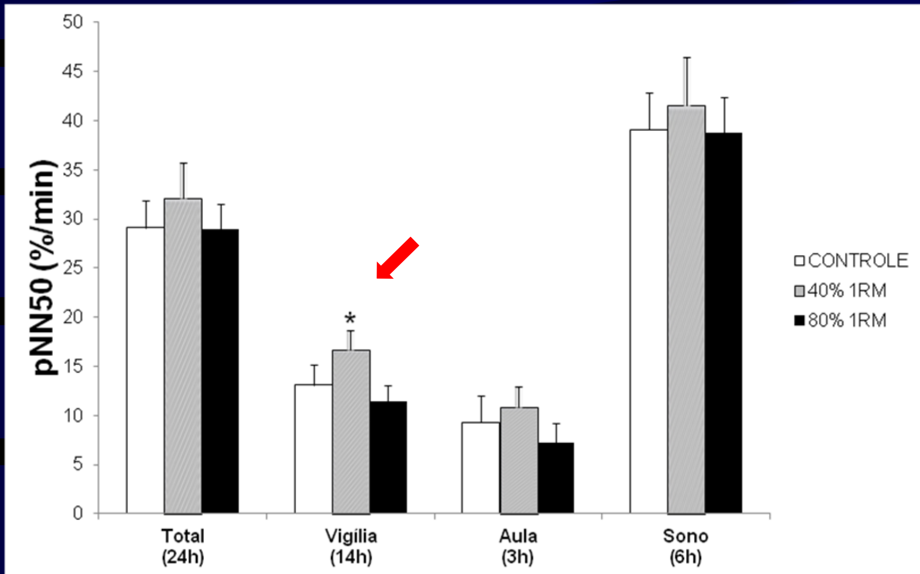
*p≤0,05 em relação às sessões Controle e 40%1RM; †p≤0,05 em relação às sessões Controle e 80%1RM.



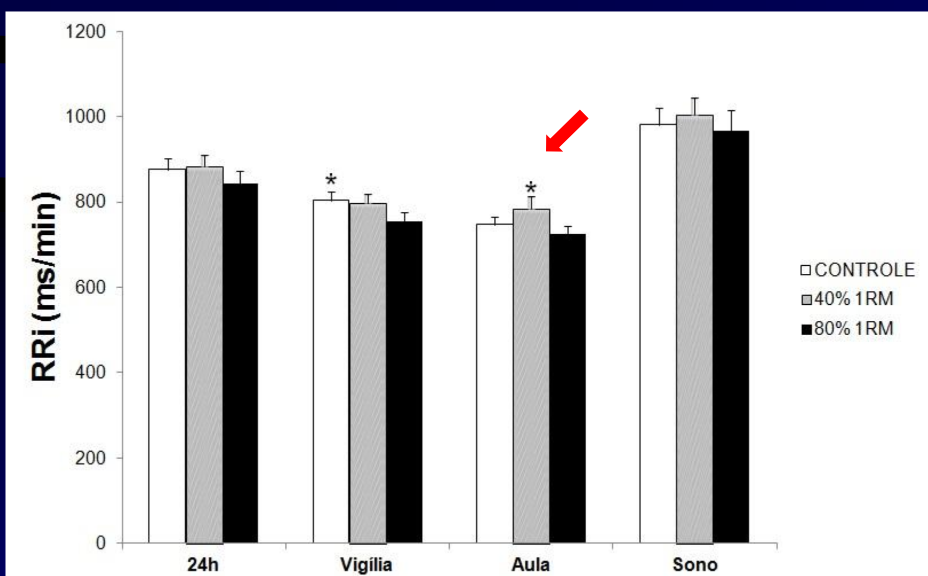
*p≤0,05 em relação às sessões Controle e 40%1RM; †p≤0,05 em relação às sessões Controle e 80%1RM; #p≤0,05 em relação à sessão 40%1RM



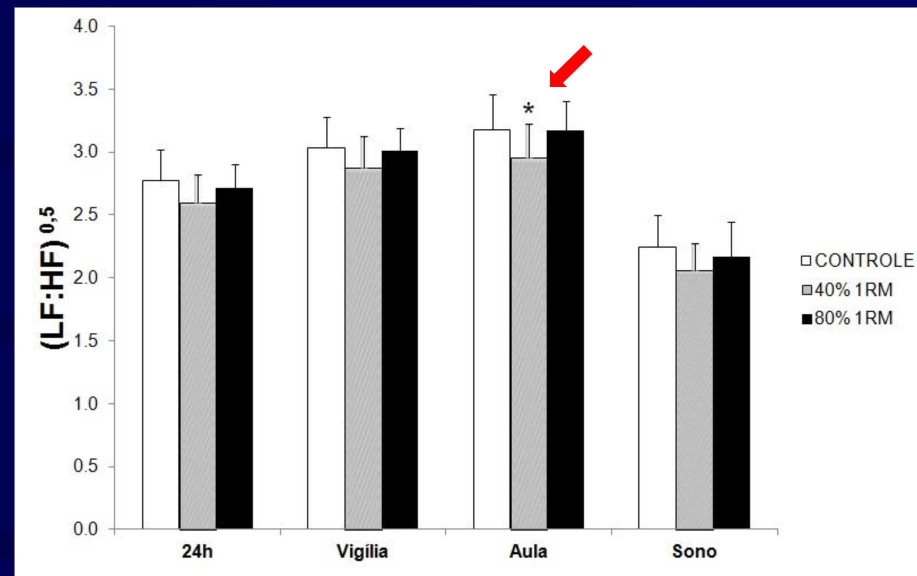
*p≤0,05 em relação à sessão Controle; †p≤0,05 em relação às sessões Controle e 80%1RM



*p≤0,05 em relação à sessão 80%1RM.



*p≤0,05 em relação à sessão 80%1RM.



*p≤0,05 em relação à sessão Controle.

A genética tem alguma influência nas respostas cardiovasculares?

- *Nem todos apresentam efeitos redutores na PA (Hagberg et al., 1999-2000; Pescatello et al., 2007; Wang et al., 2009);*

- Polimorfismo Inserção/Deleção (I/D) do gene da Enzima Conversora da Angiotensina (ECA) *(Rigat et al., 1990; Cambien et al., 1992; Tanriverdi et al., 2005; Moraes et al., 2008; Kim, 2009).*

Genótipos da ECA:

I/I	I/D	D/D
-/-	-/+	+/+
[ECA]	[ECA]	[ECA]

(Rigat et al., 1990; Alvarez et al., 2000; Jaliu et al., 2002; Tanriverdi et al., 2005).

Sistemas de regulação do tônus vascular

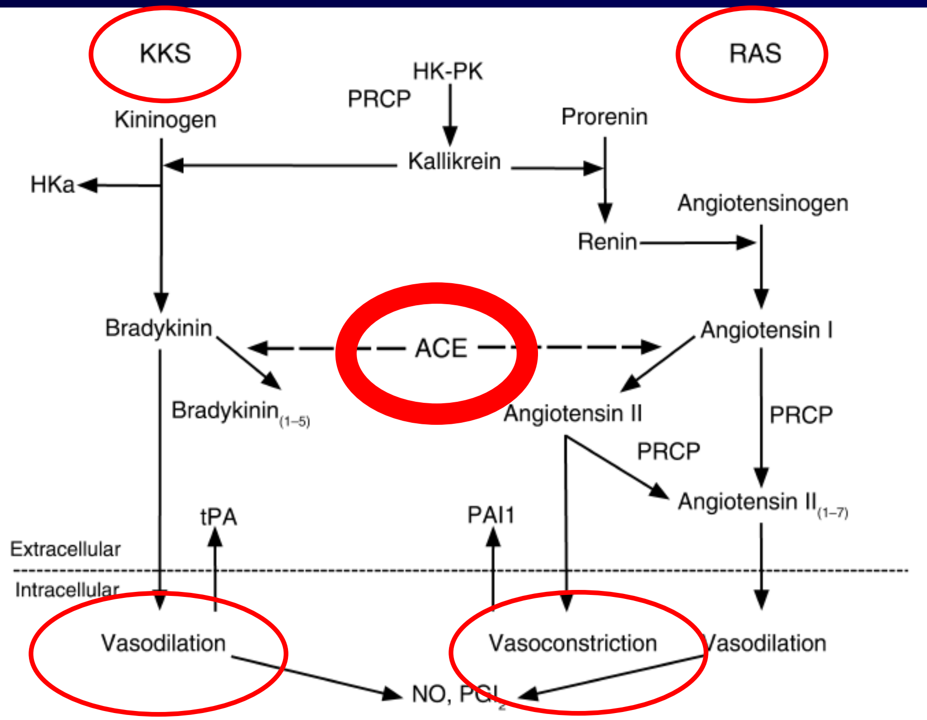


Figure 2

The interaction between the plasma KKS and RAS. Plasma kallikrein converts prorenin to renin, and renin has the ability to convert angiotensinogen to angiotensin I. Angiotensin-converting enzyme (ACE) converts inactive angiotensin I to the vasoconstrictor angiotensin II. Angiotensin II stimulates plasminogen activator inhibitor 1 (PAI1) release from endothelial cells. At the same time ACE degrades bradykinin into bradykinin$_{(1-7)}$ (not shown) or bradykinin$_{(1-5)}$, a peptide with thrombin inhibitory activity. PRCP is the enzyme that degrades angiotensin II or angiotensin I to the vasodilating peptide, angiotensin II$_{(1-7)}$. Angiotensin II$_{(1-7)}$ stimulates NO and PGI_2 formation, which potentiates the effects of bradykinin. PRCP also has the ability to convert PK to kallikrein. Formed kallikrein digests kininogens to liberate bradykinin, leaving a kinin-free kininogen (HKa) that has anti-proliferative and anti-angiogenic properties. Thus, PRCP, the same enzyme that degrades the vasoconstrictor angiotensin II, leads to the increased formation of the vasodilators bradykinin and angiotensin II$_{(1-7)}$. Finally, the resulting bradykinin stimulates tPA, NO, and PGI_2 formation, thus counterbalancing the prothrombotic effect of angiotensin II.

(Schmaiser et al., 2002- J Clin Inves)

Santana *et al. BMC Cardiovascular Disorders* 2011, **11**:71
http://www.biomedcentral.com/1471-2261/11/71

2011

BMC Cardiovascular Disorders

RESEARCH ARTICLE Open Access

The higher exercise intensity and the presence of allele I of ACE gene elicit a higher post-exercise blood pressure reduction and nitric oxide release in elderly women: an experimental study

Hugo AP ... liveira[6],
Ricardo Y ... ões[1†]

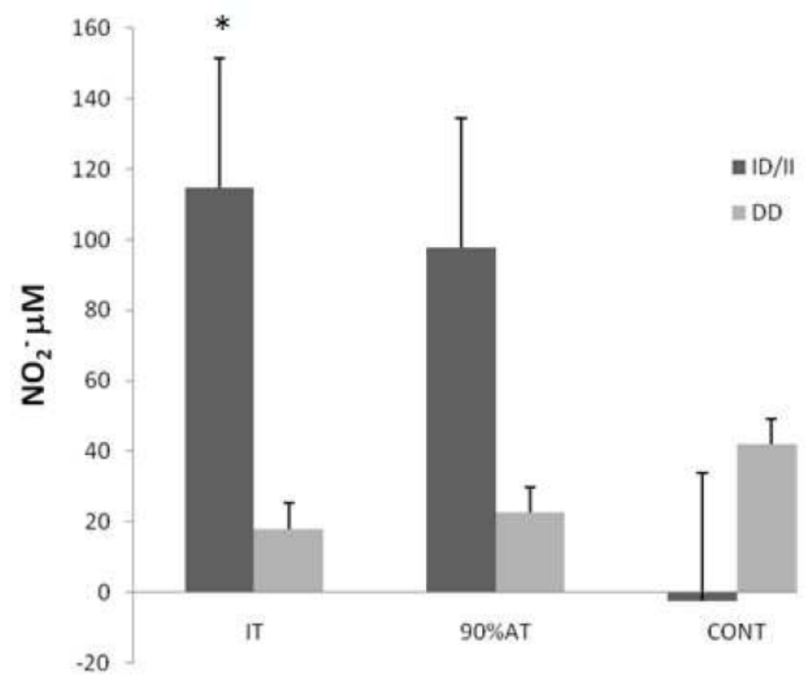
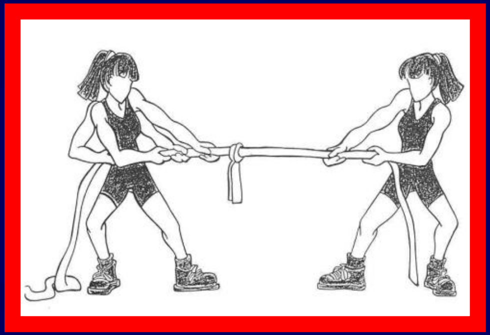


Figure 1 Mean (± SEM) delta variation of NO_2^- (nitrite) for IT (Incremental test), 90% AT (90% of anaerobic threshold) and CONT (control) sessions performed by ID/II (n = 18) and DD (n = 10) genotypes of ACE gene. * $p < 0.05$ in relation to D/D group on IT session.

‘Hot topic’



Foi visto que agudamente o ISOMÉTRICO não promove HPE *(Olher et al. 2013)* e cronicamente são escassas as evidências de efeito redutor na PA (*Cornelissen & Smart, 2013*).

O que você acha, tem efeito ou não?

ARTICLE IN PRESS

MAYO CLINIC

ORIGINAL ARTICLE

Isometric Exercise Training for Blood Pressure Management: A Systematic Review and Meta-analysis

Debra J. Carlson, BHlthSc; Gudrun Dieberg, PhD
Philip J. Millar, PhD; and Neil A. Smart, PhD

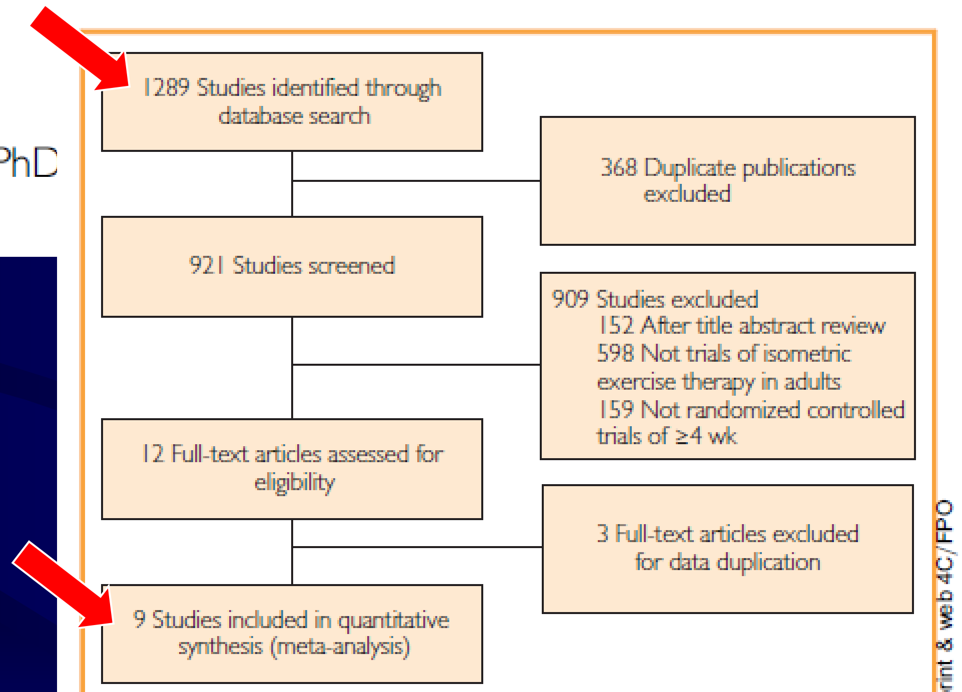


FIGURE 1. Flowchart of study selection.

(Carlson DJ et al, 2014; Mayo Clinic)

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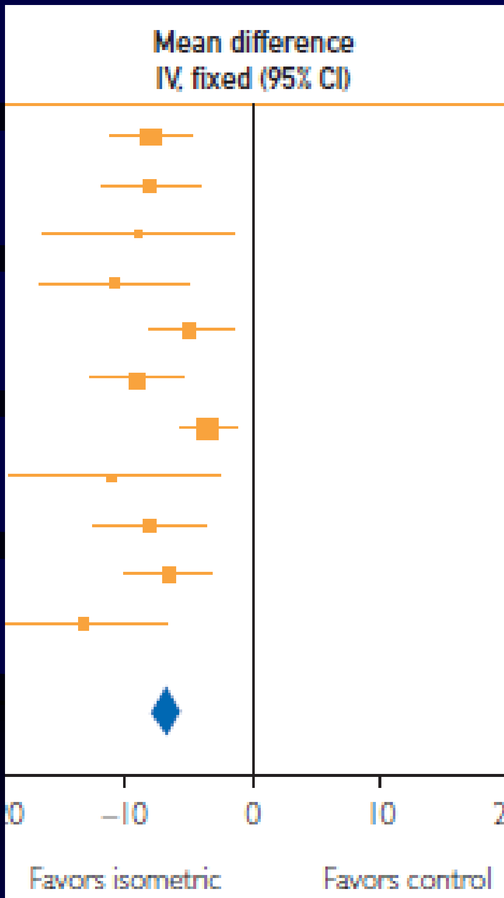
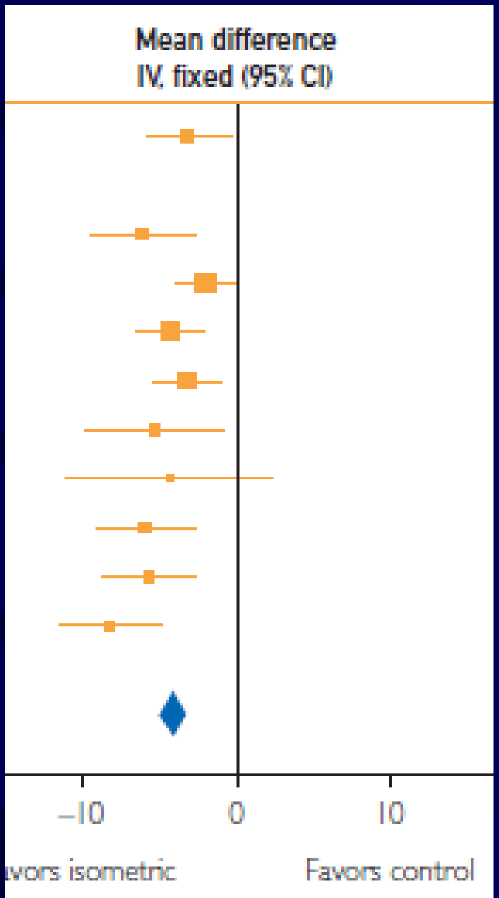


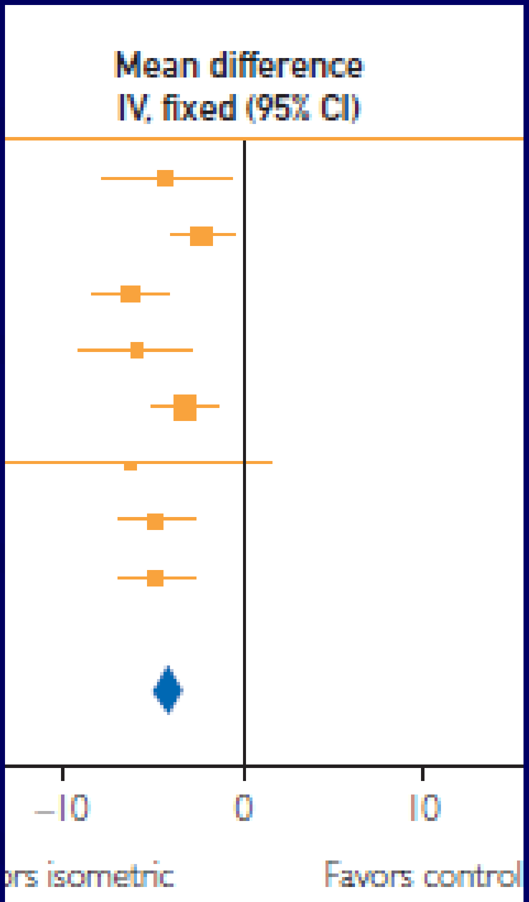
- 6,8 mmHg

PAD



- 3,9 mmHg

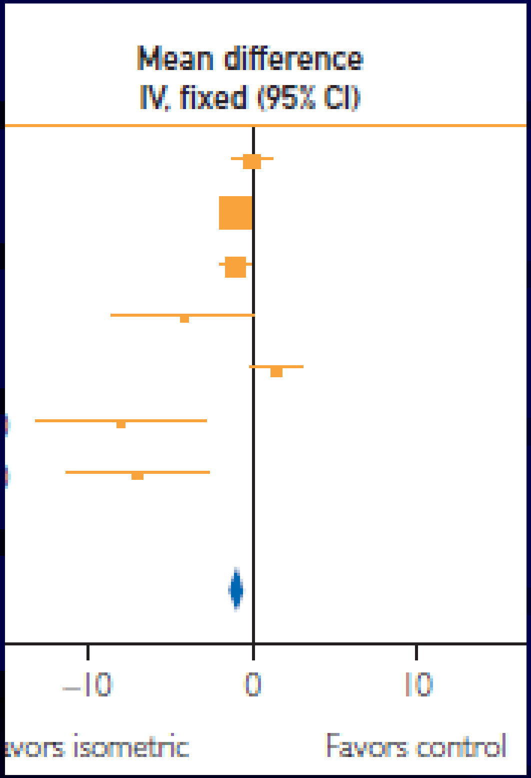
PAM



- 3,9 mmHg

(Carlson DJ et al, 2014; Mayo Clinic)

FC



- 0,79 bpm

A FC muda quase nada, o que sugere descartar a via central como mecanismo para ajustes cardiovasculares do exercício ISOMÉTRICO.

McGowan (2008) destaca que o treinamento isométrico pode aumentar a vasodilatação endotélio-dependente (mediada pelo NO) em resposta a hiperemia reativa na musculatura treinada.

(Carlson DJ et al, 2014; Mayo Clinic)

Melhor ou Pior?

VANTAGENS:

- Rapidez na realização da sessão;
- Maior aderência ao programa;
- Manutenção da respiração espontânea.

Fisiologicamente: Exercício isométrico submáximo está associado a igual ou menor aumento da FC e PAS, em comparação ao aeróbio, com aumentos da PAD (aumento da pressão de perfusão nas coronárias), o que sugere reduzida demanda de oxigênio ao miocárdio. Em conjunto ao DP menor, em comparação ao aeróbio, o isométrico diminui a chance de isquemia induzida pelo exercício.

(Millar PJ et al, 2013; Carlson DJ et al, 2014)

Sports Med
DOI 10.1007/s40279-013-0118-x

REVIEW ARTICLE

Evidence for the Role of Isometric Exercise Training in Reducing Blood Pressure: Potential Mechanisms and Future Directions

Philip J. Millar · Cheri L. McGowan · Véronique A. Cornelissen · Claudio G. Araujo · Ian L. Swaine

Generalidades

- As adaptações ao treinamento isométrico se perdem com maior rapidez;

- O isométrico parece que muda em maior grau a função e não a estrutura cardiovascular.

Adaptações Cardíacas

- VS e DC não se alteraram

Adaptações Vasculares

- Aumento do pico de fluxo sanguíneo e hiperemia reativa

- Vasos e arteríolas ajustam sua resistência/complacência o que pode aumentar a dilatação fluxo-mediada

Adaptações Autonômicas

- HF (n.u) aumentou em hipertensos após 10sem de treinamento isométrico

- LF (n.u) diminuiu em hipertensos com PA e atividade simpática altos, já em jovens não

Dúvida: Aumento do vasodilatador local ou diminuição do fluxo simpático?

(Millar PJ et al, 2013; Sports Medicine)

Aplicação Prática

Efeito redutor crônico do <u>ISOMÉTRICO</u> na PA

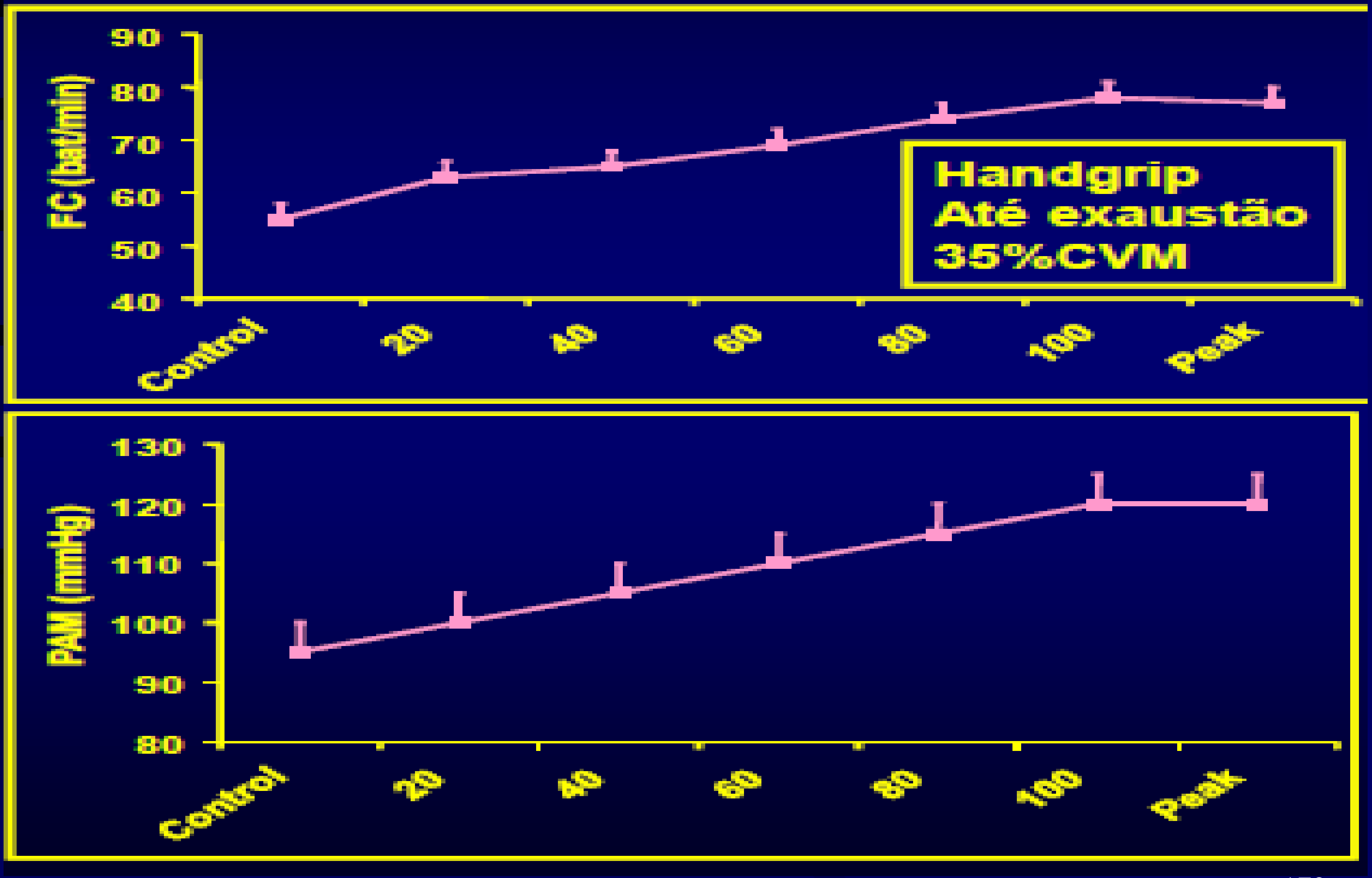
- 4 séries de *handgrip ou leg;*
- 2min cada série;
- Intensidade de 30-50% CVM;
- Intervalo de 1-4 minutos entre séries;
- Duração de 11-20min /sessão;
- Frequência de 3-5 vezes/semana;
- Programa: 4-10 semanas.

(Millar PJ et al, 2013; Carlson DJ et al, 2014)

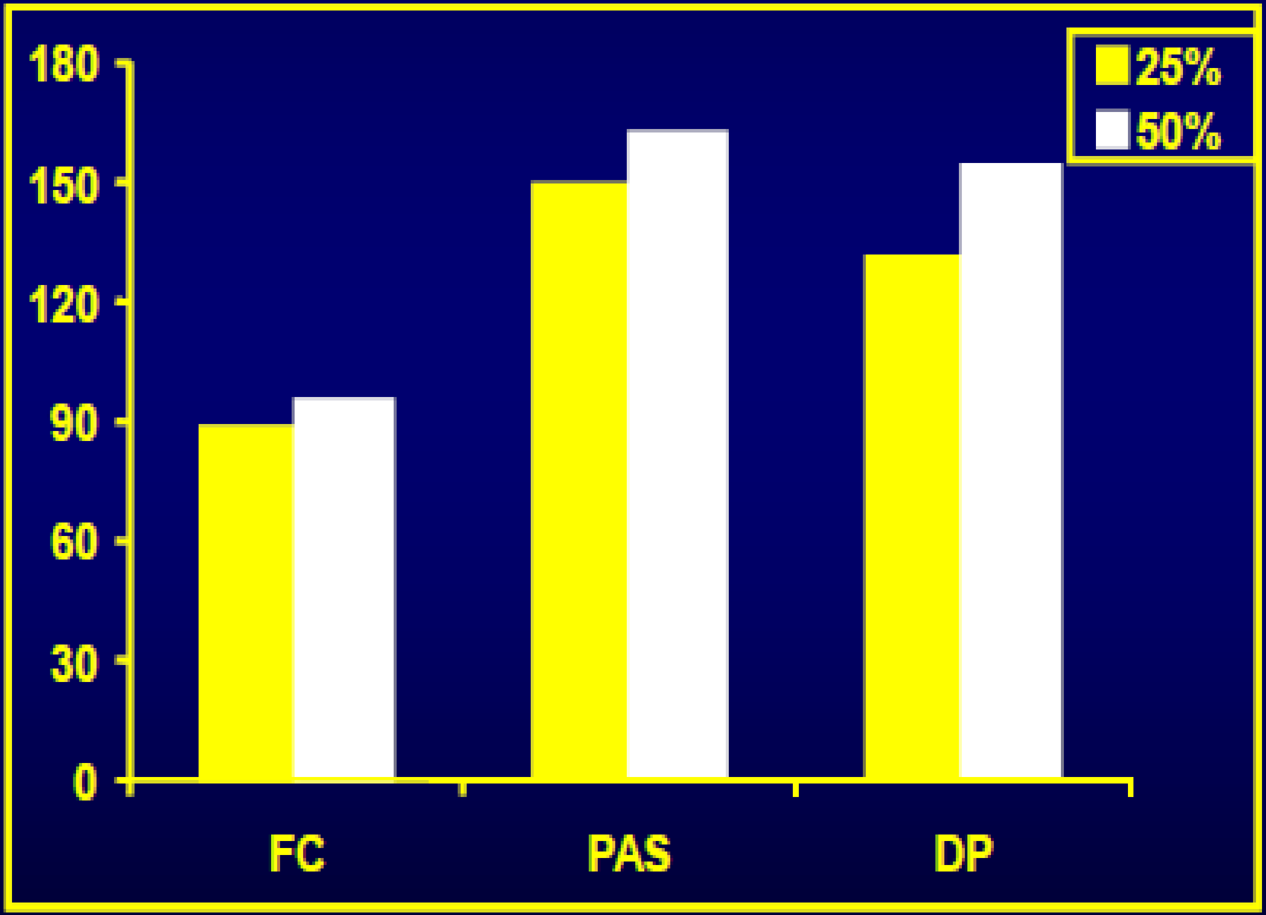
Durante a execução...

CUIDADOS

ISOMÉTRICO - DURAÇÃO

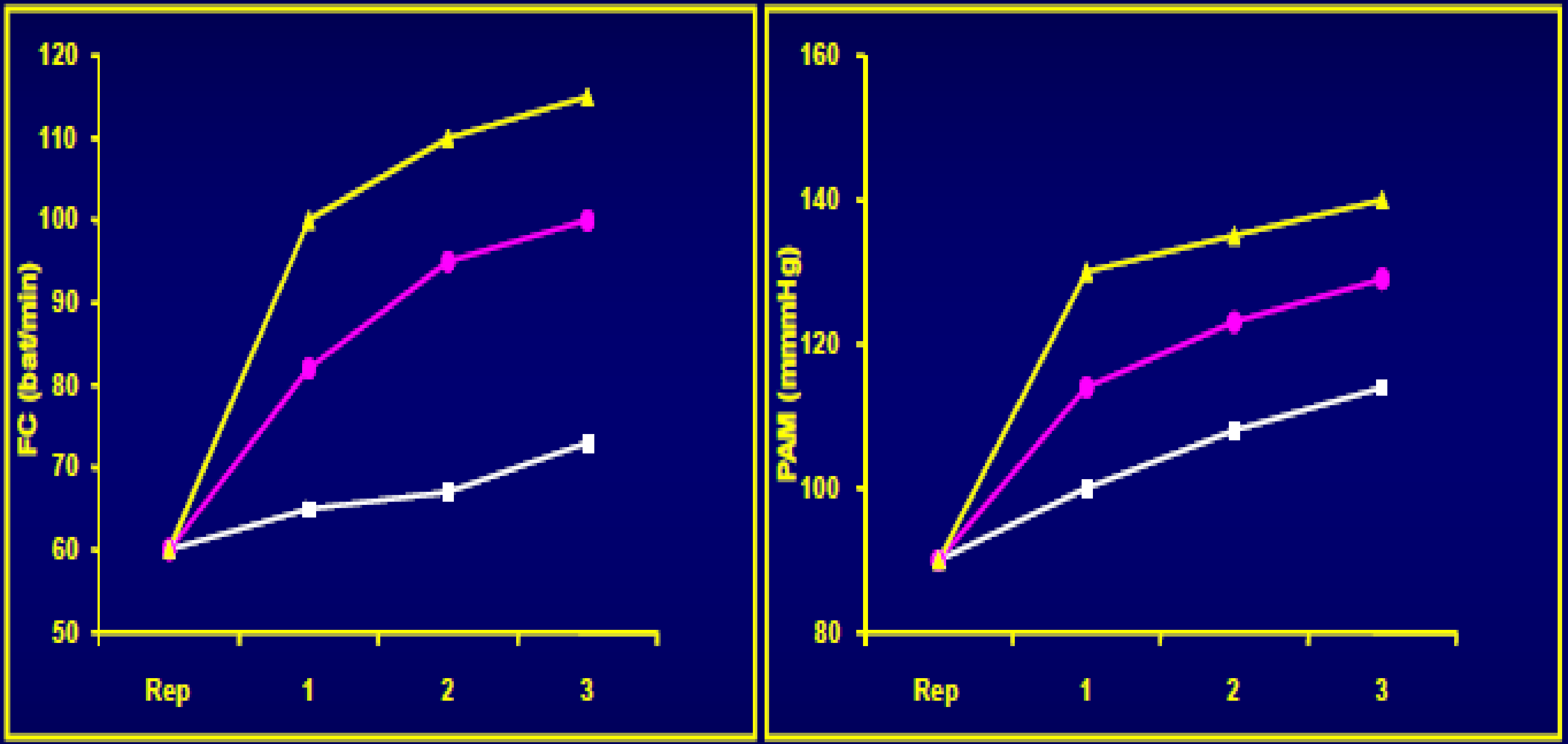


ISOMÉTRICO - INTENSIDADE



1 minuto
Braço

ISOMÉTRICO – G. MUSCULAR



3 minutos
30% CVM

Mão Perna Mão+Perna

OBRIGADO!